पंडित रविशंकर शुक्ल विश्वविद्यालय, रायपुर छत्तीसगढ़ भारत

Pt. Ravishankar Shukla University, Raipur Chhattisgarh, India

Estd-1964 – recognized by UGC U/s 2(f) and 12 (B)

NAAC "A" Grade

CRITERION-II

EVIDENCE(S), AS PER SOP

METRIC No. 1.1.1	Curricula developed and implemented have relevance to the local, national, regional and global developmental needs which is reflected in Programme outcomes (POs), Programme Specific Outcomes(PSOs) and Course Outcomes(COs) of the Programmes offered by the Institution

SCHOOL OF STUDIES IN BIOTECHNOLOGY

Pt. Ravishankar Shukla University
Raipur 492 010, Chhattisgarh

Syllabus

BIOTECHNOLOGY

M. Sc.
(Semester System)

Session
2021-2022
2022-2023

SCHEME OF EXAMINATION FOR SESSION 2021-2023

SCHOOL OF STUDIES IN BIOTECHNOLOGY

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR

M. Sc. BIOTECHNOLOGY (Semester I to IV) (Subject Code: 0408)

Paper Code	Paper	Title of Paper	Marks	
First Semester (July 2021-December 2021)				
			(External)	(Internal)**
040801	1*	Cell Biology	80	20
040802	2*	Genetics	80	20
040803	3*	Microbial Physiology	80	20
040804	4*	Bio-molecules	80	20
040805	LC-1	Lab Course 1 (Based on paper 1 & 2)	80	20
040806	LC-2	Lab Course 2 (Based on paper 3 & 4)	80	20
		Total	600	
Second Semester (January 2022-June 2022)				
Paper Code	**Paper**	**Title of Paper**	(External)	(Internal)**
040807	5*	Biostatistics, Bioinformatics & Computers in Biotechnology	80	20
040808	6*	Molecular Biology	80	20
040809	7*	Plant Biotechnology	80	20
040810	8*	Macromolecules & Enzymology	80	20
040811	LC-3	Lab Course 3 (Based on paper 5 & 6)	80	20
040812	LC-4	Lab Course 4 (Based on paper 7 & 8)	80	20
		Total	600	
Third Semester (July 2022-December 2022)				
Paper Code	**Paper**	**Title of Paper**	(External)	(Internal)**
040813	9*	Genetic Engineering	80	20
040814	10*	Biology of Immune System	80	20
040815	11*	Bioprocess Engineering & Technology	80	20
040816	12*	Environmental Biotechnology	80	20
040817	LC-5	Lab Course 5 (Based on paper 9 & 10)	80	20
040818	LC-6	Lab Course 6 (Based on paper 11 & 12)	80	20
		Total	600	
Fourth Semester (January 2023-June 2023)				
Paper Code	**Paper**	**Title of Paper**	(External)	(Internal)**
040819	13*	IPR, Biosafety, Bioethics and Nanobiotechnology	80	20
040820	14*	Advanced Techniques in Biotechnology	80	20
040821	15*	Animal Biotechnology	80	20
040822	16*	Genomics & Proteomics	80	20
040823	LC-7	Lab Course 7 (Based on paper 13 & 14)	80	20
040824	LC-8	Lab Course 8 (Based on paper 15 & 16)	80	20
		Total	600	
		OR		
040825		**Project Work*****	600	
		Dissertation	240	60
		Seminar based on project	160	40
		Viva Voce	80	20
		Grand total [Semester I + II + III + IV]	2400	

*Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) -type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

**1.Each student will be evaluated continuously throughout the semester.

2. There will be a class test based on each theory paper. The full marks will be 10 for each paper.
3. There will be a poster/oral presentation based on each theory paper. The full marks will be 10 for each presentation.
4. Each student will be required to submit a brief write-up (not more than 20 pages) on his/her poster/oral presentation.

*** 1. A student of IV semester will have the option to opt for project work in lieu of four theory papers and two lab courses provided he/she secures at-least 65% or more marks in aggregate in semester I and II.

2. The project has to be carried out in recognized national laboratories or UGC recognized universities. No student will be allowed to carry out project in private laboratories/ college/ institutions, excluding the colleges recognized as research centers by the RDC of Pt. Ravishankar Shukla University, Raipur.
3. The valuation of all the projects will be carried out by the external examiner and HoD of UTD or its nominee at the UTD Centre.

- M.Sc. Students of Biotechnology have to attend one excursion or visit in one academic year (within or outside Chhattisgarh)

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Program Learning Outcomes for M.Sc. Biotechnology

A Master in the Biotechnology program has been assumed to have:

1. An understanding of fundamentals of the life-processes at the molecular level and will be able to design laboratory experiments, manage their execution, and drawing interpretation.
2. Will be able to serve or initiate food processing industries, sewage treatment plants, brewing industries, biogas plants, bio-fertilizer unit, enzyme production and vaccine development industries.
3. Will have necessary skills for acquisition, organization and processing of data for drawing pinpointed inferences in R&D sectors.
4. Skills for gene sequencing services, primer designing and synthesis, molecular structure prediction, drug discovery and molecular diagnostics.
5. Be able to produce quality planting materials, at commercial-scale, for horticulture, agriculture, floriculture and forestry applications, following tissue culture technique.
6. Will possess ability to manipulate organisms *via* recombinant DNA technology for bioremediation, gene therapy, diagnostics, disease-models, bio-fuel, crop improvement, protein engineering, and modifying metabolic pathways.
7. Will be assumed to be acquainted with IPR that allows commercialization of the end-products of research and provide economic protection to the inventor.

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School of Studies in Biotechnology

Scheme of Examination: Semester I

Paper Code	Paper	Title of Theory/Practical Paper	Marks		
			External	Internal**	Total
040801	1	Cell Biology	80	20	100
040802	2	Genetics	80	20	100
040803	3	Microbial Physiology	80	20	100
040804	4	Bio-molecules	80	20	100
040805	LC 1	Based on Theory papers 1, 2	80	20	100
040806	LC 2	Based on Theory papers 3, 4	80	20	100
		Total Marks			**600**

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School of Studies in Biotechnology
Semester I
Paper 1: Cell Biology (Code: 040801)

M.M.80

Unit-I

1. Cell theory
2. Prokaryotic cells: Structure and function – Cell walls of eubacteria (peptidoglycan) and related molecules: Outer – membrane of Gram negative bacteria; Cell wall and cell membrane synthesis; Cell inclusions like endospores, gas vesicles.
3. Diversity of cell size and shape; diversity in prokaryotic and eukaryotic cells.

Unit-II

1. Eukaryotic cells: cell wall; plasma membrane; endoplasmic reticulum; golgi apparatus; lysosome; peroxisome; ribosome; mitochondria; chloroplast; nucleus; nucleolus; chromosome.
2. Transport of nutrients and macromolecules: osmosis; ion channels; ion pumps; active transport; protein diffusion, nuclear transport; transport across membranes; molecular mechanisms of transport; regulation of intracellular transport; intracellular vesicular trafficking.

Unit-III

1. Mitosis, meiosis and their regulation; steps in cell cycle; regulation of cell cycle; cell-cell interactions.
2. Cell signalling: cellular receptors; signalling through G-protein coupled receptors; signal transduction pathways; second messengers; regulation of signalling pathways.
3. Cell motility: cilia and flagella of eukaryotes and prokaryotes.

Unit-IV

1. Production of gametes; cell surface molecules in sperm-egg interaction in animals; molecular events during fertilization in animals, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis.
2. Development in *Drosophila* and *Arabidopsis*; gene expression and its regulation. Spatial and temporal regulation of Gene Expression

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

05/12/21

Books:

1. Gerald Karp (2007) Cell and Molecular Biology. Fifth Edition.
2. Geoffrey M. Cooper; Robert E. Hausman (2009) The Cell: A Molecular Approach.
3. E. J. Ambrose and Dorothy M. Easty (1977) Cell Biology. Second Edition
4. C.B. Powar (2005) Cell Biology. Third Edition.
5. Tortora, Funke and Case (1998) Microbiology: An introduction. Sixth Edition Binjamin/Cummings Publishing Co.
6. Lewis J. Klein smith and Valerie M. Kish (2002) Principles of cell and molecular biology. Third Edition.
7. P. K. Gupta (2003) Cell and molecular biology. Second Edition. Rastogi publications.
8. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2008). Molecular Biology of the Cell (5th Ed.). New York: Garland Science.
9. Lodish, H. F. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman.
10. Cooper, G. M., & Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM ; Sunderland.
11. Watson, J. D. (2008). Molecular Biology of the Gene (5th ed.). Menlo Park, CA: Benjamin/Cummings.

List of Practical's:-

1. To prepare the temporary stained slide of onion bulb peel to study the structure of plant cell.
2. To prepare the temporary stained slide of cheek squamous epithelial cells of mouth of Human Beings.
3. Preparation and Study of slide of mitosis using from onion root tips squash.
4. Schedule for study of mitotic index.
5. To determine the abnormal mitotic index.
6. Preparation and study of slide for meiosis using young anthers of *Allium cepa.*
7. To determine the meiotic index in the flower bud of *Allium cepa.*

Learning outcomes:

1. This paper focuses upon the understanding of fundamental structure and functions of a cell at the molecular level.
2. It lays a strong foundation in core areas of biology such as cell structure, cell division, gametogenesis, embryo development, central dogma of life, cell signaling, *etc.*
3. Student will be able to conduct studies on cell organization and function, mechanisms of gene expression, cellular bioinformatics, cell signaling, cell differentiation, *etc.*
4. Will be able to design and execute laboratory experiments on molecular and cellular aspects, and interpretation of observations.

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School of Studies in Biotechnology
Semester I
Paper 2: Genetics (Code: 040802)

M.M. 80

Unit I

1. Introduction to genetics; Beginning of genetics as a science. Early studies involving genetics
2. Mendel and genetics; Mendel's laws of genetics; Physical and chemical basis of Heredity.
3. Gene to Phenotype – Interactions between the Alleles of one gene, interfering gene interaction.
4. Fine structure of gene, Eukaryotic genome organization (Structure of chromatin, coding and non – coding sequences, satellite DNA); rearrangement in DNA. Central dogma

Unit II

1. Regulation of gene expression in Prokaryotes and Eukaryotes; Attenuation and antitermination; Operon concept; DNA methylation.
2. Mutation; Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Changes in Chromosome number and structure - Euploidy and Aneuploidy, mutagens – UV and chemical mutagens, Ames test; Dosage compensation; Mutational Assay System.
3. Inheritance: Autosomal and sex linked inheritance, Extra chromosomal inheritance, Inheritance of Organelle genes.

Unit III

1. Variation; sources of variation; selection; Heritability of variation, Process of speciation; Origin of new genes. Hardyweinberg genetic equilibrium, genetic polymorphism and selection.
2. Genes and Quantitative traits; Genotypes and Phenotypic Distribution; Heritability of Quantitative Character; Quantifying Heritability; Polygenic inheritance, Locating genes, QTL mapping
3. Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

Unit IV

1. Bacterial Genetic system: Transformation, Conjugation, Transduction, Recombination, Plasmids and Transposons. Bacterial Genetic map with reference to *E.coli*.
2. Viruses and their Genetic system: Phage I and its life cycle; RNA phases; RNA viruses; Retroviruses
3. Genetic system of Yeast and Neurospora.
4. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

05/2/21

Books:-

1. Benjamin Pierce (2017) Genetics: A Conceptual Approach. Sixth Edition, W. H. Freeman
2. Griffiths, William M. Gelbart, Jeffrey H. Miller, Richard C. Lewontin and Anthony J.F. Griffiths (2009) Modern Genetic Analysis. W. H. Freeman
3. D. Peter Snustad, Michael J. Simmons (2007) Principles of Genetics. Wiley India Pvt Ltd.
4. Sandy Primrose and Richard Twyman (2016) Principles of Gene Manipulation and Genomics. Wiley-Blackwell

List of Practical's:-

1. Demonstration of Mendel's experiments.
2. Studies of prokaryotic & eukaryotic cells.
3. Perform karyotype and determine the genetic abnormality of the given sheet.
4. To Performance and study of Mutation in bacteria.
5. To study polyploidy in onion root tips after treatment with colchicine.
6. To demonstrate Barr body in neutrophils by staining human blood smear.
7. Isolation of genetic material from Bacteria.

Learning outcomes:

1. Genetics is one of the fastest developing fields of biology. This course will provide an overview of the core concepts and key principles behind inheritance and expression of characters.
2. Advanced topics such as gene interaction, evolutionary genetics and gene regulation will further expand student's knowledge.
3. Study of molecular basis of transmission of genetic diseases will lay ground work for discovery of effective diagnosis, cure and prevention of genetic disorders.
4. It will also introduce modern technologies and methods used in studying prokaryotic and eukaryotic genetics.
5. This paper will generate knowledge on selective breeding, anther culture, population development, genetic and physical mapping, diagnosis of genetic diseases, hybridity testing methods, *etc.*
6. RGA methods will also be taught for an effective business development in this area.
7. Student will possibly be able to suggest a few easier tools that can be followed to sequence the whole genome at organizations such as hospitals, research institutions, universitis, pharmaceutical companies, agricultural and horticultural companies, genetic engineering companies, *etc.*

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School of Studies in Biotechnology

Semester I

Paper 3: Microbial Physiology (Code: 040803)

M.M. 80

Unit I

1. Microbial Evolution, Systematics and Taxonomy –New approaches to bacterial taxonomy classification including ribotyping; Ribosomal RNA sequencing; Characteristics of primary domains; Nomenclature and Bergey's Manual.

2. Microbial Growth – growth curve, measurement of growth and growth yields; Synchronous growth; Continuous culture; Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen.

Unit II

1. Methods in Microbiology – Pure culture techniques; Theory and practice of sterilization; Principles of microbial nutrition; Types of culture media: defined and undefined media, selective and differential media, minimal and enrichment media; Enrichment culture techniques for isolation of chemoautotrophs, chemohetrotrophs and photosynthetic microorganisms.

2. Metabolic Diversity among Microorganisms – Photosynthesis in microorganisms; Calvin cycle; Chemolithotrophy; oxidizing and reducing bacteria; Methanogenesis and acetogenesis, syntrophy, Nitrogen metabolism; Nitrogen fixation.

Unit III

1. Bacteria: Purple and green bacteria; Cyanobacteria; Homoacetogenic bacteria; Acetic acid bacteria; Spirilla; Spirochaetes; Pseudomonads; Lactic and propionic acid bacteria; Endospore forming rods and cocci; Mycobacteria; Chlamydia's and Mycoplasmas.

2. Archaea: Archaea as earliest life forms; Halophiles; Methonogens; Hyperthermophilic Archaea; Thermoplasma.

3. Algae, Fungi, Slime moulds and Protozoa. Viruses: Bacterial, Plant and Animal viruses; Discovery, classification and structure of viruses; Lysogeny; DNA viruses; RNA viruses; Examples of Herpes, Pox, Adenoviruses, Retroviruses.

Unit IV

1. Microbial diseases –Infectious disease transmission; Sexually transmitted diseases including AIDS; Diseases transmitted by animals (rabies, plague), insects and ticks (Rickettsias, Lime disease)

2. Host – Parasite Relationships – Normal microflora of Skin, Oral cavity, Gastrointestinal tract; Types of toxins (Exo –, Endo -, Entero -); Virulence and Pathogenesis.

3. Chemotherapy/Antibiotics – Antibiotics and Antimicrobial agents; Broad-spectrum antibiotics; Antibiotics from prokaryotes; Antifungal antibiotics; Mode of action; Resistance to antibiotics.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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Books:

1. Roger Y. Stanier, John L Ingraham, Mark L Wheelis, Rage R Painter (1992) General Microbiology. Fifth edition.The Macmillanb Press Ltd.
2. Michael T. Madigan, John Martinko, Jack Parker Brock Biology of Microorganisms. Tenth edition, Prentice-Hall.
3. Pelczar, M.J. Jr., Chan, E.C.S. and Kreig, N.R. (2009) Microbiology. Tata McGraw Hill
4. Maloy, S.R., Cronan, J.E. Jr. and Freifelder, D. Jones (1994) Microbial Genetics. Second edition, Bartlett Publishers.
5. James G. Cappuccino, Natalie Sherman (1996) Microbiology: A Laboratory Manual. Benjamin-Cummings Pub Co.
6. Lansing Prescott, John Harley, and Donald Klein (2001) Microbiology. Fifth edition. McGraw Hil
7. Tortora, Funke and Case (2016) Microbiology. Tenth Edition, Pearson Education.
8. L Y Kun (2003) Microbial Biotechnology: Principles and applications, Microbiology and Environmental Toxicology, Sharad Saxenda, Published by Manglam Publications.
9. Willey, J. M., Sherwood, L., Woolverton, C. J., Prescott, L. M., & Willey, J. M. (2011). Prescott's Microbiology. New York: McGraw-Hill.
10. Matthai, W., Berg, C. Y., & Black, J. G. (2005). Microbiology, Principles and Explorations. Boston, MA: John Wiley & Sons.
11. Lee, Y. K. (2013). Microbial Biotechnology: Principles and Applications. Hackensack, NJ: World Scientific.

List of Practical's:-

1. Preparation of liquid and solid media for growth of microorganisms.
2. Isolation and maintenance of organisms by plating, streaking and serial dilution methods. Slants and stab cultures. Storage of microorganisms.
3. Isolation of pure culture from soil and water.
4. Growth; Growth curve; Measurement of bacterial population by turbidity and serial dilution methods. Effect of temperature, pH and carbon nitrogen sources on growth.
5. Microscopic examination of bacteria, yeast and molds and study of organisms by Gram stain, Acid fast stain, staining for spores and lactophenol cotton blue mount.
6. Study of mutations by Ames test.
7. Assay of antibiotics and demonstration of antibiotics resistance.
8. Analysis of water for portability and determination of MPN.
9. Bacterial transformation.
10. Biochemical characterization of selected microbes.
11. Transduction
12. One step growth curve of bacteria

Learning outcomes:

1. This course will emphasize knowledge on diverse areas of microbiology such as bacteriology, virology, microbial evolution and applied microbiology, and will equip the students with basic as well as advanced techniques that are popularly used in these fields.
2. It will promote better understanding of microbial diseases and their prevention by in depth study of host pathogen interaction, microbial evasion of immune system, and mode of action of various antimicrobial agents.
3. As there is a huge demand for new antibiotics in the world, study of microbiology is of utmost importance for human health care and drug development.
4. Small scale food processing industries, sewage treatment plants, brewing industries, biogas plants, bio-fertilizer plant, and vaccine development units will possibly be initiated as start-ups by the students.

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School of Studies in Biotechnology

Semester I

Paper 4: Bio-molecule (Code: 040804)

M.M. 80

Unit I

1. Chemical foundations of Biology – pH, pK, acids, bases, buffers, weak bonds, covalent bonds.
2. Principles of thermodynamics and living system.

Unit II

1. **Amino acids and peptides** – classification, chemical reactions and physical properties
2. **Sugars** – classification and reactions
3. Heterocyclic compounds and secondary metabolites in living systems – nucleotides, pigments, isoprenoids.

Unit III

1. **Lipids** – classification, structure and functions.
2. **Proteins** – classification and separation, purification and criteria of homogeneity, end group analysis, hierarchy in structure, Ramachandran map.

Unit IV

1. **Polysaccharides** – types, structural features, methods for compositional analysis
2. Analytical techniques in biochemistry and biophysics for small molecules and macromolecules for quantization.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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Books:

1. Nelson and Cox (2009) Principles of Biochemistry. Fifth Edition.
2. Albert L. Lehninger (2005) Biochemistry.Second Edition.
3. Todd and Howards Mason (2004) Text book of Biochemistry. Fourth Edition.
4. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer (2007) Biochemistry, Sixth Edition
5. Voet D, Voet JG & Pratt CW (2006) Fundamentals of Biochemistry Second Edition. Wiley.
6. Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil (2007) Harper's Illustrated Biochemistry, 28th Edition.
7. Buchanan, Gruissemen & Jones (2015) Biochemistry & Molecular Biology of Plant, 2nd edition.
8. M. Debnath (2011) Tools and Techniques in Biotechnology.

List of Practical's:-

1. Qualitative test for Carbohydrate. (Molisch's test)
2. Qualitative test for Carbohydrate.(Anthrone test)
3. Qualitative test for Carbohydrate.(Benedict's test)
4. Qualitative analysis of Carbohydrate by Barfoed's test.
5. Qualitative test for amino acid by Ninhydrin reaction.
6. Qualitative test for amino acid by Xanthoprotic reaction.
7. Qualitative test for Proteins using Biuret test.
8. Qualitative test for amino acid by Millon's test.

Learning outcomes:

1. Biochemistry is the foundation of all the metabolic processes that occurs within a cell.
2. This course will develop a deep understanding of basic properties and interactions of biomolecules as life processes are studied closely at atomic and molecular levels.
3. The study of basic building blocks of life and energy metabolism will clarify underlying principles of life.
4. As biochemistry links all the other fields of biology, its application is boundless.
5. Widespread scope in biomedical research like discovery of new drugs for treating various diseases, *etc.*
6. Will be able to apply gathered knowledge in various industries engaged in enzyme production, purification, characterization, *etc.*
7. Will be capable to initiate start-ups for developing biochemical test based kits for detection of various diseases and other contaminants.

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Lab. Course 1 (Code: 040805)

Based on Theory Papers 1 and 2

Time: 6 hrs. **Total Marks – 100**

Q.1 Experiment based on Theory paper 1 (one major & one minor)	30
Q.2 Experiment based on Theory paper 2. (One major & one minor)	30
Q.3 Spotting based on Theory paper 1 and 2	10
Q.4 *Viva Voce*	10
Q.5 Sessional	20

Lab. Course 2 (Code: 040806)

Based on Theory Papers 3 and 4

Time: 6 hrs. **Total Marks – 100**

Q.1 Experiment based on Theory paper 3 (one major & one minor)	30
Q.2 Experiment based on Theory paper 4 (one major & one minor)	30
Q.3 Spotting based on Theory paper 3 and 4	10
Q.4 *Viva Voce*	10
Q.5 Sessional	20

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School of Studies in Biotechnology

Semester II

Scheme of Examination

Paper Code	Paper	Title of Theory/Practical Paper	Marks		
			External	Internal**	Total
040807	5	Biostatistics, Bioinformatics & Computers in Biotechnology	80	20	100
040808	6	Molecular Biology	80	20	100
040809	7	Plant Biotechnology	80	20	100
040810	8	Macromolecules & Enzymology	80	20	100
040811	LC 3	Based on Theory papers 5, 6	80	20	100
040812	LC 4	Based on Theory papers 7, 8	80	20	100
		Total Marks			**600**

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School of Studies in Biotechnology

Semester II

Paper 5: Biostatistics, Bioinformatics & Computers in Biotechnology (Code: 040807)

M.M. 80

Unit I

1. Brief description and tabulation of data and its graphical representation.
2. Measures of central tendency and dispersion: mean, median, mode, range, standard deviation, variance. Idea of two types of errors and level of significance.

Unit II

1. Simple linear regression and correlation.
2. Tests of significance (F & t tests), chi – square test.

Unit III

1. Introduction to Word processing, Spreadsheets and Presentation software.
2. Computer – Oriented statistical techniques: Frequency table of single discrete variable, Bubble sort, Computation of mean, variance and standard deviation.

Unit IV

1. Bioinformatics basics: Computers in biology and medicine.
2. Protein and nucleic acid databases; Biological background for sequence analysis.
3. Identification of protein sequence from DNA sequence; searching of databases similar sequence; NCBI; publicly available tools; database mining tools.
4. BTIS network in India.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

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Books:

1. Animesh K. Dutta (2007) Basic Biostatistics and Its Application. New Central Book Agency (P) Ltd. Kolkata.
2. P.K. Banerjee (2006) Introduction to Biostatistics. 3rd edition. S. Chand & Company Ltd.
3. C.S.V. Murthy (2003) Bioinformatics. First Edition, Himalaya Publishing House.
4. S.C. Rastogi, Namita Mendiratta, Parag Rastogi (2003) Bioinformatics: Concepts, Skills and Applications, CBS Publishers and Distributors, New Delhi.
5. C. Subramanian (2004) A Text Book of Bioinformatics. Dominant Publishers and Distributors, New Delhi.
6. David W. Mount (2005) Bioinformatics: sequence and genome analysis. Second edition. CBS Publishers and Distributors, New Delhi, Bangalore (India).
7. David W. Mount (2004) Bioinformatics: sequence and genome analysis; CSHL press
8. C.S.V. Murthy (2003) Bioinformatics. First Edition, Himalaya Publishing House.
9. Johnathan Pevsner (2015) Bioinformatics and Functional, 3nd edition.
10. Rosner, B. (2000). Fundamentals of Biostatistics. Boston, MA: Duxbury Press.
11. Lesk, A. M. (2002). Introduction to Bioinformatics. Oxford: Oxford University Press.
12. Mount, D. W. (2001). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
13. Baxevanis, A. D., & Ouellette, B. F. (2001). Bioinformatics: a Practical Guide to the Analysis of Genes and Proteins. New York: Wiley-Interscience.
14. Pevsner, J. (2015). Bioinformatics and Functional Genomics. Hoboken, NJ.: Wiley-Blackwell.
15. Bourne, P. E., & Gu, J. (2009). Structural Bioinformatics. Hoboken, NJ: Wiley-Liss.

List of Practical's:-

Biostatistics

1. Calculate the mean value of given 20 leaves.
2. Calculate the median of the given sample of 20 leaves.
3. Find out the mode value of given 20 leaves.
4. To complete correlation of leaf length & breadth of a given leaf sample.
5. To perform the t-test for the given data of sample. (Leaves)
6. To perform the Chi- Square test for the given data.
7. To calculate Standard deviation from the data (Sample).

Computer Application

1. Draw Histogram, Pie, Graph, Line graph.
2. Slide preparation.
3. Use of Internet in Research.

05/2/21

4. Perform spreadsheet application.
5. Compute statistical tools.

Bioinformatics

1. Search nucleotide sequence of a target gene on NCBI website and BLAST it.
2. Find out amino acid sequence of a particular protein from protein database available on public domain and compare it with other proteins.

Learning outcomes:

1. This course will impart knowledge on skills and techniques to be followed for meaningful data acquisition, handling, tabulation, organization and processing for fruitful results.
2. This course is sincerely designed to promote computer literacy and understanding of computer-based applications involved in simulation, visualization, and analyzing biological information.
3. There is a widespread scope for biostatistician in medical research, clinical decision making, and health management.
4. Knowledge imparted on bio-statistical tools and techniques could be helpful to improve research outcomes through accurate, precise and truthful interpretations.
5. Computational biology will probably boost the R&D *via in silico* experiments, and administrating the large databases of biological experiments.

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School of Studies in Biotechnology

Semester II

Paper 6: Molecular Biology (Code: 040808)

M.M.80

Unit I

1. Introduction to Molecular Biology
2. DNA Replication – Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication. Enzymes and accessory proteins involved in DNA replication.
3. DNA Repair and Recombination. Homologous recombination – Holiday junction, gene targeting, FLP/FRT and Cre/Lox recombination, RecA and other recombinases.

Unit II

1. Transcription – Prokaryotic transcription: RNA polymerase, Regulatory elements and mechanisms of transcription regulation, Transcription termination.
2. Transcription – Eukaryotic transcription: RNA polymerase, General and specific transcription factors, Regulatory elements and mechanisms of transcription regulation. Modification in RNA - 5' – cap formation, Transcription termination, 3' – end processing and polyadenylation, Splicing, Editing, Nuclear export of mRNA, mRNA stability

Unit III

1. Translation – Prokaryotic and Eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co – and post – translational modifications of proteins.
2. Protein Localization – Synthesis of secretary and membrane proteins, Import into nucleus, mitochondria, chloroplast and peroxisomes, receptor mediated endocytosis.

Unit IV

1. Oncogenes and Tumor Suppressor Genes – Viral and cellular Oncogenes, tumor suppressor genes from humans, Structure, Function and mechanism of action of pRB and p53 tumor suppressor proteins.
2. Antisense and Ribozyme technology – Molecular mechanism of Antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of ribozyme; hammer – head, hairpin and other ribozymes, strategies for designing ribozymes, Applications of Antisense and ribozyme technologies.
3. Molecular Mapping of genome – Genetic and physical maps, physical mapping and map – based cloning, Southern and fluorescence *in situ* hybridization for genome analysis, Chromosome micro dissection and micro cloning.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

05/2/21

Books:

1. Gerald Karp (2007) Cell and molecular biology, 5th Edition.
2. Lewis J. Klein smith and Valerie M. Kish (2002) Principles of cell and molecular biology, Third Edition.
3. Richard M. Twyman (1998) Advanced Molecular Biology, First South Asian Edition, Viva Books Pvt. Ltd.
4. Benjamin Lewin (2007) Gene IX, 9th Edition, Jones and Barlett Publishers.
5. J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner (2007) Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc.
6. TA Brown (2002) Genomes 2nd Edition; Bios Scientific Publishers.
7. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh and Paul Matsudaira (2008) Molecular Cell Biology, 6th Edition; WH Freeman.
8. Buchanan, Gruissemen & Jones (2015) Biochemistry & Molecular Biology of Plant, 2nd edition.
9. M. Debnath (2011) Tools and Techniques in Biotechnology.
10. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2008). Molecular Biology of the Cell (5th Ed.). New York: Garland Science.
11. Lodish, H. F. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman.
12. Cooper, G. M., & Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM ; Sunderland.

List of Practical:-

1. Extraction of DNA from plant leaves by CTAB methods.
2. Estimation of plant genomic DNA by Spectrophotometer methods.
3. Separation of plant genomic DNA by Agarose gel electrophoresis.
4. Extraction of DNA from animal cells.
5. Estimation of animal genomic DNA by Spectrophotometer methods.
6. Separation of animal genomic DNA by Agarose gel electrophoresis.
7. Separation of Bacterial proteins by vertical SDS-PAGE electrophoresis.
8. Extraction of RNA from Yeast cells.
9. Estimation of Yeast cellular RNA by Spectrophotometer methods.

Learning outcomes:

1. This course focuses molecular mechanisms underlying DNA replication, transcription, translation, protein synthesis, *etc.*
2. Furthermore, oncogenesis, antisense technology and molecular mapping have been included to establish a coherent connection with the core topics. 0
3. Entrepreneurship and technical skills for important services like gene sequencing, whole genome sequencing, primer designing and synthesis, molecular structure prediction, DNA sequence assembly analysis, will be imparted.
4. Will be able to diagnose cancerous/ diseased cells following standard procedures.
5. Will possibly be employed in any of the molecular biology based industries or be able to develop diagnostic kits based on molecular/ biochemical reactions.

School of Studies in Biotechnology

Semester II

Paper 7: Plant Biotechnology (Code: 040809)

M.M. 80

Unit I

1. Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids.
2. Tissue culture media (composition and preparation)
3. Initiation and maintenance of callus and suspension culture; single cell clones.
4. Organogenesis; somatic embryogenesis; transfer and establishment of whole plants in soil
5. Shoot – tip culture: Rapid clonal propagation and production of virus free plant

Unit II

1. Embryo culture and embryo rescue
2. Anther, pollen and ovary culture for production of haploid plants and homozygous lines
3. Protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids.
4. Germplasm conservation – Cryopreservation and slow growth cultures

Unit III

1. Plant transformation technology: Basis of tumor formation, Mechanism of DNA transfer, Features of TI and RI plasmids, role of virulence genes, use of Ti and Ri as vectors, binary vectors, markers, use of reporter genes, 35S and other promoters, multiple gene transfers, particle bombardment, electroporation, microinjection.
2. Chloroplast Transformation: Advantages, vectors
3. Application of plant transformation for productivity and performance: herbicide resistance, insect resistance, Bt genes, Non – Bt like protease inhibitors & amylase inhibitors, virus resistance, nucleocapsid gene, disease resistance, PR proteins, nematode resistance, abiotic stress, long shelf-life of fruits and flowers, male sterile lines, bar and barnase systems.

Unit IV

1. Metabolic Engineering and Industrial Products: plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, biodegradable plastics, therapeutic proteins, antibodies, edible vaccines.
2. Molecular Marker –RFLP maps, linkage analysis, RAPD markers, STS, microsatellites, SCAR (Sequence characterized amplified regions), SSCP (Single strand conformational polymorphism), AFLP, map based cloning, molecular marker assisted selection.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

Books:-

1. Razdan MK (2010) Introduction to Plant Tissue Culture 2nd Edition; Oxford & Ibh Publishing Co. Pvt Ltd.
2. Vasil IK (1994) Plant Cell and Tissue Culture; Springer.
3. Bhojwani SS and Razdan MK(1996) Plant Tissue Culture; Elsevier.
4. TJ Fu, G Singh and WR Curtis (Eds) (1999) Plant Cell and Tissue Culture for the production of Food Ingredient. Kluwer Academic/Plenum Press.
5. J Hammond, P McGarvey & V Yusibov (Eds) (2000) Plant Biotechnology, Springer Verlag.
6. H.S. Chawla (1998) Biotechnology in Crop Improvement, International Book Distributing Company.
7. H.S. Chawla (2000) Introduction to plant biotechnology. Oxford & IBH Publishing Co. (P) Ltd.
8. Buchanan, Gruissemen & Jones (2015) Biochemistry & Molecular Biology of Plant, 2nd edition.
9. M. Debnath (2011) Tools and Techniques in Biotechnology
10. Slater, A., Scott, N. W., & Fowler, M. R. (2008). Plant Biotechnology: an Introduction to Genetic Engineering. Oxford: Oxford University Press.
11. Glick, B. R., & Pasternak, J. J. (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. Washington, D.C.: ASM Press.
12. Brown, T. A. (2006). Gene Cloning and DNA Analysis: an Introduction. Oxford: Blackwell Pub.
13. Primrose, S. B., & Twyman, R. M. (2006). Principles of Gene Manipulation and Genomics. Malden, MA: Blackwell Pub.

List of Practical's:-

1. Media preparation
2. Meristem / bud culture, shoot multiplication & rooting
3. Callus culture
4. Organogenesis
5. Somatic embryogenesis
6. Plantlet acclimatization
7. Embryo culture
8. Extraction of DNA from plant
9. Estimation of plant DNA by Agarose gel electrophoresis and Spectrophotometer
10. Study of molecular markers

Learning outcomes:

1. This course will introduce knowledge on basic principles and techniques of plant tissue culture.
2. It will impart through knowledge on both basic and applied aspects of this technique in large scale production of agronomically and commercially important plants, production of disease free plantlets, and genetic engineering to develop plants with desirable characters.
3. Will be capable to go for genetic modification of existing plant species to lower the cost of food production, to increase yield, produce food materials of higher nutritional values, disease-free crop production, and restoration of endangered species.
4. Will possibly be able to initiate tissues culture based industries such as floriculture, horticulture, *etc.*

School of Studies in Biotechnology

Semester II

Paper 8: Macromolecules and Enzymology (Code: 040810)

Unit I **M.M. 80**

1. Macromolecules and supra molecules assemblies – Types of macromolecules in biological systems,
2. Molecular assemblies like membranes, ribosomes, extracellular matrix, chromatin
3. Sequencing of proteins and nucleic acids.

Unit II

1. Protein – protein and protein – ligand interactions, physical and chemical methods of study.
2. Conformational properties of polynuleotides and polysaccharides – secondary and tertiary structural features and their analysis – theoretical and experimental; protein folding – biophysical and cellular aspects

Unit III

1. Enzyme catalysis in solution – kinetics and thermodynamic analysis, effects of organic solvents on enzyme catalysis and structural consequences.
2. Physical and chemical methods for immobilization of enzyme.
3. Glyco and lipoproteins – structure and function

Unit IV

1. Protein denaturation
2. Ribozymes and Catalytic antibodies – Functional proteins – structure and drug targets (enzymes and receptors)
3. Nucleic acid hybridization – structural analysis and biological study.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

Books:

1. Nelson and Cox (2009) Principles of Biochemistry, 5th Edition.
2. Albert L. Lehninger(2005) Biochemistry, Second Edition.
3. Todd and Howards Mason (2004) Text book of Biochemistry, Fourth Edition.
4. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer (2007) Biochemistry, 6th Edition.
5. Voet D, Voet JG & Pratt CW (2006) Fundamentals of Biochemistry, 2nd Edition. Wiley
6. Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil (2007) Harper's Illustrated Biochemistry, 28th Edition
7. M. Debnath (2011) Tools and Techniques in Biotechnology.

List of Practical's:-

1. Qualitative assay of Protein by the Biuret method.
2. To estimation of Protein Qualitatively by Folin Lowry Method.
3. Estimation of cholesterol by the method of Crawford
4. Determine the activity of Alkalie Protease.
5. Determine the activity of neutral Protease.
6. Effect of temperature on the activity of α-amylase.
7. Determine the activity of catalase.
8. Determine the activity of urease.
9. Perform protein isolation by SDS PAGE.
10. Enzyme kinetics.

Learning outcomes:

1. It will provide basic understanding of structure and conformation of various biomolecules, more especially proteins.
2. This paper will impart knowledge on core principles behind enzyme structure, function and mechanism of action.
3. Imparted knowledge can be used for setting up of industries for enzyme purification, characterization, possible applications, *etc.*
4. Produced enzymes could be used as a tool in the areas such as industries of consumable products and medicine, and in agriculture sector for enhanced production and improvement of crops.

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Lab. Course 3 (Code: 040811)

Based on Theory Papers 5 and 6

Time: 6 hrs. **Total Marks – 100**

Q.1 Experiment based on Theory paper 5 (one major & one minor)	30
Q.2 Experiment based on Theory paper 6 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 *Viva Voce*	10
Q.5 Sessional	20

Lab. Course 4 (Code: 040812)

Based on Theory Papers 7 and 8

Time: 6 hrs. **Total Marks – 100**

Q.1 Experiment based on Theory paper 7 (one major & one minor)	30
Q.2 Experiment based on Theory paper 8 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 *Viva Voce*	10
Q.5 Sessional	20

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Semester III

Scheme of Examination

Paper Code	Paper	Title of Theory/Practical Paper	Marks		
			External	Internal**	Total
040813	9	Genetic Engineering	80	20	100
040814	10	Biology of Immune System	80	20	100
040815	11	Bioprocess Engineering & Technology	80	20	100
040816	12	Environmental Biotechnology	80	20	100
040817	LC 5	Based on Theory papers 9, 10	80	20	100
040818	LC 6	Based on Theory papers 11, 12	80	20	100
		Total Marks			**600**

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School of Studies in Biotechnology

Semester III

Paper 9: Genetic Engineering (Code: 040813)

M.M. 80

Unit I

1. Scope of Genetic Engineering.
2. Cloning and patenting of life forms. Genetic engineering guidelines.
3. Molecular tools and their application: Restriction enzymes, modification enzymes, molecular markers.
4. Nucleic acid purification, yield analysis
5. Nucleic acid amplification and its applications

Unit II

1. Gene cloning vectors: Plasmids, bacteriphages, phagemids, cosmids, Artificial chromosomes
2. Restriction Mapping of DNA Fragments and Map Construction, Nucleic acid sequencing.
3. cDNA synthesis and cloning: mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening.
4. Cloning interacting genes – Two and three hybrid systems. Nucleic acid micro array assay.

Unit III

1. Site – directed mutagenesis and protein engineering.
2. DNA Transfection, Southern blot, Northern blot, Western blot, Primer extension, S1 mapping, RNase protection assay, and reporter assays.
3. Expression Strategies for hetrologous genes: Vector engineering and codon optimization, host engineering; expression in bacteria, expression in Yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants
4. Phage display: Technique and applications

Unit IV

1. Processing of recombinant Proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins.
2. T – DNA and transposon tagging: Role of gene tagging in gene analysis, t – DNA and transposon tagging, Identification and isolation of genes through T – DNA or transposon; Targeted gene replacement, Chromosome engineering. Cisgenesis, intragenesis and genome editing by CRISPR-CAS
3. Gene therapy: Vector engineering. Strategies of gene delivery – Viral & non-viral, gene knockout, gene augmentation, gene correction / gene editing, gene regulation and silencing

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

08/2/21

Books:

1. Philip M. Gilmaritin (2005) Molecular Plant Biology. Edition Oxford University Press.
2. TA Brown (2005) Gene Cloning and DNA Analysis. 4th Edition.
3. Rusell and Peter (2002) Genetics Edition. Pearson Education, Inc, San Francisco.
4. Old and Primrose (2001) Principles of Gene Manipulation. 6th Edition.
5. B.D. Singh (2004) Biotechnology: An Expanding Horizons, 1st Edition.
6. W.H. Elliott and D. C. Elliott (2001) Biochemical and Molecular Biology. 2nd Edition.
7. Eldon John Gardner, Michael J. Simmons and Peter Snustad (1991) Principles of Genetics. Eigth Edition, John Wiley and Sons, INC.
8. Benjamin Lewin (2007) Genes IX. 9th Edition Pearson Education International.
9. HD Kumar (2003) Modern Concepts of Biotechnology. Third reprint Edition, Vikas Publishing House. Pvt. Ltd.
10. Brown TA (2006) Genomes, 3rd ed. Garland Science.
11. James D Watson, Richard M. Myers, Amy A. Caudy and Jan A. Witkowski (2007) Recombinant DNA: Genes and Genomes 3rd Edition; WH Freeman.
12. Sandy Primrose and Richard Twyman (2006) Principles of Gene Manipulation and Genomics 7th Edition; Wiley-Blackwell.
13. Buchanan, Gruissemen & Jones (2015) Biochemistry & Molecular Biology of Plant, 2nd edition.
14. Choudhuri, S and DB Carlson (2008) Genomics: Fundamentals and applications, 1st edition.
15. M. Debnath (2011) Tools and Techniques in Biotechnology.
16. Green, M. R., & Sambrook, J. (2012). Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

List of Practical's:-

1. Extraction of DNA from *E.coli.* Bacteria.
2. Estimation of bacterial DNA by Spectrophotometer methods.
3. Separation of bacterial genomic DNA by Agarose gel electrophoresis.
4. Hot phenol method for preparation of total cellular RNA from *E.coli.*
5. Estimation of cellular RNA by Spectrophotometer methods.
6. Restriction digestion of DNA with restriction enzymes.
7. Ligation of DNA.
8. Isolation of plasmid DNA from *E.coli.*
9. DNA amplification by PCR.

Learning outcomes:

1. This course will impart knowledge on manipulation of organisms for betterment of human society following genetic information.
2. It will delineate the principles and procedures involved in developing genetically modified organisms with desired characteristics.
3. Will be able to apply his knowledge for production of insulin, human growth hormones, human albumin, monoclonal antibodies, vaccines, and drugs.
4. Genetic engineers who can use a variety of molecular tools and technologies to rearrange fragments of human genome or an organisms genome in various sectors like pharmaceutical companies, agriculture sector, research organization, and even some hospitals or universities so as to add or remove an organisms genetic makeup for their better survival in adverse environments or for producing GMOs.

School of Studies in Biotechnology

Semester III

Paper 10: Biology of Immune System (Code: 040814)

M.M. 80

Unit I

1. Introduction – Phylogeny of immune system, innate and acquired immunity, Clonal nature of immune response.
2. Organization and structure of lymphoid organs.
3. Nature and biology of antigens and super antigens.
4. Antibody structure and function; antibody engineering
5. Antigen – antibody interactions

Unit II

1. Major histocompatibility complex
2. BCR & TCR, generation of diversity.
3. Complement system.
4. Cells of immune system – Hematopoiesis and differentiation, Lymphocyte trafficking, B – lymphocyte, T – lymphocyte, Macrophages, Dendritic cells, Natural Killer and lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells.

Unit III

1. Regulation of immune response – Antigen processing and presentation, generation of humoral and cell mediated immune responses; Activation of B – and T – lymphocytes; cytokines and their role in immune regulation; T – cell regulation, MHC restriction; Immunological tolerance.
2. Cell – mediated cytotoxicity: Mechanism of T cell and NK cell mediated lysis, Antibody dependent cell mediated cytotoxicity, and macrophage mediated cytotoxicity.
3. Hypersensitivity, Autoimmunity.

Unit IV

1. Transplantation: General concept and Application
2. Immunity to infectious agents (intracellular parasites (malaria), helminthes, bacterial (tuberculosis), viruses, (AIDS) infections and other congenital and acquired immunodeficiencies, vaccines.
3. Hybridoma Technology and Monoclonal antibodies

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

Books:-

1. Thomas J. Kindt, Barbara A. Osborne and Richard A. Goldsby (2007) Immunology, 6th Edition; WH Freeman.
2. Peter Delves, Seamus Martin, Dennis Burton, Ivan Roitt (2006) Roitt's Essential Immunology, 11th Edition; Wiley-Blackwell.
3. H.D. Kumar (2003) Modern Concepts of Biotechnology 3rd Edition, Vikas Publishing House. Pvt. Ltd.
4. K. Banerjee and N. Banerjee (2006) Fundamental of Microbiology and Immunology, First Edition. New Central Book Agency (P) Ltd. Kolkata.
5. Brostoff J, Seaddin JK, Male D, Roitt IM.(2002) Clinical Immunology, 6th Edition, Gower Medical publishing.
6. Abul K. Abbas, Andrew H. Lichtman, & Shiv Pillai (2007) Cellular and Molecular immunology; Elsevier Inc
7. M. Debnath (2011) Tools and Techniques in Biotechnology.
8. Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kuby, J. (2006). Kuby Immunology. New York: W.H. Freeman.
9. Murphy, K., Travers, P., Walport, M., & Janeway, C. (2012). Janeway's Immunobiology. New York: Garland Science.
10. Paul, W. E. (2012). Fundamental Immunology. New York: Raven Press.

List of Practical's:-

1. Enumeration of WBC in blood sample.
2. Preparation of a blood smear and differential blood count.
3. To separate serum from the given blood sample.
4. To determine Albumin Globulin ratio in given serum sample.
5. Estimation of serum protein by Folin Lowry test.
6. Isolation of Immunoglobulin.
7. Separation of serum protein by SDS PAGE.
8. Detection of class specific Antibody by Double Diffusion method.
9. Observe Ag-Ab interaction by Immunoelectrophoresis.
10. Observe Ag-Ab interaction by counter current Immunoelectrophoresis.
11. Study of Agglutination reaction
12. Study of ELISA technique.
13. Immuno diffusion test.
14. Blood group determination by slide agglutination reaction.

Learning outcomes:

1. This course will lay the foundations of immune system and its applications in understanding disease pathogenesis and immunity.
2. This will cover the basic principle behind the rising epidemic of allergies and the challenges of current organ transplantation technology.
3. It will provide insight into pathogenesis and host pathogen interaction in some of the deadliest diseases.
4. In depth knowledge in this area will allow to use immuno molecules in diagnostic and clinical intervention strategies, including therapeutic manipulation of the immune system for cancer treatment, vaccine development and transplant tolerance.
5. Clinicians work related to patient-facing or laboratory work like undertaking original medical research designing, planning and carrying out controlled experiments and trials,
6. Devising and testing hypotheses using appropriate analytical techniques, analyzing and interpreting data, *etc*., will be imparted.

School of Studies in Biotechnology

Semester III

Paper 11: Bioprocess Engineering & Technology (Code: 040815)

M.M. 80

Unit I

1. Introduction to Bioprocess Engineering.
2. Kinetic of microbial growth and death
3. Isolation, Preservation and Maintenance of industrial Microorganisms.
4. Media for industrial fermentation
5. Air and Media Sterilization

Unit II

1. Types of fermentation processes: Bioreactors-Analysis of batch, Fed – batch and continuous bioreactors, stability of microbial reactors, analysis of mixed microbial populations, specialized reactors (pulsed, fluidized, photo bioreactors).
2. Measurement and control of bioprocess parameters.

Unit III

1. Downstream processing: Introduction, Removal of microbial cells and solid matter, foam reparation, precipitation, filtration, centrifugation, cell disruption, liquid – liquid extraction, chromatography, Membrane process, Drying and crystallization, Effluent treatment: D.O.C. and C.O.D. treatment and disposal of effluents.
2. Whole cell Immobilization and their industrial applications.

Unit IV

1. Industrial production of chemicals: Alcohol (ethanol), Acids (citric acetic and gluconic), solvents (glycerol, acetone, butanol), Antibiotics (penicillin, streptomycin, tetracycline), Amino acids (lysine, glutamic acid), Single cell protein. Use of microbes in mineral beneficiation and oil recovery.
2. Introduction to food technology: Elementary idea of canning and packing, Sterilization and pasteurization, of food products, technology of typical food/food products (bread, cheese, idli), Food preservation.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

Books:-

1. Shuler ML and Kargi F (2002) Bioprocess Engineering: Basic concepts. 2nd Edition, Prentice Hall, Engelwood Cliffs.
2. Stanbury and Whittaker (1997) Principles of Sterilization techniques, First Indian reprint Edition. Aditya Book (P) Ltd. New Delhi.
3. Michael J. Waites (2008) Industrial microbiology: an introduction 7th Edition; Wiley-Blackwell.
4. Damien and Devies (1994) Microbial Technology.
5. LE Casida (1994) Industrial Microbiology
6. H Patel (2003) Industrial Microbiology. 4th Edition.
7. KS Bilgrami and AK Pandey (1998) Introduction to Biotechnology. Edition 2nd.
8. U Satayanarayan (2005) Biotechnology. First Edition Books and Allied (P) Ltd. Kolkata.
9. Baily JE and Ollis DF. (1986) Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York.
10. Mansi EMTEL, Bryle CFA (2007) Fermentation Microbiology and Biotechnology. 2nd Edition, Taylor & Francis Ltd, UK,
11. Shara L. Aranoff, Daniel R. Pearson, Deanna Tanner Okun, Irving A. Williamson, Dean A. Pinkert (2009) Industrial Biotechnology; Nova Science.
12. Stanbury, P. F., & Whitaker, A. (2010). Principles of Fermentation Technology. Oxford: Pergamon Press.
13. El-Mansi, M., & Bryce, C. F. (2007). Fermentation Microbiology and Biotechnology. Boca Raton: CRC/Taylor & Francis.
14. Lee, Y. K. (2013). Microbial Biotechnology: Principles and Applications. Hackensack, NJ: World Scientific.

List of Practical's:-

1. Isolation and identification of microorganisms from industrial waste water.
2. Determination of thermal death point (TDP) and thermal death time (TDT) of microorganism (Bacteria and Fungi).
3. To study the production of citric acid by *Aspergillus niger* and also qualitative and quantitative test.
4. To study the bacterial growth curve.
5. To study the fungal growth curve.
6. Enzyme kinetics.
7. Bio-ethanol production.

Learning outcomes:

1. This course focuses on principles behind designing and development of equipments, and procedures involved in manufacturing of industrially important products such as pharmaceuticals, nutraceuticals, alcohol, enzymes, antibiotics, acids, polymers, *etc.*, from biological materials.
2. It also deals with studying various biotechnological processes involved in isolation and identification of industrially important microorganisms.
3. This course will also enable the students to understand the basic principles and processes behind food packaging and preservation processes.
4. As bioprocess covers all the physical and biological sciences, it will enable various bioprocess researches, developments, and manufacturing functions for biotherapeutics and other bioproducts, including by-products which are obtained from renewable resources like bioprocessing, agricultural materials, and waste-processing.

School of Studies in Biotechnology

Semester III

Paper 12: Environmental Biotechnology (Code: 040816)

M.M. 80

Unit I

1. Environment: Basic concepts and issues.
2. Environmental Pollution: Types of pollution, Methods for the measurement of pollution; Methodology of environmental management – the problem solving approach, its limitations.
3. Air pollution and its control through Biotechnology

Unit II

1. Water pollution and its control: Water as a scarce natural resource, sources of water pollution, Need for water management, Measurement of water pollution, waste water collection, waste water treatment – physical, chemical and biological treatment processes
2. Microbiology of waste water treatments, aerobic process: Activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds.
3. Anaerobic process: Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactors.

Unit III

1. Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries. Bioremediation
2. Xenobiotics in Environment – Ecological considerations, oil pollution, surfactants, pesticides.

Unit IV

1. Biopesticides in integrated pest management.
2. Solid wastes: Sources and management (composting, wormiculture and methane production).
3. Global Environmental Problems: Ozone depletion, UV – B, green house – effect and acid rain, their impact and biotechnological approaches for management.
4. Role of National organization in Biotechnology.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

Books:-

1. Gareth G. Evans, Judy Furlong (2011) Environmental Biotechnology: Theory and Application. 2nd Edition; John Wiley and Sons
2. Hans-Joachim Jördening, Josef Winter (2005) Environmental biotechnology: concepts and applications; Wiley-VCH.
3. Indu Shekhar Thakur (2006) Environmental Biotechnology: Basic concepts and Applications. First Edition. I. K. International Pvt. Ltd.
4. A.K. Chatterji (2002) Introduction to Environmental Biotechnology. First Edition. Prentice Hall of India Pvt. Ltd. New Delhi.
5. Manoj Tiwari, Kapil Khulbe and Archana Tiwari (2007) Environmental Studies. First Edition, I. K. International Publishing House Pvt. Ltd.
6. H.D. Kumar (2003) Modern Concepts of Biotechnology. Third reprint Edition, Vikas Publishing House. Pvt. Ltd.
7. B.D. Singh (2004) Biotechnology: Expanding Horizons, 1st Edition. Kalyani Publishers.
8. Alan Scragg (2005) Environmental Biotechnology First Edition, reprinted. Oxford University Press.
9. L Y Kun(2003)Microbial Biotechnology: Principles and applications.
10. M. Debnath (2011)Tools and Techniques in Biotechnology.
11. B. Ritmann and P. L. McCarty, (2000), Environmental Biotechnology: Principle & Applications, 2nd Ed., McGraw Hill Science.

List of Practical's:-

1. To determine the total suspended solids of water.(TSS)
2. To determine the total dissolved solids of water.(TDS)
3. Determination of Dissolved oxygen (DO) of water.
4. Determination of chemical oxygen demand (COD) of water.
5. Determination of biochemical oxygen demand (BOD) of water.
6. To screen the antagonism between *Trichoderma* sp. and *Curvularia* sp.
7. Determination of effect of fungicide on the growth of fungi (*Trichoderma* sp.).
8. Effect of fungicide on the antagonism between *Trichoderma* sp. and *Curvularia* sp.
9. To determine the Most Probable number (MPN) of a given water sample.

Learning outcomes:

1. This course unifies environmental sciences and biotechnology by the inception of applications of biotechnology in environmental conservation and mitigation of pollution. It emphasizes on the utilization of various biological processes in solid waste management and, bioremediation of industrial wastes and xenobiotics.
2. It elucidates the global environmental problems, their impacts and mitigation strategies.
3. Facilitate opportunities in private as well as Govt. organizations providing bioremediation services, environmental consulting companies with clients in the manufacturing sector.
4. Imported knowledge will allow developing appropriate techniques utilizing microbes for remediating a particular area, and the pollutants unique to it.
5. Various firms like bio-plastic production unit, biofuel plant, sewage treatment plants, enzyme manufacturing units, *etc.*, will be able to establish.
6. Plant, and microbe based bioremediation process can be exploited for societal benefit.

Lab. Course 5 (Code: 040817)

Based on Theory Papers 9 and 10

Time: 6 hrs. **Total Marks – 100**

Q.1 Experiment based on Theory paper 9 (one major & one minor)	30
Q.2 Experiment based on Theory paper 10 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 *Viva Voce*	10
Q.5 Sessional	20

Lab. Course 6 (Code: 040818)

Based on Theory Papers 11 and 12

Time: 6 hrs. **Total Marks – 100**

Q.1 Experiment based on Theory paper 11 (one major & one minor)	30
Q.2 Experiment based on Theory paper 12 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 *Viva Voce*	10
Q.5 Sessional	20

School of Studies in Biotechnology

Semester IV

Scheme of Examination

Paper Code	Paper	Title of Theory/Practical Paper	Marks		
			External	Internal**	Total
040819	13	IPR, Biosafety, Bioethics and Nanobiotechnology	80	20	100
040820	14	Advance Techniques in Biotechnology	80	20	100
040821	15	Animal Biotechnology	80	20	100
040822	16	Genomics & Proteomics	80	20	100
040823	LC 7	Based on Theory papers 13, 14	80	20	100
040824	LC 8	Based on Theory papers 15, 16	80	20	100
		Total Marks			**600**

School of Studies in Biotechnology

Semester IV

Paper 13: IPR, Biosafety, Bioethics and Nanobiotechnology (Code: 040819)

M.M. 80

Unit – I

1. **IPR :** Introduction to intellectual property; types of IP: patents, trademarks, copyright & related rights, plagiarism, industrial design, traditional knowledge, geographical indications, protection of new GMOs; International framework for the protection of IP; IP as a factor in R&D.

2. **Entrepreneurship in bio-business :** Introduction and scope in Bio-entrepreneurship, Types of bio-industries Strategy and operations of bio-sector firms; Entrepreneurship development program of public and private agencies (MSME, DBT, BIRAC, Make In India).

Unit II

1. **Biosafety** - introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of pathogenic microorganisms; definition of GMOs; principles of environmental risk assessment and food and feed safety assessment

2. **Bioethics** – cloning and stem cell research, Human, plants, microbes and animal experimentation, animal rights/welfare, Agricultural biotechnology – Genetically engineered food, Protection of environment and biodiversity – biopiracy.

Unit – III

1. **Nanobiotechnology** Introduction to Nanobiotechnology: Concepts, historical perspective; Different formats of nanomaterials and applications;

2. Cellular Nanostructures; Nanopores; Bimolecular motors; Synthesis and characterization of different nanomaterials.

Unit – IV

1. Nanoparticles for diagnostics; concepts of smart stimuli responsive nanoparticles, implications in cancer therapy,

2. Nanodevices for biosensor development

3. Thin films: synthesis and applications.

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

Books:-

1. Onetti, A., & Zucchella, A. Business Modeling for Life Science and Biotech Companies: Creating Value and Competitive Advantage with the Milestone Bridge. Routledge.
2. Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.
3. Desai, V. (2009). The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub. House.
4. Ganguli, P. (2001). Intellectual Property Rights: Unleashing the Knowledge Economy.New Delhi: Tata McGraw-Hill Pub.
5. National IPR Policy, Department of Industrial Policy & Promotion, Ministry of Commerce, GoI
6. National Portal of India. http://www.archive.india.gov.in
7. National Biodiversity Authority. http://www.nbaindia.org
8. Recombinant DNA Safety Guidelines (1990) Department of Biotechnology, Ministry of Science and Technology, Govt. of India. Retrieved from- http://www.envfor.nic.in/divisions/csurv/geac/annex-5.pdf
9. Recombinant DNA Safety Guidelines, 1990 Department of Biotechnology, Ministry of Science and Technology, Govt. of India. Retrieved from- http://www.envfor.nic.in/divisions/csurv/geac/annex-5.pdf
10. Wolt, J. D., Keese, P., Raybould, A., Fitzpatrick, J. W., Burachik, M., Gray, A., Wu, F. (2009) Problem Formulation in the Environmental Risk Assessment for Genetically Modified Plants. Transgenic Research, 19(3), 425-436. doi:10.1007/s11248-009-9321-9
11. Craig, W., Tepfer, M., Degrassi, G., & Ripandelli, D. (2008) An Overview of General Features of Risk Assessments of Genetically Modified Crops. Euphytica, 164(3), 853-880. doi:10.1007/s10681-007-9643-8
12. Guidelines for Safety Assessment of Foods Derived from Genetically Engineered Plants. 2008.
13. Guidelines and Standard Operating Procedures for Confined Field Trials of Regulated Genetically Engineered Plants. 2008. Retrieved from http://www.igmoris.nic.in/guidelines1.asp
14. Alonso, G. M. (2013). Safety Assessment of Food and Feed Derived from GM Crops: Using Problem Formulation to Ensure "Fit for Purpose" Risk Assessments. Retrieved from http://biosafety.icgeb.org/inhousepublicationscollectionbiosafetyreviews
15. Sandra J. Rosenthal, David W. Wright (2005) Nanobiotechnology Protocols. Humana Press Inc. 999 Riverview Drive, Suite, 208, Totowa, New Jersery.
16. PC Trivedi (2008) Nanobiotechnology. Pointer Publishers.
17. GL Hornyak, HF Tibbals, and J Dutta (2008) Fundamentals of Nanotechnology.
18. Rita Khare (2013) Concepts in Nano Biotechnology.
19. Shimasaki, C. D. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier.
20. Complete Reference to Intellectual Property Rights Laws. (2007). Snow White Publication Oct.
21. Kuhse, H. (2010). Bioethics: an Anthology. Malden, MA: Blackwell.
22. World Intellectual Property Organisation. http://www.wipo.int
23. David S. Goodsell, (2004); Bionanotechnology: Lessons from Nature; Wiley-Liss.

List of Practical's:-

1. Synthesis of Nanomaterials.
2. Characterization of Nanomaterials.
3. Plagiarism detection by using different online plagiarism-tools.
4. Write-down guidelines for GMO.
5. Find and list-out bio-safety rules for food & beverage.
6. List out IPR of a researcher.
7. Find and list-out different bio-safety rules to be followed in the laboratories.
8. Find and list-out different bio-safety rules to be considered during management of biohazard materials.

Learning outcomes:

1. The study of IPR will impart basic understanding and awareness towards the values of intellectual property and various ways of its protection. It will instill a desire among the students for innovation and entrepreneurship.
2. Biosafety is an integral part of any scientific research and, the knowledge of safety procedures and precautions is a priority in any experiment. This course will guide the students to not only assess the risk, which may be appearing during any experimentation, but also to derive its management strategies.
3. Bioethics is an emerging field which deals with various ethical issues arising as a result of advances in medicine and biotechnology. It will educate the students to recognize boundaries of research in stem cells, cloning and animal experimentation. The course introduces the students with global issues of genetically modified crops, biodiversity conservation and biopiracy.
4. Knowledge of IPR will allow protection of researcher's piece of work like literary or artistic work, images, symbols, *etc.*
5. IPR will aim to reward the innovator; so as to improve socio-economic progress by allowing commercialization of the end-products of any research.
6. Knowledge of IPR could be applied to various ethical issues pertaining to biotechnical researches.
7. Knowledge of biosafety regulations will allow safer handling as well as disposal of biohazards.

School of Studies in Biotechnology

Semester IV

Paper 14: Advanced Techniques in Biotechnology (Code: 040820)

M.M. 80

Unit I

1. Principles and application of: Centrifugation, Chromatography (Paper, Thin layer, gas and liquid chromatography, LCMS), Electrophoresis.
2. RIA and autoradiography in biology, ELISA.

Unit II

1. Principles and application of Thermocycler
2. Microscopy: Light and compound microscopes, Confocal microscopy, Scanning & Electron microscopy, Phase Contrast and fluorescence microscopy.

Unit III

1. Principles and application of DNA micro array
2. Principles and application of: Colorimetry, Spectrophotometry, densitometry, Fluorescence spectrophotometry.
3. Molecular structure determination using NMR and X- ray diffraction

Unit IV

1. Principles and application of Cytophotometry
2. Flow cytometry
3. Southern, Northern, and Western Blotting.
4. DNA sequencer

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

Books:-

1. K. Wilson and J. Walker (2018) Principle and Techniques of Biotechnology and Molecular Biotechnology. Cambridge University Press.
2. Upadhya and Upadhya(2009) Biophysical Chemistry. Mumbai : Himalaya Pub. House.
3. David, L. Nelson and Michael, M. Cox Lehniger (2008) Principal of Biochemistry. 5th Edition. W.H. Freeman and Company, New York.
4. Anthony J.F. Griffiths, William M. Gelbart, Richard C. Lewontin and Jeffrey H. Miller; (1999)Modern Genetic Analysis. Publisher W. H. Freeman.
5. Ralf Pörtner (2013) Animal cell biotechnology: methods and protocols. Humana Press.
6. M. Debnath (2011) Tools and Techniques in Biotechnology.
7. Campbell, I. D. (2012). Biophysical Techniques. Oxford: Oxford University Press.
8. Serdyuk, I. N., Zaccai, N. R., & Zaccai, G. (2007). Methods in Molecular Biophysics: Structure, Dynamics, Function. Cambridge: Cambridge University Press.
9. Rajagopal Vadivambal, Digvir S. Jayas. (2015). Bio-Imaging: Principles, Techniques, and Applications. ISBN 9781466593671 - CAT# K20618.
10. Alberto Diaspro, Marc A. M. J. van Zandvoort. (2016). Super-Resolution Imaging in Biomedicine. ISBN 9781482244342 - CAT# K23483.

List of Practical's:-

Perform various advance laboratory techniques, like –

1. Centrifugation.
2. Chromatography.
3. Spectrophotometry.
4. Electrophoresis.
5. Perform the advance biotechnological techniques, like – ELISA, PCR, Southern blotting, etc.

Learning outcomes:

1. This course will equip the students with basic principles behind the working of various sophisticated instruments and techniques used popularly in biotechnology.
2. The course is designed to bridge the gap between theory and practical applications of various techniques which will play a pivotal role in discovery of new drugs, biopharmaceuticals and bioactive compounds.
3. Knowledge of instrumentation is quite essential for discovery of novel molecules, their extraction, purification, quantification and quality assessment.
4. Will possibly be able to suggest necessary improvements in the instruments which may enhance their sensitivity and accuracy.

School of Studies in Biotechnology

Semester IV

Paper 15: Animal Biotechnology (Code: 040821)

M.M. 80

Unit I

1. Animal cell: Structure and organization
2. Equipment's and materials for animal cell culture
3. Primary and established cell line cultures.
4. Constituents of culture media and their application
5. Application of animal cell culture

Unit II

1. Biology and characterization of the cultured cells, measuring parameters of growth
2. Basic techniques of mammalian cell culture *in vitro*; disaggregating of tissue and primary culture; maintenance of cell culture; cell separation
3. Scaling - up of animal cell culture.
4. Cell synchronization: Cell growth stages
5. Cell cloning: Basic techniques for cell cloning
6. Cell transformation: Characteristics of transformed cells

Unit III

1. Stem cell cultures, embryonic stem cells and their applications.
2. Cell culture based vaccines: General introduction, Vaccines for Malaria and AIDS
3. Somatic cell genetics.
4. Ethical issues in relation to animal biotechnology

Unit IV

1. Transgenic animals: Mice, Sheep, Birds and Fish
2. Apoptosis.
3. Tissue engineering: Elementary idea of tissue engineering, Artificial skin, artificial cartilage

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

Books:-

1. RW Masters (2000) Animal Cell Culture Practical Approach: Oxford University Press.
2. Ralf Pörtner (2007) Animal cell biotechnology. Humana Press.
3. M Clynes (2012) Animal Cell Culture Techniques.
4. Nigel Jenkins (1999) Animal Cell Biotechnology methods and Protocols. Humana Press, Totowa, New Jersey.
5. B.D. Singh Biotechnology (2004) Expending Horizons. First Edition. Kalyani Publishers, Ludhiana.
6. U Satyanarayana (2005) Biotechnology. Books and Allied (P) Ltd., Kolkata.

List of Practical's:-

1. Extraction, estimation and separation of DNA from blood
2. Extraction, estimation and separation of DNA from spleen
3. Extraction, estimation and separation of DNA from muscle tissue
4. To perform mechanical disaggregation of soft tissues of chick, for recovery of cells.
5. To perform enzymatic disaggregation of tissue, for recovery of cells.

Learning outcomes:

1. This course involves the study of basic principles and techniques of animal tissue culture and is one of the most important fields of biology that has played a pivotal role in advancement of medicine and disease biology. This course will advance the students in the field of biomedical research.
2. Aid in IVF, vaccine production, animal cell line production, and maintenance.
3. Will be able to go for animal cell and tissue culture for product development.

School of Studies in Biotechnology

Semester IV

Paper 16: Genomics & Proteomics (Code: 040822)

M.M. 80

UNIT – I

1. Genomics – General introduction, Types of genomics, Structural genomics, Functional genomics, Comparative genomics, Genome sequencing, Genome mapping, Future of genomics
2. Plant Genomics
3. Genomics in medicine: Gene medicine, Disease models, The impact of genomics on medicine

UNIT – II

1. Human genome project, Methods of gene sequencing: - Random shotgun sequencing, EST. Whole genome shotgun sequencing, Genome prediction and gene counting, Single nucleotide polymorphisms (SNPs)
2. Comparative Genomics: Sequence comparison, Comparative genomics in bacteria, Comparative genomics in Eukaryotes & organelles

UNIT – III

1. Proteomics – General concept, Gene and Protein, Types of proteomics, Structural proteomics and Functional proteomics
2. Methods of study the protein, Protein arrays, protein chips, System biology, Practical application of proteomics

UNIT – IV

1. Future of proteomics, Analysis of protein structure,
2. Protein-Protein interactions, Protein database, Global analysis of protein. Expression analysis and characterization of protein

NOTE: Questions will be asked as per the new policy of question paper. In which, 20 multiple choice questions (covering entire syllabus of the paper), 8 very short answer (2-3 sentences) type questions (two from each unit), 8 short answer (about 75 words) type questions (two from each unit), and 5 long answer (about 150 words) type questions (at least one from each unit) will be asked. Each question will cover entire (4) units of the paper.

Books:-

1. Primrose & Twyman (2013) Principles of Gene Manipulation and Genomics.
2. TA Brown (2015) Gene cloning and DNA analysis: An introduction.
3. Guido Grandi (2004) Genomics, Proteomics & Vaccines.
4. Primrose & Twyman (2008) Genomics: Application in Human biology.
5. Introduction to molecular Genetics and Genomics; JBH Publication
6. Timothy Palzkill (2002) Proteomics.
7. U Satyanarayana (2005) Biotechnology. Books and Allied (P) Ltd., Kolkata.
8. P.K. Gupta (2004) Biotechnology and Genomics. Rastogi Publication.
9. S Choudhuri and DB Carlson (2008) Genomics: Fundamentals and applications, 1st edition
10. Johathan Pevsnev (2015) Bioinformatics and Functional. 3rd edition.

List of Practical's:-

1. Find out and study the sequence similarity by BLAST & FASTA.
2. To study the genome map from NCBI resource.
3. To study the basic functionality of genome by genome browser.
4. Study the whole genome of Hepatitis B virus and Human Mitochondrial Genome using genome databases of Gene Bank.
5. Study the single nucleotide polymorphism (SNP) of human genome using SNP databases of NCBI (Example: MTHFR gene)
6. Study the Sequence comparison in bacterial genome using Gene Bank (16S Ribosomal DNA sequence of *Rickettsia* sp.)
7. To study the Multiple Alignment Sequence by using CLUSTAL OMEGA tools.
8. To determine the sequence of database of RNA families by using Rfam.
9. To retrieve the protein sequence by Swiss Prot database
10. Study the Protein protein and Protein nucleotide interaction using Gene Bank databases (Example : Human 40S ribosome)

Practical References:-

1. Shui Qing Ye (2007) Bioinformatics: A Practical Approach. Chapman & Hall Taylor & Francis Gen.
2. Mount D. W (2005) Bioinformatics – Sequence & Genome Analysis. CBS Publishers & Distributors (Pvt) Ltd.
3. Bela Tiwari (2007) Introductory Bioinformatics For Users: The Practicals.
4. Griffiths-Jones S, Bateman A, Marshall M, Khanna A, Eddy SR (2003). "Rfam: an RNA family database". Nucleic Acids Res. 31 (1): 439–41.

Learning outcomes:

1. This will enable the students to acquire knowledge about the basic structural and functional aspects of genes and proteins.
2. It focuses on the unified applications of genomics and proteomics in the fields of medicine such as drug discovery, identification of potential vaccine candidates, *etc.*
3. A novel and fruitful research area called as 'genoeconomics' can be established in which sequencing of the complete genome of organisms will reveal similarities and dissimilarities among individual at various taxonomical levels.
4. This paper has wide scope in the field of drug discovery, cancer therapy, *etc.*

Lab. Course 7 (Code: 040823)

Based on Theory Papers 13 and 14

Time: 6 hrs. **Total Marks – 100**

Q.1 Experiment based on Theory paper 13 (one major & one minor)	30
Q.2 Experiment based on Theory paper 14 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 *Viva Voce*	10
Q.5 Sessional	20

Lab. Course 8 (Code: 040824)

Based on Theory Papers 15 and 16

Time: 6 hrs. **Total Marks – 100**

Q.1 Experiment based on Theory paper 15 (one major & one minor)	30
Q.2 Experiment based on Theory paper 16 (one major & one minor)	30
Q.3 Spotting based on Theory papers	10
Q.4 *Viva Voce*	10
Q.5 Sessional	20

Project (Code: 040825)

Project Work	External	Internal	Total
Dissertation	240	60	300
Seminar based on project	160	40	200
Viva Voce	80	20	100
Total			**600**

1. A student of IV semester will have the option to opt for project work in lieu of four theory papers and two lab courses provided he/she secures at-least 65% or more marks in aggregate in semester I and II.

2. The project has to be carried out in recognized national laboratories or UGC recognized universities. No student will be allowed to carry out project in private laboratories/ college/ institutions, excluding the colleges recognized as research centers by the RDC of Pt. Ravishankar Shukla University, Raipur.

3. The valuation of all the projects will be carried out by the external examiner and HoD of UTD or its nominee at the UTD Centre.

The project work should be related to the field of Biotechnology. The project report should include declaration by the candidate, certificate by the supervisor, acknowledgement, title and introduction along with the following points:

1. Introduction
2. Review of Literature
3. Materials and Methods
4. Results & Discussion
5. Summary
6. Bibliography

Learning outcomes:

1. Will develop skills to plan and conduct investigational work; gain practical knowledge, think scientifically, writing research report.
2. Make them able to carry-out small piece of research work, using knowledge and expertise acquired.

SYLLABUS

2021-2022

PT. RAVISHANKAR SHUKLA UNIVERSITY

RAIPUR

CHHATTISGARH

SYLLABUS

CODE 321 & 322

M.Sc. CHEMISTRY

SEMESTER EXAMINATION

2021-2022

PT. RAVISHANKAR SHUKLA UNIVERSITY

RAIPUR-492010, CHHATTISGARH

VISION

The vision of the School of Studies in Chemistry is to develop an environment of enthusiasm and passionate involvement with continuous advancement in chemical sciences for producing human resource with world-class competence and skills in pure & applications of chemical sciences by; 1) providing world-class and user-friendly teaching methodologies for students of advanced studies, 2) Inculcating the research temperament of user-folks under the inter-disciplinary platform of industry-academia-research institutes with promotion of research consultancies and collaborations with institutes of national and international importance

MISSION

1. To develop the School, a centre of excellence for higher education and knowledge resources
2. To promote understanding the value of self-learning, creating and competence building:
   a) By providing world-class education through university teaching departments and schools.
   b) By promoting inter-disciplinary research and professional consultancy services and student exchange program with institute of national and international repute
   c) By creating environment conducive to nurture creativity and scientific temper

M. Sc. Chemistry (Programme Outcome)

Students of M. Sc. in chemistry will:

- Learn the latest advancement in different branches of chemical sciences, under the designed syllabus for theory and laboratory courses and their learning performance will be examined through performance on assignments, semester examinations and laboratory experiments/project performances.
- Develop a thorough knowledge of experimental approaches to solving problems of a chemical sciences and will develop an ability to extend that knowledge to the solution of new problems.
- Have writing and oral communication skills in a scientific manner, with especial emphasis on chemical sciences.
- Have knowledge to design a research project in chemical sciences.
- Integrate and apply relevant knowledge to problems that emerge from the broader interdisciplinary subfields (life, environmental and material sciences).

Students majoring in chemistry will:

- Demonstrate his/her mastery in: advanced analytical tools, environmental chemistry, organic and biochemistry, inorganic, and physical chemistry.
- Demonstrate critical thinking and analytical problem-solving abilities. She/he will be able to integrate chemical concepts and ideas learned in lecture courses with skills learned in laboratories to formulate hypotheses, propose and perform experiments,
- Demonstrate fundamental laboratory skills, essential knowledge of sophisticated instruments, knowledge of different software for models and simulation, laboratory safety protocols, and demonstrate proficiency in using computers to solve chemical problems.

- Demonstrate effective scientific communication skills – both written and oral. Students will be able to write review article, reports and present the results of scientific work
- Obtain information from library, online and literature resources that will support the solving of chemical and research problems.

Programme Specific Outcome

- Programme will be able to get global level research opportunities to students to pursue Ph.D programme, targeted approach of competitive Exams such as CSIR – NET/GATE/SET, discipline specific competitive exams conducted by service commission, etc.
- The students will be able to get employment opportunities in various chemical and pharmaceutical industries
- Understands the background of Physical chemistry, Inorganic reaction and organic reaction mechanisms, Environmental analytical chemistry and instrumental methods of chemical analysis, separation techniques and analytical methods.
- To gains complete knowledge about all fundamental aspects Physical, Inorganic, Organic, and Analytical Chemistry.

Course Outcome from Syllabus

Paper	Name of Paper	Learning Outcome
CH-101	Group Theory and chemistry of metal complex	After studying this paper (Course), students will be able to • Understand the principle of group theory and molecular symmetry. • Classify the molecules into point groups. • Critically understand the symmetry based spectroscopic properties of the molecules. • Understand principles of structure and bonding of metal complexes. • Understand about structural bonding, chemical reactivity and structural aspect of various complexes, metal-ligand equilibria in solution, isopoly and heteropoly acids, metal clusters, chains, rings.
CH-102	Concepts in Organic chemistry	• Understand about nature and bonding of organic molecules, conformational analysis and stereochemical aspect of organic molecules, reaction intermediate such as carbocation, carbanion as well as free radical, and their stability reactivity and types of reaction • Understand about pericyclic reaction, types in presence of heat and light.
CH-103	Quantum Chemistry, Thermodynamic and Chemical Dymanic-I	• Learners will be expected to learn the basic concepts of postulates of quantum mechanics, Schrodinger wave equation, particle in a box and fundamental mathematics required to study physical chemistry. The first part of course develops the relevant mathematical methods for chemistry and quantum mechanics. • The second part of the course develops some important concepts of thermodynamics like chemical potential, partial molar properties, Vant Hoff equation, fugacity and Gibbs Duhem equation. Students will also gain knowledge about electrochemistry of solution, ion solvent interactions, Debye-Huckel Onsager,

		activity and activity coefficients and electrified interfaces etc. • The last part of this course will provide an advanced level in-depth understanding about chemical kinetics, rate and rate laws, various theories of reaction rates, salt effect, chain and oscillatory reactions
CH-104	Theory and Applications of spectroscopy-I	• Understand about the electromagnetic radiation, principle and theory of microwave, Infrared and Raman spectroscopy as well as their real applications in food, water, air, clinical samples analysis.
CH-105	Lab Course - I	• Development of deeper understanding of concepts. • Experiencing experimental procedure directly. • Development of skill for qualitative and quantitative analysis of ores and minerals. • Development thinking skills (critical, quantitative, qualitative). • Development data analysis skills. • Development experimental skills (e.g., design, observation, and use of equipment). • Development communication skills, including those involved in working in groups.
CH-106	Lab Course - II	• Development of deeper understanding of basic concepts of Adsorption/surface chemistry, CMC, Phase equilibria, Chemical kinetics, Conductometry, pH metry, Potentiometry, Solution/molecular weight. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development data analysis skills. • Development communication skills, including those involved in working in groups.
CH-201	Transition Metal complexes	After studying this paper (Course), students will be able to • Understand about the reaction mechanism of transition metal complexes. • Interpretation of electronic spectra, and magnetic properties of transition metal complexes. • Experience the building bridges between inorganic and organic chemistry. • Learn the relationship between structure& bonding and the reactions of organometallic compounds. • Understand the Aryl, allyl of transition metal complex, carbon multiple bond and fluxional behaviour of organometallic compounds
CH-202	Reaction Mechanism	• Recognize the basic practical skills for the synthesis and analysis of organic compounds. • Recall the fundamental principles of organic chemistry that include chemical bonding, nomenclature, structural isomerism, stereochemistry, chemical reactions and mechanism. • Name the functional groups and different class of organic compounds. • Predict the reactivity of an organic compound from its structure.

		• Develop basic skills for the multi-step synthesis of organic compounds. • Understanding the nucleophile and electrophile group and their properties. • Understanding the Various reaction mechanisms such as SN_1, SN_2, for both aromatic and aliphatic system. • Understanding the reaction mechanism and reactivity with different electron withdrawing and electron donating group. • Understanding the chemical reaction of carbon- carbon multiple bonds with different reagent and their stereochemistry, chemoselectivity, regioselectivity. • Understanding the chemical reaction of carbon- Oxygen and heteroatom multiple bonds with different reagent and their stereochemistry, chemoselectivity, regioselectivity. • Understand the reactivity toward the conjugated aldehydes, ketones, acid and acid derivative to synthesize the new organic molecules. • Able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments. • Able to explore new areas of research in both chemistry and allied fields of science and technology. • Able to recognize many functional groups and their reactivity • Understand the influence of bond polarization on a molecule's structure and reactivity
CH-203	Quantum Chemistry, Thermodynamic and Chemical Dynamic-II	• Under stands about application of matrices in quantum chemistry, Angular momentum in quantum chemistry, approximate methods, statistical thermodynamics, electrochemistry, chemical dynamic-II.
CH-204	Theory and Applications of Spectroscpoy-II	• Understand about the principle and theory of Ultraviolet and visible spectroscopy, Scattering spectroscopy, Mass spectrometry, Nuclear magnetic resonance spectrophotometryas well as their real applications in food, water, air, clinical samples analysis.
CH-205	Lab Course - III	• Development of deeper understanding of basic concepts of organic chemistry, synthesis and design of organic molecules, separation purifications. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development data analysis skills. • Development communication skills, including those involved in working in groups.
CH-206	Lab Course - IV	• Development of deeper understanding of basic concepts of Statistical and error data analysis, Use of computer program, Flame photometric, Nephelometric, determinations, electrophoresis, spectroscopy. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development communication skills, including those involved in

		working in groups.
CH-301	Resonance Spectroscopy, Photochemistry and Organocatalysis	• Understand about the principle and application of ESR, NQR, PAS, PES. • Understand about the photochemical reaction, determination of chemical reaction miscellaneous photochemical reaction, Organometallic chemistry
CH-302	Chemistry of Biomolecules	• Understand about Bioenergetics, electron transfer in biological system, transport and storage of dioxygen by biomolecules, reactivity and characteristics of metalloenzymes, the enzyme model, host guest chemistry, chirality biomimetic chemistry, types of enzymes coenzyme and their applications • Understand about Biopolymer interaction, thermodynamic of biopolymer solution, cell membrane and transport of ions.
CH-303	Catalysis, Solid state and surface Chemistry	• Students should base basic knowledge about the Acid –Base concepts, Acid-Base Catalysis, Enzyme catalysis. They will be expected to know the acidity function and their application in reaction mechanism, Nucleophiles, Alpha Nucleophiles and different scales. Students will be able to formulate the concept of surface chemistry, micellization and adsorption. • Students are expected to learn determination of CMC and derivation of different models of thermodynamics of micellization, and Gibbs Adsorption isotherm and surface tension and capillary action. • Students will gain an advanced level understanding of the solid-state chemistry, crystal defects and non-stoichiometry, electronic properties and Band theory of semiconductor. • The last part of the course will help in developing knowledge about polymers and macromolecules, and their applications. It will provide an advanced level in-depth understanding about kinetics of polymerization, determination of molecular mass of polymers and chain configuration of macromolecules.
CH-304	Analytical Techniques and data analysis	• Understand about sample preparation, digestion and statistical analysis, separation technique, Thermal and Automated methods (TGA, DTA, DSC), Electrochemical concept and their applications.
CH-305	Lab Course - V	• Development of deeper understanding of basic concepts of physical chemistry experiments. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development data analysis skills. • Development communication skills, including those involved in working in groups.
CH-306	Lab Course - VI	• Development of deeper understanding of basic concepts of Spectrophotometry, pH-metry, Polarography, Flame photometric determination, separation and quantitative estimation. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment).

		• Development data analysis skills. • Development communication skills, including those involved in working in groups.
CH-401	Instrumental Methods of Analysis	• Understand about the Instrumentation, principle and application of advanced Chromatography, X-ray and proton induced spectroscopy, atomic emission spectroscopy, Atomic absorption spectroscopy and hyphenated techniques.
CH-402	Natural Product and Medicinal Chemistry	• **Understanding about the Terpenoids and Carotenoids**: Classification, nomenclature, occurrence, isolation, general methods of structure determination of Citral, Geraniol, α-Terpineol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β – Carotene. • **Understanding about the Alkaloids:** Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on Nitrogen heterocyclic ring, role of alkaloids in plant. Synthesis and biosynthesis of the following: Ephedrine, (+)- Coline, Nicotine, Atropine, Quinine and Morphine. • **Understanding about the Steroids:** Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Esterone, Progesterone, Aldostrone and Biosythesis of cholesterol. • **Understanding about the Plant Pigments**: Occurrence, nomenclature and general method of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzine, Butein, Aureusin, Cyanidin-7-arebinoside, Cyanidin, Hirsutidin. • **Understanding about the Drug design:** Development of new drugs procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, Structure-Activity Relationship (SAR), Factors affecting bioactivity, resonance, inductive effect. Theories of drug activity: occupancy theory, rate theory, induced fit theory. Quantitative Structure Activity Relationship (QSAR). Concepts of drug receptors, lipophilicity, phamacophore, pharmacological activity and typical range of parameters related to drug likeness. General introduction of pharmacokinetics and pharmacodynamics. • **Understanding about the Anteoplastic Agents**: Introduction, Alkylating agents, antimetabolites, carcinolytic antibiotics, mitoticinhibitors. • **Understanding about the Antibiotics**: Constitution and synthesis of penicillins, chloramphenicol, tetracycline and streptomycin. • **Understanding about the Antimalarials**: Synthesis and properties of the following Antimalarial: 8-amino quinolone derivatives-Pamaquine, Primapune, Pentaquinr, Isopentaquine, 4-amino quinolone derivatives- Santoquine, Camaquine, Acridine derivatives-Mepracrine, Azacrin, Pyrimidine and Biguanid derivatives- Paludrine, Pyremethamine.

CH-403	Material and Nuclear Chemistry	• Understand about the non-equilibrium thermodynamic • Material chemistry; design, synthesis characterization and applications • Understand about the supramolecular chemistry: design, synthesis and application • Nuclear and radiochemistry
CH-404	Environmental and Applied Chemical Analysis	• Understand about the Air pollution monitoring and analysis, soil, water, Food, cosmatics, clinical and drug analysis,
CH-405	Lab Course - VII	• Development of deeper understanding of basic concepts of organic chemistry, synthesis and design of organic molecules, isolation, separation and purifications. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development data analysis skills. • Development communication skills, including those involved in working in groups.
CH406	Lab Course - VIII	• Development of deeper understanding of basic concepts of Spectrophotometry, pH metry. Flamephotometric determination, separation and quantitative estimation. Soil, water sample analysis. • Experiencing experimental procedure directly. • Development experimental skills (e.g., design, observation, and use of equipment). • Development data analysis skills. • Development communication skills, including those involved in working in groups.

EXAMINATION SCHEME

M.Sc. examination will be conducted in four SEMESTERS. Each semester exam shall consist of FOUR THEORY PAPERS AND TWO LAB COURSES.

SEMESTER –I (20 CREDIT)

THEORY (16 CREDIT)

PAPER Number and Paper Code	COURSE	CREDIT	DURATION	INTERNAL ASSESSMENT	THEORY MARKS	TOTAL MARKS
1 (CH–101)	GROUP THEORY AND CHEMISTRY OF METAL COMPLEXES	4	4 Hrs	20	80	100
2 (CH–102)	CONCEPTS IN ORGANIC CHEMISTRY	4	4 Hrs	20	80	100
3 (CH–103)	QUANTUM CHEMISTRY, THERMODYNAMICS AND CHEMICAL DYNAMICS - I	4	4 Hrs	20	80	100
4 (CH–104)	THEORY AND APPLICATIONS OF SPECTROSCOPY-I	4	4 Hrs	20	80	100

PRACTICAL (4 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	MARKS
5 (CH–105)	Lab Course - I	2	8 Hrs	100
6 (CH–106)	Lab Course - II	2	8 Hrs	100

SEMESTER –II (20 CREDIT)

THEORY (16 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	INTERNAL ASSESSMENT	THEORY MARKS	TOTAL MARKS
1 (CH–201)	TRANSITION METAL COMPLEXES	4	4 Hrs	20	80	100
2 (CH–202)	REACTION MECHANISMS	4	4 Hrs	20	80	100
3 (CH–203)	QUANTUM CHEMISTRY, THERMODYNAMICS AND CHEMICAL DYNAMICS - II	4	4 Hrs	20	80	100
4 (CH–204)	THEORY AND APPLICATIONS OF SPECTROSCOPY-II	4	4 Hrs	20	80	100

PRACTICAL (4 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	MARKS
5 (CH–205)	Lab Course - III	2	8 Hrs.	100
6 (CH–206)	Lab Course - IV	2	8 Hrs.	100

SEMESTER –III (20 CREDIT)

THEORY (16 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	INTERNAL ASSESSMENT	THEORY MARKS	TOTAL MARKS
1 (CH–301)	RESONANCE SPECTROSCOPY, PHOTOCHEMISTRY AND ORGANOCATALYSIS	4	4 Hrs	20	80	100
2 (CH–302)	CHEMISTRY OF BIOMOLECULES	4	4 Hrs	20	80	100
3 (CH–303)	CATALYSIS, SOLID STATE AND SURFACE CHEMISTRY	4	4 Hrs	20	80	100
4 (CH–304)	ANALYTICAL TECHNIQUES AND DATA ANALYSIS	4	4 Hrs	20	80	100

PRACTICAL (4 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	MARKS
5 (CH–305)	Lab Course - V	2	8 Hrs.	100
6 (CH–306)	Lab Course - VI	2	8 Hrs.	100

SEMESTER –IV (20 CREDIT)

THEORY (16 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	INTERNAL	THEORY	TOTAL MARKS
1 (CH–401)	INSTRUMENTAL METHOSS OF ANALYSIS	4	4 Hrs	20	80	100
2 (CH–402)	NATURAL PRODUCS AND MEDICINAL CHEMISTRY	4	4 Hrs	20	80	100
3 (CH–403)	MATERIAL AND NUCLEAR CHEMISTRY	4	4 Hrs	20	80	100
4 (CH–404)	ENVIRONMENTAL AND APPLIED CHEMICAL ANALYSIS	4	4 Hrs	20	80	100

OR
OPTIONAL PAPER

CH-404a	MEDICINAL CHEMISTRY
CH-404b	CHEMISTRY OF SURFACTANTS
CH-404c	CHEMISTRY AND APPLICATION OF PESTICIDES
CH-404d	MOLECULAR SYMMETRY, COORDINATION AND ORGANOMETALLIC 404 d CHEMISTRY
CH-404e	NANOCHEMISTRY
CH-404f	CHEMISTRY OF NATURAL PRODUCTS
CH-404g	POLYMERS
CH-404h	FORENSIC CHEMISTRY

PRACTICAL (4 CREDIT)

PAPER Number and paper code	COURSE	CREDIT	DURATION	MARKS
5 (CH-405)	Lab course VII or seminar	2	8 Hrs	100
6 (CH-406)	Lab course VIII	2	8 Hrs	100
		Or		
7 (CH-407)	**Project Work**	2	---------	100
8 (CH-408)	**Seminar**	2	-----------	100

SCHEME FOR LABORATORY EXPERIMENT EXAMINATION

EXPERIMENT	MARKS
Object-1	30
Object -2	30
Viva-voce	20
Sessional Marks	20
TOTAL MARKS	**100**

FIRST SEMESTER

PAPER NO 1. CH –101

GROUP THEORY AND CHEMISTRY OF METAL COMPLEXES

Max. Marks 80

UNIT - I

SYMMETRY AND GROUP THEORY IN CHEMISTRY: Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroup. Conjugacy relation and classes. Point symmetry group. Schoenflies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh}, etc. groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use in spectroscopy.

UNIT - II

A. METAL-LIGAND BONDING: Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, bonding and molecular orbital theory.

B. METAL-COMPLEXES: Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.

UNIT –III

A. METAL–LIGAND EQUILIBRA IN SOLUTION: Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.

B. ISOPOLY ACID AND HETEROPOLYACID: Isopoly and heteropoly acids of Mo and W. Preparation, properties and structure. Classification, Preparation, properties and structures of borides, carbides, nitrides and silicides. Silicates- classification and Structure, Silicones- preparation, properties and application.

UNIT – IV

A. METAL CLUSTERS: Higher boranes, carboranes, metalloboranes and metallocarboranes. Metal carbnonyl and halide cluster, compounds with metal-metal multiple bonds.

B. CHAINS: catenation, heterocatenation, intercatenation.

C. RINGS: Borazines, phosphazines.

BOOK SUGGESTED:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes and Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
4. Comprehensive Coordination Chemistry Eds. G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.

PAPER NO 2. CH –102

CONCEPTS IN ORGANIC CHEMISTRY

Max. Marks 80

UNIT - I

A. **NATURE OF BONDING IN ORGANIC MOLECULES:** Localized and Delocalized chemical bond, conjugation and cross-conjugation, Bonding in Fullerenes, Bonds weaker than covalent, addition compounds,

Crown ether complexes and cryptands. Inclusion compounds, Cyclodextrins, Catenanes and Rotaxanes.

B. **AROMATICITY:** Aromaticity in benzonoid and non-benzenoid compounds, Huckel anti-aromaticity, homo-aromaticity. PMO approach for Aromaticity, Annulenes.

UNIT - II

A. **CONFORMATIONAL ANALYSIS**: Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding.

B. **STEREOCHEMISTRY:** Elements of symmetry, chirality, molecules with more than one chiral center, methods of resolution, optical purity, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon - Biphenyls, allenes and spiranes, chirality due to helical shape.

UNIT - III

A. **REACTION INTERMEDIATES:** Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. Sandmeyer reaction, Free radical rearrangement and Hunsdiecker reaction.

B. **ELIMINATION REACTIONS:** The E_2, E_1 and E_1cB mechanisms. Orientation of the double bond. Reactivity, effects of substrate structures, attacking base, the leaving group and the medium.

UNIT - IV

PERICYCLIC REACTIONS: Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions - conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions - antrafacial and suprafacial additions, 4n and 4n+2 system, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements - suprafacial and antarafacial shifts of H, sigmatrophic shifts involving carbon moieties, 3,3- and 5,5- sigmatropic rearrangements. Claisen, Cope and Aza-Cope rearrangements. Ene reaction.

BOOKS SUGGESTED:

1. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
2. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
3. Structures and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
4. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
5. Modern Organic Reactions, H. O. House, Benjamin.
6. Principles of Organic Synthesis, R. O. C. Norman and J. M. Coxon, Blackle Academic and Professional.
7. Pericyclic Reactions, S. M. Mukherji, Macmillan, India.
8. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillian.
9. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
10. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
11. Rodd's Chemistry of Carbon Compounds, Ed. S. Coff
12. Organic Chemistry, Vol 2, I. L. Finar, ELBS.
13. Stereo selective Synthesis: A Practical Approach, M. Nogradi, and VCH.
14. Organic Chemistry, Paula Yurkanis Bruice, Pearson Education.

PAPER NO 3. CH –103

QUANTUM CHEMISTRY, THERMODYNAMICS AND CHEMICAL DYNAMICS - I

Max. Marks 80

UNIT - I

A. MATHEMATICAL CONCEPTS IN QUANTUM CHEMISTRY:

Vector quantities and their properties. Complex numbers and Coordinate transformation. Differential and Integral Calculus, Basic rules of differentiation and Integration applications.

B. The Schrodinger equation and postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz Particle in a box, the harmonic oscillator, the rigid rotator, the hydrogen atom.

UNIT –II

BASICS OF THERMODYNAMICS: Maxwell's thermodynamic relations, Vant's Hoff hypothesis. Partial molar volume and partial molar heat content. Chemical potential, Gibbs-Duhem equation, variation of chemical potential with temperature and pressure. Chemical potential of ideal gases, pure solids, liquids and mixture of ideal gases. Activity and Fugacity, Determination of Fugacity, Variation of Fugacity with Temperature and Pressure.

UNIT –III

ELECTROCHEMISTRY–I: Electrochemistry of solution. Debye-Huckel Onsager treatment and its extension, ion solvent interactions. Debye-Huckel Limiting Law. Debye-Huckel theory for activity coefficient of electrolytic solutions. Determination of activity and activity coefficient, ionic strength, Thermodynamics of electrified interface equations. Derivation of electro-capillarity, Lippmann equation (surface excess), methods of determination.

UNIT –IV

CHEMICAL DYNAMICS –I: Methods of determining rate laws, consecutive reactions, collision theory of reaction rates, steric factor, Activated complex theory, kinetic salt effects, steady state kinetics, and thermodynamic and kinetic control of reactions. Dynamic chain (Hydrogen-bromine and Hydrogen-chlorine reactions) and Oscillatory reactions (Belousov-Zhabotinsky reaction etc.)

BOOKS SUGGESTED :

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Coulson's Valence, R. McWeeny, ELBS.
3. Chemical Kinetics, K. J. Laidler, Pearson.
4. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
5. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N. Reddy, Plenum.
6. Thermodynamics for Chemists, S. Glasstone EWP.
7. An Introduction to Electrochemistry S. Glasstone EWP.
8. Organic Chemist's Book of Orbitals. L. Salem and W.L. Jorgensen, Academic Press
9. The Physical Basis of Organic Chemistry, H. Maskill, Oxford University Press

PAPER NO 4. CH - 104

THEORY AND APPLICATIONS OF SPECTROSCOPY- I

Max. Marks 80

UNIT - I

UNIFYING PRINCIPLES:

Electromagnetic radiation, interaction of electromagnetic radiation with matter-absorption, emission transmission, reflection, dispersion, polarization and scattering, Uncertainty relation and natural line width and natural line broadening, transition probability, selection rules, intensity of spectral lines, Born-Oppenheimer approximation, rotational, vibrational and electronic energy levels. Region of spectrum, representation of spectra, F.T. spectroscopy, computer averaging, lasers.

UNIT- II

MICROWAVE SPECTROSCOPY:

Classification of molecules in term of their internal rotation mechanism, determination of rotation energy of diatomic and polyatomic molecules, intensities of rotational spectral lines, effect of isotopic substitution on diatomic and polyatomic molecules, intensities of rotational spectral lines and parameters of rotational energy of linear and the transition frequencies, non-rigid rotators, spectral lines and parameters of rotational energy of linear and symmetric top polyatomic molecules. Application in determination of bond length.

UNIT- III

INFRA RED SPECTROSCOPY:

Introduction, simple and anharmonic oscillators in vibrational spectroscopy, diatomic-vibrating rotator, Modes of vibration in polyatomic molecules, vibration-coupling, Fourier Transform IR spectroscopy: instrumentation, interferometric spectrophotometer, sample handling, Factors influencing vibrational frequencies, Application of IR spectroscopy: Interpretation of IR spectra of normal alkanes, aromatic hydrocarbons, alcohols, phenols, aldehydes, ketones, ethers, esters, carboxylic acids, amines and amides.

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UNIT- IV

RAMAN SPECTROSCOPY:

Classical and quantum theories of Raman effect, pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, Coherent anti Stokes Raman spectroscopy (CARS), Instrumentation , Application of Raman effect in molecular structures, Raman activity of molecular vibration, structure of CO_2, H_2O, N_2O, SO_2, NO_3^-, ClF_3.

BOOKS SUGGESTED

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Fundamentals of Molecular Spectroscopy, C.N. Banwell.
3. Spectroscopy, B.K. Sharma, Goel Publication.
4. Organic Spectroscopy: Principles and Applications, Jag Mohan, Narosa Publication.
5. Spectroscopy Methods in Organic Chemistry, D.H. Williams & I. Fleming, Tata Mcgraw-Hill Publication.
6. Spectrophometric Identification of Organic Compounds, R.M. Silversteion & F. X. Webster, John Wiley Publication.

PAPER NO 5. CH - 105

LABORATORY COURSE–I

Max. Marks 100

1. QUALITATIVE ANALYSIS OF MIXTURE CONTAINING EIGHT RADICALS INCLUDING TWO LESS COMMON METAL FROM AMONG THE FOLLOWING BY SEMI MICRO METHOD.

1) *Basic Radicals :*

Ag, Pb, Hg, Bi, Cu, Cd, As, Sb, Sn, Fe, Al, Cr, Zn, Mn, Co, Ni, Ba, Sr, Ca, Mg, Na, K, Ce, Th, Zr, W, Te, Ti, Mo, U, V, Be, Li, Au, Pt.

2) *Acid Radicals :*

Carbonate, Sulphite, Sulphide, Nitrite, Nitrate, Acetate, Flouride. Chloride, Bromide, Iodide, Sulphate, Borate, Oxalate, Phosphate, Silicate, Thiosulphate, Ferrocyanide, Ferricyanide, Sulphocyanide, Chromate, Arsenate and Permanganate.

2. QUANTITATIVE ANALYSIS:

Involving separation of two of the following in ores, alloys, or mixtures in solution, one by volumetric and the other by gravimetric methods.

3. ESTIMATION OF:

1) Phosphoric acid in commercial orthophosphoric acid.
2) Boric acid in borax.
3) Ammonia in ammonium salts.
4) Manganese dioxide in pyrolusite.
5) Available chlorine in bleaching powder.
6) Hydrogen peroxide in commercial samples.

4. PREPARATIONS:-

Preparation of selected inorganic compound and their studies by I.R. electronic spectra, Mössbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds

(1) $VO(acac)_2$
(2) $TiO(C_9H_8NO)_2 . 2H_2O$
(3) cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
(4) $Na[Cr(NH_3)_2(SCN)_4]$
(5) $Mn(acac)_3$
(6) $K_2[Fe(C_2O_4)_3]$
(7) Prussian Blue, Turnbull's Blue.
(8) $[Co(NH_3)_6][Co(NO_2)_6]$
(9) cis-$[Co(trien)(NO_2)_2]Cl.H_2O$
(10) $Hg[Co(SCN)_4]$
(11) $[Co(Py)_2Cl_2]$
(12) $[Ni(NH_3)_6]Cl_2$
(13) $Ni(dmg)_2$
(14) $[Cu(NH_3)_4]SO_4 . H_2O$

BOOKS SUGGESTED

1. Vogel's Textbook of Quantitative Analysis, revi Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly, Prentice Hall.

PAPER NO 6. CH –106

LABORATORY COURSE –II

Max. Marks 100

ADSORPTION/SURFACE CHEMISTRY

1. Surface Tension - Concentration relationship for solutions (Gibbs equation).
2. To verify the Freundlich and Langmuir Adsorption isotherms using acetic acid/Oxalic acid and activated charcoal.
3. Determination of CMC of surfactants.

PHASE EQUILIBRIA

1. To Construct the Phase diagram for three component system (e.g., chloroform-acetic acid-water).

CHEMICAL KINETICS

1. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.
2. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
3. Determination of the rate constant for the decomposition of hydrogen peroxide by Fe^{3+} and Cu^{2+} ions.
4. Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion).

SOLUTIONS/MOLECULAR WEIGHTS

1. Determination of molecular weight of non-volatile substances by Landsberger method.
2. Determination of Molar masses of Naphthelene/acetanilide.
3. Molecular weight of polymers by viscosity measurements.

CONDUCTOMETRY

1. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
2. Determination of solubility and solubility product of sparingly soluble salts (e.g., $PbSO_4$, $BaSO_4$) conductometrically.
3. Determination of pK_a of Acetic acid and verification of Ostwald dilution law.

POTENTIOMETRY/pH METRY

1. Determination of the strength of strong and weak acids in a given mixture using a potentiometer/pH meter.
2. Determination of the dissociation constatnt of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.
3. Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method.
4. Determination of Redox potential of Fe^{++}/Fe^{+++} system.
5. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.
6. Enzyme kinetics –inversion of sucrose.
7. Determine the specific and molecular rotation of optically active substances.

BOOKS SUGGESTED

1. Experiments and Techniques in Organic Chemistry, D.Pasto, C. Johnson and M.Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
3. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
   Handbook of Organic Analysis –Qualitative and Quantitative, H. Clark, Adward Arnold.
4. Vogel's Textbook of Practical Organic Chemistry,
5. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
6. Findley's Practical Physical Chemistry, B.P. Levi
   Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

SECOND SEMESTER

PAPER NO1 . CH - 201

TRANSITION METAL COMPLEXES

Max. Marks 80

UNIT - I

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, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect. 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.

UNIT - II

ELECTRONIC SPECTRA AND MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES:

Spectroscopic ground states, Correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), Selection rules, mechanism for break down of the selection rules, intensity of absorption, band width, spectra of d-d metal complexes of the type $[M (H_2O)]^{n+}$, spin free and spin paired ML_6 complexes of other geometries, Calculations of Dq, B and parameters, spin forbidden transitions, effect of spin-orbit coupling, Spectrochemical and Nephelauxetic series. Magnetic properties of complexes of various geometries based on crystal field model, spin free-spin paired equillibria in octahedral stereochemistry.

UNIT - III

A. **TRANSITION METAL COMPLEXES:** Transition metal complexes with unsaturated organic molecules, alkanes, allyl, diene dienyl, arene and trienyl complex, preparations, properties, nature of bonding and structure features. Imporant reaction relating to nucleophilic and electrophilic attack on ligands and organic synthesis.

B. **TRANSITION METALS COMPOUND WITH BOND TO HYDROGEN:** Transition Metals Compounds with Bond to Hydrogen.

UNIT-IV

A. **ALKYLS AND ARYLS OF TRANSITION METALS:** Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis.

B. **COMPOUNDS OF TRANSITION METAL - CARBON MULTIPLE BONDS :** Alkylidenes, low valent carbenes, nature of bond and Structural characteristics.

C. **FLUXIONAL ORGANOMETALLIC COMPOUNDS:** Fluxionality and dynamic equilibria in compounds such as olefin, -allyl and dienyl complexes.

BOOKS SUGGESTED :

1. Principles and applications of organotransition metal chemistry, J.P.Collman, L.S.Hegsdus, J. R. Norton and R.G. Finke, University Science Books.
2. The Organometallic chemistry of the Transition metals, R. H. Crabtree, John Wiley.
3. Metallo - organic chemistry, A.J. Pearson, Wiley.
4. Organometallic chemistry, R.C. Mehrotra and A. Singh, New age International.

PAPER NO 2. CH - 202

REACTION MECHANISMS

Max. Marks 80

UNIT - I

A. **ALIPHATIC NUCLEOPHILIC SUBSTITUTION:** The S_N2, S_N1, mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, ambident nucleophile and regioselectivity.

B. **AROMATIC NUCLEOPHILIC SUBSTITUTION:** The S_N1, S_N2 mechanisms. Reactivity effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser, and Smiles rearrangements.

UNIT - II

A. **ALIPHATIC ELECTROPHILIC SUBSTITUTION:** Mechanisms of- S_E2 S_E1, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

B. **AROMATIC ELECTROPHILIC SUBSTITUTION:** The arenium ion mechanism, orientation and reactivity.

The ortho/para ratio, ipso attack, orienation in other ring systems.Θ Reactivity-Effect of substrates and electrophilles. Vilsmeir reaction and Gattermann-Koch reaction.

UNIT - III

ADDITION TO CARBON-CARBON MULTIPLE BONDS: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings Hydroboration, Micheal reaction. Shrapless asymetric epoxdation.

UNIT - IV

ADDITION TO CARBON-HETERO MULTIPLE BONDS: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids esters and nitriles.Addition of Grignard Reagents, Organo-Zinc and Organo-lithium to carbonyls and unsaturated carbonyl compounds, Wittig reaction.

Mechanism of condensation reactions involving enolates - Aldol, Knoevenagel and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

BOOKS SUGGESTED :

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March,Johan Wiley.
2. Modern Organic Reactions, H. O. House, Benjamin.
3. Principles of Organic Synthesis, R. O. C. Norman and J. M. Coxon, Blackle Academic & Professional.
4. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
5. Structures and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
6. Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillian

PAPER NO 3. CH –203

QUANTUM CHEMISTRY, THERMODYNAMICS AND CHEMICAL DYNAMICS - II

Max. Marks 80

UNIT –I

A. **APPLICATION OF MATRICES IN QUANTUM CHEMISTRY:** Addition and multiplication, inverse and transpose of matrices. Determinants, in quantum Chemistry.

B. **ANGULAR MOMENTUM IN QUANTUM CHEMISTRY:** Angular momentum, angular momentum Operators. Eigen functions and Eigen values Angular momentum, ladder operators.

C. **APPROXIMATE METHODS:** The variation theorem, linear variation principle. Perturbation theory (first order and non-degenerate). Applications of variation method and perturbation theory to the Helium atom.

UNIT –II

STATISTICAL THERMODYNAMICS: Probability, permutations and combinations concepts of probability, Maxwell Boltzmann distribution. Different ensembles and Partition functions translational, rotational, vibrational and Electronic. Thermodynamic function using appropriate Partition function. Fermi-Dirac and Bose-Einstein Statistics and statistical basis of entropy. Heat capacity of solids, Debye and Einstein Models.

UNIT –III

ELECTROCHEMISTRY –II: Structure of electrified interfaces. Gouy-Chapman, Stern, Over potentials and exchange current density, Derivation of Butler –Volmer equation, Tafel plot. Semiconductor interfaces, Theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interfaces. Electro catalysis influence of various parameters. Hydrogen electrode.

UNIT –IV

CHEMICAL DYNAMICS –II: General features of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method. Molecular reaction dynamics, Dynamics of molecular motions, probing the transition state, dynamics of barrierless chemical reactions in solutions, dynamics of unimolecular reaction. [Lindemann –Hinshelwood , RRK and Rice-Ramsperger-Kassel-Marcus {RRKM}] theories of unimolecular reactions.

BOOKS SUGGESTED :

1. The Chemistry Mathematics Book, E. Steiner, Oxford University Press.
2. Mathematics for Chemistry, Doggett and Sutclilffe, Longman.
3. Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill.
4. Chemical Mathematics, D.M, Hirst, Longman.
5. Applied Mathematics for Physical Chemistry, J.R. Barrante, Prentice Hall.
6. Basic Mathematics for Chemists, Tebbutt, Wiley.
7. Physical Chemistry, P.W. Atkins, ELBS.
8. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
9. Quantum Chemistry, Ira N. Levine, Prentice Hall.
10. Coulson's Valence, R. McWeeny, ELBS.
11. Chemical Kinetics, K. J. Laidler, Pearson.
12. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
13. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N. Reddy, Plenum.
14. Thermodynamics for Chemists, S. Glasstone EWP.
15. An Introduction to Electrochemistry S. Glasstone EWP.
16. Physical Chemistry, Ira N. Levine McGraw Hill.
17. Physical Chemistry, Silbey, Alberty, Bawendi, John-Wiley.

PAPER NO 4 . CH - 204

THEORY AND APPLICATIONS OF SPECTROSCOPY –II

Max. Marks 80

UNIT - I

ULTRAVIOLET AND VISIBLE SPECTROSCOPY:

Introduction, intensity of vibrational-electronic spectra and Frank-Condon principle for dissociation energy, rotational fine structure of electronic-vibrational spectra, Shape of some molecular orbitals

viz., H_2, He_2, N_2, O_2. Electronic spectra of organic molecules, chromophores, application of electronic spectroscopy: spectrophotometric studies of complex ions, determination of ligand/metal ratio in a complex, identification of compounds, determination of stability constants.

UNIT -II

SCATTERING SPECTROSCOPY:

Principle, instrumentations and application of Auger spectroscopy, Scanning Electron Microscopy, Electron diffraction of gases and vapours, The Wierl equation and co-related method.

Theory, instrumentation and application of turbidimetry, nephelometry, fluorometry.
Fluoroscence and phosphorescence and factors affecting them.

UNIT - III

MASS SPECTROMETRY:

Introduction, basic principles, separation of the ions in the analyzer, resolution, molecular ion peak, mass spectral fragmentation of organic compounds, factors affecting fragmentation, McLafferty rearrangement. Instrumentation, Characteristics of mass spectra of Alkanes, Alkenes, Aromatic hydrocarbons, Alcohols, Amines. Nitrogen rule, ring rule, Molecular weight and formula determination, Gas chromatography-Mass spectrometry.

UNIT - IV

NUCLEAR RESONANCE SPECTROPHOTOMETRY:

Theory of NMR spectroscopy, interaction of nuclear spin and magnetic moment, chemical shift, processional motion of nuclear particles in magnetic field, spin-spin splitting, coupling constants, factor affecting the chemical shift, shielding effect, effect of chemical exchange, hydrogen bonding, instrumentation of Fourier transform NMR spectrophotometer, structure determination of organic compounds, Carbon-13 NMR spectroscopy, Multiplicity-proton (^1H) decoupling-noise decoupling, off resonance decoupling, selective proton decoupling, chemical shift.

BOOKS SUGGESTED

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Fundamentals of Molecular Spectroscopy, C.N. Banwell.
3. Spectroscopy, B.K. Sharma, Goel Publication.
4. Organic Spectroscopy : Principles and Application, Jag Mohan, Narosa Publication.
5. Spectroscopic Methods in Organic Chemistry, D.H. Williams & I. Fleming, Tata Mcgraw-Hill Publication.
6. Spectrophometric Identification of Organic Compounds, R.M. Silverstein & F.X. Webster, John Wiley Publications.

PAPER NO 5. CH - 205

LABORATORY COURSE –III

Max. Marks 100

1. GENERAL METHODS OF SEPARATION AND PURIFICATION OF ORGANIC COMPOUNDS WITH SPECIAL REFERENCE TO:

1) Solvent Extraction
2) Fractional Crystallization

2. DISTILLATION TECHNIQUIES:

Simple distillation, steam distillation, Fractional distillation and distillation under reduced pressure.

3. ANALYSIS OF ORGANIC BINARY MIXTURE:

Separation and Identification of organic binary mixtures containing at least one component with two substituents.
(A student is expected to analyse at least 10 different binary mixtures.)

4. PREPARATION OF ORGANIC COMPOUNDS: SINGLE STAGE PREPARATIONS.

1) **Acetylation:** Synthesis of β-Naphthyl acetate from β-Naphthol / Hydroquinone diacetate from Hydroquinone.
2) **Aldol condensation:** Dibenzal acetone from benzaldehyde.
3) **Bromination:** p-Bromoacetanilide from acetanilide.
4) **Cannizzaro Reaction:** Benzoic acid and Benzyl alcohol from benzaldehyde.
5) **Friedel Crafts Reaction:** o-Benzoyl Benzoic acid from phthalic anhydride.
6) **Grignard Reaction:** Synthesis of triphenylmethanol from benzoic acid,
7) **Oxidation:** Adipic acid by chromic acid oxidation of cyclohexanol.
8) **Perkin's Reaction:** Cinnamic acid from benzaldehyde.
9) **Sandmeyer Reaction:** p-Chlorotoluene from p-toluidine/o-Chlorobenzoic acid from anthranilic acid.
10) **Schotten Baumann Reaction:** β-Naphthyl benzoate from:β-Naphthol / Phenyl benzoate from phenol.
11) **Sulphonation Reaction:** Sulphanilic acid from aniline.

BOOK SUGGESTED :

1. Practical Organic chemistry by A. I. Vogel.
2. Practical Organic chemistry by Mann and Saunders.
3. Practical Organic chemistry by Garg and Salija.
4. The Systematic Identification of Organic compounds, R. L. Shriner and D. Y. Curtin.
5. Semimicro Qualitative Organic Analysis, N.D. Cheronis, J. B. Entrikin and E. M. Hodnett.
6. Practical Physical chemistry by Alexander Findlay.
7. Experimental Physical chemistry, D. P. Shoemaker, G. W. Garland and J. W. Niber, Mc Graw Hill Interscience.
8. Findlay's Practical Physical chemistry, revised B

PAPER NO 6. CH –206

LABORATORY COURSE –IV

Max. Marks 100

I. ERROR ANALYSIS AND STATISTICAL DATA ANALYSIS

1. Linear Regression Analysis
2. Curve Fitting
3. Student "t" Test
4. Data Analysis Using Basic Statistical Parameters
5. Calibration of volumetric Apparatus, Burette, Pipette Weight Box etc.

II. USE OF COMPUTER PROGRAMMES

The students will learn how to operate a PC and how to run standard programmes and packages. Execution of linear regression, X-Y plot, numerical integration and differentiation as well as differential equation solution programmes. Monte Carlo and Molecular dynamics. Programmes with data preferably from physical chemistry laboratory. Further, the student will operate one or two or the packages such as MICROSOFT ECXEL, WORLD, POWERPOINT, SPSS, ORIGIN, MATLAB, EASYPLOT.

III. A. FLAME PHOTOMETRIC DETERMINATIONS

1. Sodium and potassium when present together.
2. Sodium/potassium in solid samples.
3. Solid Sodium and Potassium in Liquid Samples.
4. Lithium/calcium/barium/strontium.
5. Cadmium and magnesium in tap water.

B. NEPHELOMETRIC DETERMINATIONS

1. Sulphate
2. Phosphate
3. Silver

IV. ELECTROPHORESIS

1. To separate cations of inorganic salts by paper electrophoresis.
2. Capillary Electrophoresis of water –soluble Vitamines

V. SPECTROSCOPY

1. Verification of Beer's Lambert Law.
2. Determination of stoichiometry and stability constant of inorganic (e.g. ferric –salicylic acid) and organic (e.g. amine-iodine) complexes, thiocyanate.
3. Characterization of the complexes by electronic and IR, UV spectral data.
4. Determination of Indicator constant (pK_a) of methyl red.

BOOK SUGGESTED :

1. Computer and Common Sense, R. Hunt and J. Shelley, Prentice Hall.
2. Computational Chemistry, A.C. Norris.
3. Microcomputer Quantum Mechanics, J.P. Killngbeck, Adam Hilger.
4. Computer Programming in FORTRAN IV, V. Rajaraman, Prentice Hall.
5. An Introduction to Digital Computer Design, V. Rajaraman and T. Radhakrishnan, Prentice Hall.
6. Experiments in Chemistry, D.V. Jahagirgar.

THIRD SEMESTER

PAPER NO 1. CH - 301

RESONANCE SPECTROSCOPY, PHOTOCHEMISTRY AND ORGANOCATALYSIS

Max. Marks 80

UNIT –I

A. **ELECTRON SPIN RESONANCE SPECTROSCOPY**: Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron).

B. **NUCLEAR QUADRUPOLE RESONANCE SPECTROSCOPY:** Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant, splitting, applications.

UNIT –II

A. **PHOTOELECTRON SPECTROSCOPY:** Basic principle both for atoms and molecules; Photo-electric effect, ionization process, Koopman's theorem, Spectra of simple molecules, Auger electron spectroscopy, Determination of Dipole moment.

B. **PHOTOACOUSTIC SPECTROSCOPY:** Basic principle of Photo acoustic Spectroscopy (PAS), PAS – gases and condensed system Chemical and Surface application.

UNIT –III

A. **PHOTOCHEMICAL REACTIONS :** Interaction of electromagnetic radiation with matter, Photophysical processes , Stern Volmer equation, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, Actinometry.

B. **DETERMINATION OF REACTION MECHANISM**: Classification, rate constants and life times of reactive energy states –determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions.

C. **MISCELLANEOUS PHOTOCHEMICAL REACTIONS**: Photo-Fries reactions of anilides, Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photodegradation of polymers, Photochemistry of vision.

UNIT –IV

A. **ORGANOCATALYSIS**

General Principles: Energetic, Catalytic cycles, catalytic efficiency and life time, selectivity. Type of organometallic reaction: Ligand substitution, Oxidative addition, reductive elimination and insertion and deinsertion. Homogeneous catalysis: Hydrogenetion of alkenes, Hydroformylation, Monsanto acetic acid synthesis, Wacker oxidation of alkenes, Alkenes metathesis, Palladium-Catalysed C-C bond forming reactions, asymmetric oxidation. Heterogenous catalysis: The nature of heterogenous catalysts, Fischer- Tropsch synthesis, alkene polymerization.

BOOK SUGGESTED:

1. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, Wiley.
2. Fundamentals of Photochemsitry, K.K. Rohtagi-Mukherji, Wiley-Eastern.
3. Essentials of Molecular Photochemistry, A. Gilbert and J. Baggott, Blackwell Scientific Publications.
4. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
5. Introductory Photochemistry, A. Cox and T. Camp, McGraw-Hill.
6. Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.
7. Application of Spectroscopy of Organic Compounds, J.R. Dyer, Prentice Hall.
8. Photochemistry, R.P. Kundall and A. Gilbert, Thomson Nelson.
9. Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.
10. Shriver & Atkins Inorganic Chemistry: P.Atkins, T.Overtone, J. Rourke, M. Weller, F. Armstrong, Oxford University Press
11. Inorganic Chemistry: C.E. Housecraft, A.G. Sharpe, Pearson Education Limited.
12. Inorganic Chemistry: Principles of Structure and Reactivity: J.E. Huheey, E.A. Keiter, R.L.Keiter, O.K. Medhi, Pearson Education
13. Organometallic Chemistry: A Unified Approach: R.C. Mehrotra, A.Singh, New Age International Publishers.

PAPER NO 2. CH - 302

CHEMISTRY OF BIOMOLECULES

Max. Marks 80

UNIT –I

- **A. BIOENERGETICS:** Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.
- **B. ELECTRON TRANSFER IN BIOLOGY**: Structure and function of metalloproteins in electron transport processes –cytochromes and ion-sulphur proteins, synthetic models.
- **C. TRANSPORT AND STORAGE OF DIOXYGEN:** Heme proteins and oxygen uptake, structure and function of haemoglobin, myoglobin, haemocyanins and haemerythrin, model synthetic complexes of iron, cobalt and copper.

UNIT –II

- **A. METALLOENZYMES**: Zinc enzymes –carboxypeptibase and carbonic anhydrase. Iron enzymes – catalase, peroxidase and cytochrome P-450. copper enzymes- superoxide dismutase. Molybdenum oxatransferase enzymes –xanthine oxidase.
- **B. ENZYME MODELS**: Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality. Biomimetic chemistry, Cyclodextrin-based enzyme models, calixarenes, ionophores, synthetic enzymes or synzymes.

UNIT –III

- **A. ENZYMES :** Nomenclature and classification of Enzyme. Induced fit hypothesis, concept and identification of active site by the use of inhibitors.
- **B. CO-ENZYME CHEMISTRY:** Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid, vitamin B_{12}.
- **C. BIOTECHNOLOGICAL APPLICATIONS OF ENZYMES:** Techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilization enzymes in medicine and industry. Enzymes and Recombinant DNA Technology.

UNIT –IV

- **A. BIOPOLYMER INTERACTIONS:** forces involved in biopolymer interaction. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curves.
- **B. THERMODYNAMICS OF BIOPOLYMER SOLUTIONS**: Thermodynamics of biopolymer solution, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechnochemical system.
- **C. CELL MEMBRANE AND TRANSPORT OF IONS**: Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport and Nerve conduction.

BOOK SUGGESTED:

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.L. Lippard and J.S. Valentine, University Science Books.
3. Inorganic Biochemistry vols II and I.Ed G.L. Eichhorn, Elservier.
4. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
5. Bioinorganic Chemistry, I. Bertinin, H.B. Gary, S.J. Lippard and J.S. Valentine, University Science.
6. Inorganic Biochemistry vols I and II ed. G.L. Eichhorn, Elsevier.
7. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-verlag.
8. Understanding Enzymes, Trevor palmer, Prentice Hall.
9. Enzyme Chemistry : Impact and Applications, Ed. Collin J Suckling, Chapman and Hall.
10. Enzyme Mechanisms Ed, M.I. Page and A. Williams, Royal Society of Chemistry.
11. Fundamentals of Enzymology, N.C. Price and L. Stevens, Oxford University Press.
12. Immobilizaed Enzymes: An Introduction and Applications in Biotechnology, Michael D. Trevan, and John Wiley.

13. Enzymatic Reaction Mechanisms, C. Walsh, W.H. Freeman.
14. Enzyme Structure and Mechanisms, A Fersht, W.H. Freeman.
15. Biochemistry: The Chemical Reacitons of liging cells, D.E. Metzler, Academic Press.
16. Principles of Biochemistry, A.L. Lehninger, Wroth Publishers.
17. Biochemistry, L. Stryer, W.H. Freeman.
18. Biochemistry, J. David Rawn, Neil Patterson.
19. Biochemistry, Voet and Voet, John Wiley.
20. Outlines of Biochemistry, E.E. Conn and P.K. Stumpf, John Wiley.
21. Bioorganic Chemistry : A Chemistry Approach to Enzyme Action, H. Dugas and C. Penny, Springer-Verlag.
22. Biochemistry and Molecular Biology of Plants, Buchanan, Gruissem and Jones, I.K. International Pvt. Ltd.

PAPER NO 3. CH –303

CATALYSIS, SOLID STATE AND SURFACE CHEMISTRY

Max. Marks 80

UNIT –I

ACIDS, BASES, ELECTROPHILES, NUCLEOPHILES AND CATALYSIS:

Acid-base dissociation, Electronic and structural effects, acidity and basicity. Acidity function and their applications. Hard and soft acids and bases. Nucleophilicity scales. Nucleofugacity. The alpha effect. Ambivalent Nucleophilies. Acid base catalysis-specific and general catalysis. Bronsted catalysis, Enzyme Catalysis.

UNIT –II

MICELLES AND ADSORPTION :

Micelles : Classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of Surfactants. Thermodynamics of micellization - phase separation and mass action models. Reverse micelles, micro-emulsion. Micellar Catalysis, Surface tension capillary action, pressure difference across curved surface (Laplace equation), vapor pressure of droplets (Kelvin equation), Gibbs adsorption isotherm.

UNIT –III

SOLID STATE CHEMISTRY - I :

Crystal defects and Non-stoichiometry - Perfect and imperfect crystals, intrinsic and extrinsic defects - point defect, line and plane defects, vacancies - Schottky defects and Frankel defects. Thermodynamics of Schottky and Frenkel defect, formation of color centres, non-stoichiometry and defects. Electronic properties and Band theory of semiconductors.

UNIT –IV

MACROMOLECULES :

Polymer - Definition types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization.

Molecular mass and average molecular mass. Molecular mass determination (Osmometry, Viscometry, diffusion and light scattering methods), Sedimentation, chain configuration of macromolecules, calculation of average dimensions of various chain structures.

BOOK SUGGESTED :

1. G.W. Castellan, "Physical Chemistry", Addison- Lesley Publishing Co.
2. E.A. Moelwyn Hughes, "Physical Chemistry", Pergamon Press.
3. Denbigh, "Chemical Equilibria", D. Van Nostrand.
4. J. Rose, "Dynamic Physical Chemistry" Sir Issac Pitman and Sons.
5. Solid state "Chemistry and its Applications, A.R. West, Plenum.
6. Principle of Solid State H.V. Kar, Wiley Eastern.
7. Solid State Chemists, D.K. Chakrabarty, New Age International (P) Ltd.
8. Micelles, Theoretical and Applied Aspects, V. Moral Plenum.
9. The Chemistry Mathematics Book, E. Steiner, Oxford University Press.
10. Mathematics for Chemistry, Doggett and Sutcliffe, Longman.
11. Mathematical Preparation for Physical Chemistry, F. Daniels, McGraw Hill.
12. Chemical Mathematics, D.M. Hirst, Longman.
13. Applied Mathematics for Physical Chemistry, J.R. Barrante, Prentice Hall.
14. Basic Mathematics for Chemists, Tebbutt, Wiley.
15. Quantum Chemistry, Ira N. Levine, Prentice Hall.
16. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.

PAPER NO 4. CH –304

ANALYTICAL TECHNIQUES AND DATA ANALYSIS

Max. Marks 80

UNIT –I

SAMPLE PREPARATION, DEGESTION AND STATISTICAL ANALYSIS

A. Sampling - Collection, Preservation and preparation of sample, Techniques of sampling of solid, liquid and gaseous samples, Operation of drying and preparing a solution of the analyte.

Principle, methodology and application of different types of digestions such as acid digestion, base digestion, enzymatic and microwave digestion for liquid and solid materials.

B. Evolution and procession of Analytical Data, Precision and Accuracy, Types of Errors, Propagation of errors, Normal Distribution Curve, Standard deviation, Confidence limit, Graphical presentation of result-method of average, Method of Linear least square, Significant figures, Statistical aid to hypothesis of testing- t-test, F-test, Correlation coefficient, Rejection of data.

UNIT –II

SEPARATION TECHNIQUES

A. Principle of Solvent Extraction, Methods of Extraction, Efficiency of extraction, Selectivity of extraction, applications.

B. Principle, classification of chromatographic techniques, Technique and applications of paper chromatography, Thin-layer chromatography, HPTLC, Column chromatography.

UNIT –III

THERMAL AND AUTOMATED METHODS

A. Principle, Instrumentation, Applications of TGA, DTA and DSC methods.

B. Automated methods, Principle, instrumentation and application of flow injection analysis.

UNIT –IV

ELECTROCHEMISTRY

A. Principles and instrumentation of pH potentiometry, coulometry and counductometry.

B. Basic principles, Diffusion current, polarized electrode, Micro electrode, Dropping Mercury Electrode llkovic equation, Polarographic wave, Qualitative analysis Stripping methods, Cyclic Voltammetry, Amperometric titration :-curves, Differential pulse polarography and Square wave polarography.

BOOK SUGGESTED :

1. Fundamental of Analytical Chemistry- Skoog D.A. and West D.M.
2. Saunders, College Publication.
3. Textbook of Quantitative Inorganic Analysis-Vogel A.I.
4. Principles and Practice of Analytical Chemistry-Fifield F.W and Kealey
5. D. Black well Science
6. Instrumental Analysis R. Braun, McGraw Hill, International Edition.
7. Analytical Chemistry, Christian, G.D., WSE/Wiley.
8. Instrumental Analysis, Willard Meritt Dean, CBS.
9. Chemical Analysis, Brawn, McGraw Hill.
10. Fundamental of Analytical Chemistry-Skoog D.A. and West D.M.
11. Principles of instrumental analysis, Skoog Holler - Niemann.
12. Instrumental analysis, Wizard Dean and Merit.
13. Principle and PRACTICAL analytical chemistry, Fifield and Kealey.

PAPER NO 5. CH - 305

LABORATORY COURSE –V

Max. Marks 100

1. To calculate the activity with given radioactive source.
2. Determination of the half-life of Radionuclide.
3. Determination of absorption coefficient & half
4. Determination of absorption coefficient & half thickness of lead for gamma radiation.
5. Determination of range and energy of β particle
6. Prove the inverse square law for gamma rays.
7. Measurement of gamma ray energy by gamma ray spectrometry.
8. Determination of the partition coefficient for iodine between carbon tetrachloride & (a) Water, (b) aqueous potassium iodide.
9. Study of kinetics of exchange between ethyl iodide & the iodide ion.
10. Determination of the solubility product of lead iodide.
11. Determination of the dissociation constant of Barium Nitrate.
12. Determination of the concentration of iodine in a given sample (KI), by isotope dilution technique.
13. To study the effect of temperature, concentration of the reactant and catalyst on the rate of a chemical reaction (Hydrolysis/Nucleophilic Substituttion).
14. Reaction between Sodium Formate and Iodine by
    (i) Volumetric Method.
    (ii) Conductometric Method.
16. Saponification of ethyl acetate
    (i) Volumetric Method.
    (ii) Conductometric Method.
17. Reaction between Acetone and Iodine.
18. To study the autocatalylic reaction between $KMnO_4$ and Oxalic acid.
19. Reaction between $K_2S_2O_8$ and Iodine.
20. Determination of pKa by Kinetic Measurement.
21. Evaluation of Equilibrium constants from kinetic data.
22. Determination of rate constant of the decomposition of benzene diazonium chloride at different temperature.
23. To study the photolysis of uranyl oxalate.
24. To study the effect of substate catalyst etc (i) HCl, $K_2S_2O_8$ (ii) KOH, NaOH.
25. To study the Activation parameters.
26. To study the solvent effect using some Aprotic & Protic Solvents.
27. To examine the substituent effect (Hammett equation).
28. To study the effect of Electrolyte on the rate hydrolysis (KCl, NaCl,)
29. To study some simple enzyme catalyzed reaction.
30. To study the Micellar Catalyzed Reaction.

Some advanced level sophisticated instrument based (FTIR, NMR, GC-MS, AAS, FLUORESCENCE SPECTROPHOTOMETER, TENSIOMETER etc) experiments may be given to the students.

BOOK SUGGESTED:

1. Basic Experiment with radioisotopes by John, N. Andrews & David J. Hornsey, Pitam Publishing New York.
2. Practical radiochemistry by M.F.C. Ladd & W.H. Lee, Cleaver Hune press Ltd.
3. Practical Physical Chemistry by Alexander Findlay.
4. Experimental Physical Chemistry, D.P. Shoemaker, C.W. Garland and J.W. Niber, Mc Graw Hill Interscience.
5. Findlay's Physical Practical Chemistry, revised B.Phys.Levitt,Longman.

PAPER NO 6. CH –306

LABORATORY COURSE –VI

Max. Marks 100

A. SPECTROPHOTOMETRIC DETERMINATIONS

I. Manganese / Chromium, Vanadium in steel sample.

II. Nickel / Molybdenum / Tungsten / Vanadium / Uranium by extractive spectrophotometric method.

III. Fluoride / Nitrate / Phosphate.

V. Zirconium –Alizarin Red –S complex: Mole-ratio method.

VI. Copper –Ethylene diamine complex: Slope-ratio method.

B. pH METRY

Stepwise proton-ligand and metal-ligand stability constant of complexes by Leving –Rossoti methods.

C. POLAROGRAPHY

Composition and stability constant of complexes.

D. FLAME PHOTOMETRIC DETERMINATIONS.

(i) Sodium and potassium when present together

(ii) Lithium / calcium / barium / strontium.

(iii) Cadium and magnesium in tap water.

E. REFRACTOMETRY

1. Determination the specific and molar refraction of a given liquid by abbe Refractometer.
2. Determine the variation of refractive index.
3. To verify law of refraction of mixture (glycerol + water).

F. SEPARATION AND QUANTITATIVE ESTIMATION OF BINARY AND TERNARY MIXTURES BY THE USE OF FOLLOWING SEPARATION TECHNIQUES:

1. Paper chromatography –Cadmium and Zinc, Zinc and Magnesium.
2. Thin –layer chromatography –separation of nickel, manganese, cobalt and zinc.
3. Ion-exchange.
4. Solvent extraction.
5. Electrophoretic separation.

Some advanced level sophisticated instrument based (FTIR, NMR, GC-MS, AAS, FLUORESCENCE SPECTROPHOTOMETER, TENSIOMETER etc) experiments may be given to the students

BOOK SUGGESTED :

1. Quantitative Inorganic Analysis, A.I. Vogel.
2. Test book of quantitative chemical analysis, A.I. Vogel.
3. Practical Physical chemistry, A.M. James and F.E. Prichard, Longman.
4. Findley’s Practical Physical Chemistry, B.P. Levi
5. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

FOURTH SEMESTER

PAPER NO 1. CH - 401

INSTRUMENTAL METHODS OF ANALYSIS

Max. Marks 80

UNIT –I

ADVANCED CHROMATOGRAPHY:

A. Ion chromatography: Ion exchange equilibrium, Ion-exchange packing and Inorganic Applications.

B. Size exclusion chromatography: Column packing, Theory of size of exclusion chromatography and applications.

C. Supercritical fluid chromatography: Properties of supercritical fluid SFC-Instrumentation and operating variables, comparison with other types of chromatography, applications.

D. Capillary Electrophoresis and capillary electro chromatography : overviews and applications

UNIT –II

X-RAY AND PROTON INDUCED SPECTROSCOPY:

A. X-Ray fluorescent method: Principles-Characteristics x-ray emission. Instrumentation x-ray tube, Radioactive sources. Wavelength dispersive instruments. Energy dispersive instruments. Analytical Applications-Qualitative Analysis.

B. Proton Induced X-Ray Spectroscopy : Theory, instrumentation and application.

UNIT –III

ATOMIC EMISSION SPECTROSCOPY

A. Selectivity, sensitivity and interferences of atomic spectroscopy.

B. Theory, instrumentation and application of flame photometer, AES, ICP-AES and AFS.

UNIT –IV

ATOMIC ABSORPTION SPECTROSCOPY AND HYPHENATED TECHNIQUES

A. Theory instrumentation and application of flame and graphite furnace AAS, cold-vapor and hydride generation AAS.

B. Theory, instrumentation and application of hyphenated techniques i.e. GC/HPLC/-MS, GC/IC/HPLC-ICP-MS.

BOOK SUGGESTED:

1. Instrumental methods of analysis, Willard, Meritt and Dean.
2. Basic concepts of analytical chemistry, S.M. Khopkar, John Wiley & Sons.
3. Metallurgical analysis, S.C. Jain.
4. Material Science and Engineering. An Introduction, W.D. Callister, Wiley.
5. Material Science, J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rawlings, ELBS.
6. Fundamentals of Analytical Chemistry, Skoog, Welt, Holler and Crouch Thomson Learning Inc.

PAPER NO 2. CH - 402
NATURAL PRODUCT AND MEDICINAL CHEMISTRY

Max. Marks 80

UNIT-I

A. **Terpenoids and Carotenoids**: Classification, nomenclature, occurrence, isolation, general methods of structure determination of Citral, Geraniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β – Carotene.

B. **Alkaloids:** Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on Nitrogen heterocyclic ring, role of alkaloids in plant. Synthesis and biosynthesis of the following: Ephedrine, (+)- Coline, Nicotine, Atropine, Quinine and Morphine.

UNIT-II

A. **Steroids:** Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterome, Testosterone, Esterone, Progestrone, Aldostrone and Biosythesis of cholesterol.

B. **Plant Pigments**: Occurrence, nomenclature and general method of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzine, Butein, Aureusin, Cyanidin-7-arebinoside, Cyanidin, Hirsutidin.

UNIT- III

Drug Design

A. Development of new drugs procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, Structure-Activity Relationship (SAR), Factors affecting bioactivity, resonance, inductive effect. Theories of drug activity: occupancy theory, rate theory, induced fit theory. Quantitative Structure Activity Relationship (QSAR).

B. Concepts of drug receptors, lipophilicity, phamacophore, pharmacological activity and typical range of parameters related to drug likeness.

C. General introduction of pharmacokinetics and pharmacodynamics.

UNIT – IV

A. **Anteoplastic Agents**: Introduction, Alkylating agents, antimetabolites, carcinolytic antibiotics, mitotic inhibitors.

B. **Antibiotics**: Constitution and synthesis of penicillins, chloramphenicol, tetracycline and streptomycin.

C. **Antimalarials**: Synthesis and properties of the following Antimalarial: 8-amino quinolone derivatives-Pamaquine, Primapune, Pentaquinr, Isopentaquine, 4- amino quinolone derivatives-Santoquine, Camaquine, Acridine derivatives-Mepracrine, Azacrin, Pyrimidine and Biguanid derivatives- Paludrine Pyremethamine.

Book Suggested:

1. Natural Products: Chemistry and Biological Significance, J. Mann, R. S. Davidson, J. B. Hobbs.
2. D. V. Banthrope and J. B. Harbrone, Longman, Essex., Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
3. Chemistry, Biologcal and Pharmacological properties of Medicinal Plants from the Americans, Ed. Kurt Hostettmann, M. P. Gupta and A. Marston, Harwood Academic Publishers.
4. Introduction to Flavonoids, B. A. Bhom, Harwood Academic Publishers.
5. New Trends in Natural Product Chemistry, Att-ur-Rahman and M. I. Choudhary, Harwood, Academic Publishers.

6. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers.
7. Introduction to medicinal Chemistry, A Gringuage, Wiley-VCH.
8. Burger’s Medicinal Chemistry-1 (Chapter-9 and Ch- 14), Drug Ed. M. E. Discovery, Wolff, John Wiley.

PAPER NO 3. CH - 403

MATERIAL AND NUCLEAR CHEMISTRY

Max.Marks 80

UNIT- I

NON EQUILIBRIUM THERMODYNAMICS: Fundamental concepts, Forces and Fluxes, Entropy production, Phenomenological Laws and Onsager's r for biological systems, coupled reactions.

UNIT- II

MATERIAL CHEMISTRY:

Preparation and Properties of Nanoparticles, Materials-Metals, Ceramics (Oxide, carbides, sulphides, nitrides). Physical and chemical Methods, Size and Shape controlled Synthesis, Sol-gel methods, Optical Properties, Electrical and Magnetic Properties, Application of Nanoparticles. Characterization of Nanoparticles (SEM, TEM etc.)

UNIT-III

SUPRAMOLECULAR CHEMISTRY:

Properties of covalent bonds, bond length, inter bond angles, Force constant, bond and molecular dipole moment, molecular and bond polarizability.

Intermolecular Forces, hydrophobic effects, Electro static, induction, dispersion and resonance energy, Hydrogen bond, Magnetic interactions. Principles of molecular association ad organization Biological marcomolecules, Molecular receptors and design principal, cryptands, Cyclophanes, calixeranes and cyclodextrins. Supramoleular reactivity and catalysis.

UNIT-IV

NUCLEAR AND RADIOCHEMISTRY

NUCLEAR THEORY :

Nuclear cross section and nuclear radii, nuclear shells and magic numbers, theory of nuclear shell model, nuclear potentials, square well and simple harmonic oscillator potentials, application, liquid drop model, semi-empirical mass equation, application and limitations.

NUCLEAR FISSION :

Mass, energy and charge distribution of fission products, decay chains, prompt and neutrons, liquid drop model of nuclear fission.

NUCLEAR ENERGY :

Nuclear fission, chain reaction, multiplication factor, nuclear reactors

APPLIED RADIOCHEMISTRY :

Radioactive isotopes, purity and strength of radioisotopes. Radiochemical principle in the use of tracers, Application of Tracers in Chemical investigations, Physico-chemical methods, Analytical applications, Age determinations, Medical applications, Agricultural application.

BOOKS SUGGESTED:

1. Nuclear and Radiochemistry by G. Friedlander, J.W. Kennedy & J.M. Miller, John Willey and Sons, New York.
2. Source Book an Atomic Energy – S. Glasstone, Affiliated East –West Press Pvt. Ltd. New Delhi.
3. Nuclear Physics by I. Kaplan, Addision –Willey Publishing company, London.

s

4. Nuclear Chemistry and its applications, M. Haissinsky, Addision –Welsley, Publishing Company, London.
5. Essentials of Nuclear chemistry, H.J. Arnikar, Wiley Eatern Ltd, New Delhi.
6. Molecular Mechanics, U. Burkert and N.L. Allinger, ACS Monograph 177, 1982.
7. Mechanism and Theory in Organic Chemistry, T.H. Lowry and K.C. Richardson, Harper and Row.
8. Introduction to Theoretical Organic Chemistry and Molecular Modelling, W.B. Smith, VCH, Weinheim.
9. Physical Organic Chemistry, N.S. Isaacs, ELBS./ Longman.
10. Supramolecular Chemistry: concept and Perspectives, J.M. Lehn, VCH.
11. The Chemistry Mathematics Book, E. Steiner, Oxford University Press.
12. Chemical Mathematics, D.M, Hirst, Longman.
13. Applied Mathematics for Physical Chemistry, J.R. Barrante, Prentice Hall.
14. Quantum Chemistry, Ira N. Levine, Prentice Hall.
15. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.

PAPER NO 4. CH - 404

ENVIRONMENTAL & APPLIED CHEMICAL ANALYSIS

Max. Marks 80

UNIT –I

AIR POLLUTION MONITORING AND ANALYSIS

Classification of air pollution monitoring levels, air quality, standards and index, monitoring and analysis of selected air borne pollutants: SO_2, NO_x, SPM, VOC's, Pb, CO_2, POP's, Hg, carbon and ozone. Air pollution control devices Viz ESP, scrubber technique, baghouse filters etc. Atmospheric chemistry of acid rains, photochemical smog, green house effect, global warming, ozone hole.

UNIT –II

SOIL AND WATER POLLUTION

Soil and water quality standards, monitoring and analysis of selected soil water contaminants: COD, pesticides, heavy metals, POPs, fluoride, cyanide, nitrate, phosphate, oil & grease, Geobiochemical impact of municipal solid waste, steel plant~~s~~ effluent, domestic sewage. Control devices of water pollutants.

UNIT –III

FOOD ANALYSIS

A. Introduction to general Constituents of food, Proximate Constituents and their analysis, Additives-Introduction -Types - Study of preservatives colors and Antioxidants and method of estimation, adulteration - Introduction, Types, Test for adulterants.

B. Introduction standards composition and analysis of following foods : Wheat, Bread, Biscuits, Jam, Jelly, Honey, Milk, Ice Cream, Butter, Cheese, Milk Powder, Oils and Fats, Tea, Coffee, Soft drinks, Alcoholic beverages, Cereal and pulses, Confectionery, Fruits, Vegetables, Egg, Fish, Meat.

UNIT –IV

COSMETICS, CLINICAL AND DRUG ANALYSIS

A. Introduction of Cosmetics, evaluation of cosmetics materials, raw material and additives, Cosmetics colors, Perfumes in cosmetics, Cosmetics formulating, introduction, standards and methods of analysis, Creams, face powders, Make-up, Shaving preparations, Bath preparations.

B. Concepts and principles of analytic methods commonly used in the clinical species: i.e. ammonia, blood urea Nitrogen, Ca, Cl, CO_2, Fe, K, Li, Mg, Na, P, urea, glucose.

Method for analysis of proteins (i.e. albumin, bilirubin, creatinine, cholesterol, HDL-cholesterol, triglycerides, creatinine) and Enzymes (i.e. Aanine Aminotransferase, acid phosphatase, alkaline phosphatase, amylase, aspartate, aminotransferase, cholinesterase, lactate, and lipase).

BOOK SUGGESTED :

1. Environmental Chemistry, S.E. Manahan, Lewis Publishers.
2. Environmental chemistry, Sharma and Kaur, Krishna Publishers.
3. Environmental Chemistry, A.K. De, Wiley Eastern.
4. Environmental Chemistry, Analysis, S.M. Khopkar, Wiley Eastern.
5. Standard Method of Chemical Analysis, F.J. Welcher Vol. III, Van Nostrand Reinhold Co.
6. Environmental Toxicology, Ed. J. Rose, Gordon and Breach Science Publication.
7. Environmental Chemistry, C. Baird, W.H. Freeman.
8. Analytical chemistry, G.D. Christian, J. Wiley.
9. Fundamentals of Analytical Chemistry, D.A. Skoog, D.m. West and F.J. Holler, W.B. Saunders.
10. Analytical Chemistry - Principles, J.H. Kennedy, W. Saunders.
11. Analytical Chemistry-Principles, and Techniques, L.G. hargis, Prentice Hall.
12. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, W.B. Saunders.
13. Principles of Instrumental Analysis, D.A. Skoog, W.B. Saunders.
14. Quantitative Analysis, R.A. Day, Jr. and A.L. Underwood, Prentice Hall.
15. Environmental Solution Analysis, S.M. Khopkar, Wiley Eastern.

16. Basic Concepts of Analytical Chemistry, S.M. Khopkar, Wiley Eastern.
17. Handbook of Instrumental Techniques for Analytical Chemistry, F. Settle, Prentice Hall.
18. Environmental Biotechnology, Indushekhar Thakur, I.K. International Pvt. Ltd.
19. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, Thompson Learning Inc.
20. APHA, 1977, "Methods of Analysis of air, water and soil" Washington US.

OPTIONAL PAPERS
CH-404 a
MEDICINAL CHEMISTRY

UNIT I

(a) **DRUG DESIGN**: Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structure – activity relationship (SAR). Theories of drug activity: Occupancy theory, rate theory, induced fit theory. Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors. Lipophilicity and Lipinski Rule of 5.

(b) **PHARMACOKINETICS**: Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetics parameters in defining drug disposition and in therapeutics.

(c) **PHARMACODYNAMICS**: Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, membrane active drugs, drug metabolism, biotransformation significance of drug metabolism in medicinal chemistry.

UNIT II

(a) **ANTINEOPLASTIC AGENTS**: Introduction, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and Mitotic inhibitors. Mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurine.

(b) **CARDIOVASCULAR DRUGS**: Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function. Direct acting arteriolar dilators. Synthesis of amyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolo, oxyprenolo.

UNIT III

(a) **LOCAL ANTIINFECTIVE DRUGS**: Introduction and general mode of action. Synthesis of sulphonamides, furazolidine, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, isoniazid, ethionamide, ethambutal, fluconazole, econozole, griseofulvin, chloroquin and primaquin.

(b) **ANTIBIOTICS**: Cell wall biosynthesis, inhibitors, β-lactam rings, antibiotic inhibiting protein synthesis.

Synthesis of penicillin G, penicillin V, ampicillin, amoxicillin, chloramphenicol, cephalosporin, tetracycline and streptomycin.

UNIT IV

PSYCHOACTIVE DRUGS- THE CHEMOTHERAPY OF MIND : Introduction, neurotransmitters, CNS depressants, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazipines, busipirone.Antipsychotic drugs – the neuroleptics, antidepressants, butyrophenones, serendipity and drug development, stereochemical aspects of psychotropic drugs. Synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin, ethosuximode, trimethadione, barbiturates, thiopental sodium, glutethimide.

Books Suggested

1. Introduction to Medicinal Chemistry, A Gringuage, Wiley-VCH
2. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed Robert F. Dorge
3. An Introduction to Drug Design, S. S. Pandeya and J.R.Dimmock, New Age International.
4. Burgers's Medicinal Chemistry and Drug Discovery, Vol-1(Chapter-9 and Chapter-14), Ed. M.E. Wolff, John Wiley.
5. Goodmann and Gilman's Pharmacological Basis of Therapeutics, Mc-Graw Hill.
6. The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press.
7. Strategies for Organic Drug Synthesis and Design, D.Lednicer, John Willey

CHEMISTRY OF SURFACTANTS
CH-404 b

UNIT- I

OVERVIEW OF SURFACTANTS: Classification of Surfactants, Physicochemical Properties of Surfactants, Critical Micelle Concentration , Determination, Effect of Additives,Aggregate Shapes , Structure and Morphology, Novel and New Generation Surfactants, Aggregation Behavior.

UNIT-II

PRINCIPLES OF SELF-ASSEMBLY: Closed and Continuous Association , Surfactant MicellizationPseudo-Phase Model , Mass Action Model, Estimation of Micelle Size ,Size Dispersion of Micelles, Concentration Dependence of Micelle Size , Phase Behavior, Aggregation Behavior.

UNIT-III

SURFACTANT MIXTURES: Ideal and Non-Ideal Mixed Micelles ,Regular Solution Model Size and Composition Distribution of Aggregates ,Nonionic –ionic Surfactant Mixtures ,Ionic -Ionic Surfactant Mixtures,Origin of Ideal and Non-Ideal Mixing Behavior, Polymer SurfactantInteraction.

UNIT-IV

APPLICATIONS OF SURFACTANTS: Micellar Catalysis, Quantitative Models ,Micellar Enzymology, Phenomenon of Solubilization , Solubilization in Mixed Micelles, Drug Surfactant Interaction, Protein Surfactant Interactions, Microemulsions and its applications, Industrial Application of Surfactants.

Books:

1. Surfactants Edited by Th. F. Tadros, Academic Press
2. Micelles : Theoretical and Applied Aspects by Y. Moroi
3. Chemistry and Technology of Surfactants by R. J. Farn Wiley

CHEMISTRY AND APPLICATION OF PESTICIDES
CH-404c

UNIT-1

INTRODUCTION: What is pesticides, classification of pesticides, utility of pesticides, categories of toxicity, Threshold limit value, LD 50 value, Effect of pesticides in food, House hold and Human health.

UNIT-2

CHEMICAL TOXICOLOGY: Biochemical effects of pesticides, pesticides persistence, bioaccumulation and biomagnifications of pesticides, Toxicology of pesticides, Toxicology of organophosphates, carbamates, organochlorine and Dermal Toxicology of pesticides.

UNIT-3

INSTUMENTAL TECHNIQUES IN PESTICIDES DETECTION: Spectrophotometry, paper chromatography,

Thin layer chromatography (TLC), GC-MS, indicator tube, High performance (pressure) Liquid chromatography (HPLC).

UNIT-4

PESTICIDES AND ITS RESIDUE ANALYSIS: Steps in pesticides residue analysis, clean-up, concentration (evaporation), Analysis, Extent of residue of pesticides in different commodities.

References

- Environmental chemistry. A.K De. New Age International Pvt. Ltd. 6th edition.
- Soil Testing and Analysis,plant, water and pesticide residues- Patiram,Bajendra N.S. Azad, Thakur and T.Ramesh.Agricultural,Horticultural,Food and Veterinary Science Book.2nd edition.
- Toxicology of pesticides: Experimental,clinical and regulatory perspectives. Edited by: Lucio G. Costa,Corrado L. GalliSheldon D. Murphy.Springer,1st edition.
- Persistent Pesticide in the Environment- C.A Edward, CRC Press Inc.,Florida 2nd edition.
- Agricultural chemicals and chemical mutagens- C.L.Canoria.
- Progress in pesticide Biochemistry and Toxicology- D.H Hutson and T.R Roberts. Willey,7th edition.
- Air pollution from Pesticides and Agricultural process. Lee,R.F., Jr.CRC Press Inc., Florida, 1976,174.

MOLECULAR SYMMETRY, COORDINATION AND ORGANOMETALLIC CHEMISTRY CH-404 d

UNIT – I

SYMMETRY AND GROUP THEORY IN CHEMISTRY: Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroup.Conjugacy relation and classes.Point symmetry group.Schonflies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh} etc. groups to be worked out explicitly). Character of a representation.The great orthogonality theorem (without proof) and its importance.Character tables and their use; spectroscopy.

UNIT – II

A. METAL-LIGAND BONDING: Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, bonding and molecular orbital theory.

B. ELECTRONIC SPECTRA AND MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES: Spectroscopic ground states, Correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), Selection rules, mechanism for break down of the selection rules, intensity of absorption, band width, spectra of d-d metal complexes of the type $[M(H_2O)]^{n+}$, spin free and spin paired ML6 complexes of other geometries, Calculations of Dq, B and parameters, spin forbidden transitions, effect of spin-orbit coupling, Spectrochemical and Nephelouxetic series.

UNIT – III

A. 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, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect. 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.

B. METAL–LIGAND EQUILIBRA IN SOLUTION: Stepwise and overall formation onstants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexs with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.

UNIT – IV

METAL π-COMPLEXES: Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand. B. Tranisition metal complexes with unsaturated organic molecules,alkanes ,allyl ,dienedienyl,arene and trienyl complex,preparations,properties,nature of bonding and structure features.Important reaction relating to nucleophilic, electrophilic attack on ligands and organic synthesis.Alkylidenes, low valentcarbenes nature of bond and Structural characteristics.

NANOCHEMISTRY

CH-404 e

UNIT I

GENERIC METHODOLOGIES FOR NANOCHEMISTRY AND NANOTECHNOLOGY

Introduction and classification, What is nanotechnology?, Classification of nanostructures, Nanoscale architecture, Summary of the electronic properties of atoms and solids, The isolated atom, Bonding between atoms, Giant molecular solids, The free electron model and energy bands, Crystalline solids, Periodicity of crystal lattices, Electronic conduction, Effects of the nanometre length scale, Changes to the system total energy, Changes to the system structure, How nanoscale dimensions affect properties

UNIT -II

MATERIAL CHEMISTRY

Preparation and Properties of Nanoparticles, Materials-Metals, Ceramics (Oxide, carbides, sulphides, nitrides).physical and chemical Methods, Size and Shape controlled Synthesis, Sol-gel methods, Optical Properteis, Electrical and Magnetic Properties, Application of Nanoparticles.

UNIT-III

CHARACTERIZATION METHODS

X-ray diffraction, Debye-Scherer formula, dislocation density, micro strain, Synchrotron Radiation, Principle and Applications, Raman Spectroscopy and its Applications, Dynamic Light Scattering (DLS). Electron microscopes: scanning electron microscope (SEM), transmission electron microscope (TEM), atomic force microscope (AFM), scanning tunneling microscope (STM), XPS, Working Principle, Instrumentation and Applications. Differential scanning calorimeter (DSC), Thermogravimetric/Diffferential Thermal Analyzer (TG/DTA), UV – Visible Spectrophotometer, FTIR, Principle and Applications, Photoluminescence (PL) Spectroscopy.

UNIT-IV

APPLICATIONS ON NANOCHEMISTRY

Nanobiology, Introduction, Bio-inspired nanomaterials, Interaction Between Biomolecules and Nanoparticle Surfaces, Different Types of Inorganic Materials Used for the Synthesis of Hybrid Nano-bio Assemblies, Applications of Nano in Biology, Nanoprobes for Analytical Applications, Current Status of Nanobiotechnology, Future Perspectives of Nanobiology; Nanosensors, Electrochemical, Nanobiosensors, Smart Dust; Nanomedicines, Nanodrug Administration Diagnostic and Therapeutic Applications.

References:

1. Nanoparticles: From Theory to Application Edited by Gu¨nter Schmid, @ 2004 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
2. Nanoparticles and Catalysis Edited by Didier Astruc @ 2008 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
3. Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller, Fraser Armstrong, Mike HagermanShriver and Atkin's Inorganic Chemistry, Fifth Edition, Oxford, 2010.
4. Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.
5. Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.
6. Nano:The Essentials: Understanding Nanoscience and Nanotecnology, T.Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.

CHEMISTRY OF NATURAL PRODUCTS

CH-404 f

UNIT-I **Terpenoids and Carotenoids** **15 Hrs**

Classification; nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule.Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules; Citral, Geraniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-Carotene.

UNIT-II **Alkaloids** **15 Hrs**

Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation classification based on nitrogen heterocyclic ring, role of alkaloids in plants.Structure, stereochemistry, biosynthesis and synthesis of the following: Ephedrine, (+)- Coniine, Nicotine, Atropine, Quinine and Morphine.

UNIT-III **Gteroids**

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone.

UNIT -IV **Plant Pigments** **7 Hrs**

Occurrence, nomenclature, general methods of structure determination, isolation and synthesis of Apigenin, Luteolin, Quercetin, myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin. Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

UNIT -V **Porphyrins**

Structure and synthesis of Haemoglobin and Chlorophyll.

UNIT -VI **Prostaglandins**

Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE_2 and $PGF_{2\alpha}$.

UNIT-VII . **Pyrethroids and Rotenones**

Synthesis and Reaction of Pyrethroids and Rotenones

Books Suggested :

1. Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson,
2. J B Hobbs, D.V. Banthrope and J B Harborne, Longman
Organic Chemistry, Vol 2 , IL Finar ELBS
3. New Trends in Natural Products Chemistry , A R Rahman and M I Choudhury, Harwood Academic Publishers
4. Roods Chemistry of Carbon Compounds, Ed S. Coffey, Elsevier

POLYMERS

CH-404 g

8 Hrs

UNIT- I Basics

Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers.Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous system.

UNIT- II Polymer Characterization **14 Hrs**

Polydispersion-average molecular weight concept. Number, weight and viscocity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. End-group, viscocity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance.

UNIT-III Structure and Properties **14 Hrs**

Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structure of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point Tm- melting point of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, Tg-Relationship between Tm and Tg, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

UNIT-IV Polymer Processing **12 Hrs**

Plastics, elastomers and fibres. Compounding. Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

UNIT-V Properties of Commercial Polyme **12 Hrs**

Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resions and silicone polymers. Functional polymers- Fire retarding polymers and electrically conducting polymers. Biomedical polymers- contact lens, dental polymers, artificial heart, kidney, skin and blood cells.

Books Suggested :

1. Textbook of Polymer Science, F W . Billmeyer Jr. Wiley
2. Polymer Science, V R Gowarikar, N V Viswanathan and J Sreedhar, Wiley Eastern
3. Contemporary Polymer Chemistry, H R Alcock and F W Lambe, Prentice Hall
4. Physics and Chemistry of Polymers, J M G Cowie, Blackie Academic and Professional

FORENSIC CHEMISTRY

Course -404h

Unit-I

Introduction to Forensic Science

Forensic science : methodologies and applications used in the forensic context. Organic and inorganic chemical analyses of physical evidence, principles of serology and DNA analysis, ballistics, arson, fingerprint analysis, drug analysis,

Unit-II

Forensic Chemistry

Chemical aspects of forensic science as it applies to criminal investigation and laboratory preparation. Instrumentation and chemistry associated with crimes. properties of the chemical evidence.. Details of the methods employed for analysis, such as color test, Chromatography (GC, GLC, HPLC), mass spectrometry (MS), GC-MS. Laboratory course. Instrumental Aspects of Liquid Chromatography Solvent delivery systems, sample inlets, temperature control, coupled column systems, detectors, and indirect detection other Separation Techniques

Unit-III

Toxicology

General principles and fundamentals of forensic toxicology, poisons, action, toxicity, postmortem characteristics, samples required for toxicological analysis and methods of collection, methods of preservation and analysis. Chemical, toxicological and pathological characteristics of commonly abused drugs, including the following: ethanol, barbiturates, narcotics, stimulants, and hallucinogens

Unit-IV

Applications of Forensic Chemistry

Investigation of crime against society, food adulteration, environmental pollution, use and distribution of unsafe chemicals, career in criminal investigation, in the laboratory analysis of forensic evidence,. Drug Enforcement Administration, Food and Drug Administration, Environmental Protection Agency, and Occupational Safety and Health Administration. environmental sciences, industrial hygiene,.

PAPER NO 5.CH-405 and 407

(Combination should be- Lab course VII + Lab course VIII OR Seminar + Project work)

LABORATORY COURSE-VII

Max. Marks 100

A. MULTI-STEP SYNTHESIS OF ORGANIC COMPOUNDS

(i) Beckmann Rearrangement: Benzanilide from benzene (Benzene Benzophenone Benzophenone oxime Benzanilide).

(ii) Benzilic Acid Rearrangement: Benzilic acid from Benzoin (Benzoin Benzil Benzilic acid)

(iii) Skraup's synthesis (Synthesis of heterocyclic Quinoline from o - Amino phenol

(iv) p-Bromoaniline from Aniline (Aniline Acetanilide p - Bromoacetanilide p -Bromoaniline)

(v) p-Nitroacetanilide from Acetanilide (Aniline Acetanilide p - Nitroactanilide p - Nitroaniline)

(vi) m Nitroaniline from Benzene (Benzene Nitrobenzene m - dinitrobenzene m- nitroaniline)

(vii) Acridone from Anthranilic acid (Anthranilic acid o - Chlorobenzoic acid N –Phenylanthranilic acid Acridone)

(viii) Enzymatic Synthesis Enzymatic reduction : Reduction of ethylace enantiomeric excess of S(+) ethyl - 3 - hydroxybutanone and determine its optical purity.

B. QUANTITATIVE ORGANIC ANALYSIS

(i) Estimation of Sulphur by Messenger's Method.

(ii) Estimation of Nitrogen by Kjeldahl Method.

C. ESTIMATION OF FUNCTIONAL GROUP

(i) Extimation of Aniline.

(ii) Estimation of Amino Group By Acetylation Method.

(iii) Estimation of Hydroxyl Group By Acetylation Method.

(iv) Estimation of Carbonyl Group By Hydrazone Formation Method.

(v) Estimation of Carboxyl Group By Titration Method.

(vi) Determination of Equivalent Weight of Carboxylic Acid By Silver Salt Method.

(vii) Estimation of Glucose By Fehling Solution Method.

(viii) Estimation of Glycine By Titration Method.

D. EXTRACTION OF ORGANIC COMPOUNDS FROM NATURAL SOURCES

(i) Isolation of caffeine from leaves.

(ii) Isolation of Casein from milk.

(iii) Isolation of lactose from milk.

(iv) Isolation of nicotine dipicrate from tabacco.

(v) Isolation of Cinchonine from cinchona bark.

(vi) Isolation of Piperine from black pepper.

(vii) Isolation Lycopene from tomatoes.

(viii) Isolation of β–Carotene from carrots.

(ix) Isolation of Limonene from citrus rinds.

(x) Isolation of protein and carbohydrates from seeds –colour test

(xi) Extraction of Fatty oil from seeds and determination of refractive index of the oil.

(xii) Isolation of protein and carbohydrate (as reducing sugars) from seed-colour test.

E. Some advanced level sophisticated instrument based (FTIR, NMR, GC-MS, AAS, FLUORESCENCE SPECTROPHOTOMETER, TENSIOMETER etc) experiments may be given to the students. SUGGESTED BOOKS:

1. Practical Organic chemistry by A. I. Vogel.
2. Practical Organic chemistry by Mann and Saunders.
3. Practical Organic chemistry by Garg and Saluja.
4. The Systematic Identification of Organic compounds, R. L. Shriner and D. Y. Curtin.
5. Semimicro Qualitative Organic Analysis, N.D. Cheronis, J. B. Entrikin and E. M. Hodnett.
6. Experimental Organic chemistry, M. P. Doyle and W. S. Mungall.
7. Small Scale Organic preparation, P. J. Hill.
8. Experimental Biochemistry, by B.S.Roa and V.Deshpande. I.K. International Pvt.Ltd.
9. Comprehensive Practical Organic Chemistry, Preparation and Qualitative Analysis, V.K.Ahluwalia and Renu Aggarwal, University Press.

OR

Seminars

Seminar topics should be related to M. Sc. Syllabus or research oriented topics on recent trends in chemical sciences

PAPER NO6. CH –406 and 408

(Combination should be- Lab course VII + Lab course VIII OR Seminar + Project work)

LABORATORY COURSE –VIII

Max. Marks 100

A.TITRIMETIC/GRAVIMETRIC DETERMINATIONS

(i) Manganese in iron / Steel by Bismuthate / Linganane –Karplus/Periodate methods.

(ii) Maganese in pyrolusite ores.

(iii) Nickel in steel by dimethylglyoxine method.

(iv) Lead by dithizone precipitation.

B. SPECTROPHOTOMETRIC DETERMINATIONS

(i) Maganese/Chromium / Vanadium / Copper / Lead in Steel and Environmental / Industrial effluent samples.

(ii) Nickel / Molybdenum / Tungsten / Vanadium / Uranium by extractive spectrophotometric methd.

(iii) Fluoride / Nitrite / Phosphate in tap / pond / river industrial waste water.

(iv) Iron in water samples by thiocyanate and phenanthroline methods.

C. CHROMATOGRAPHIC SEPARATION

(i) Sepraration and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

(ii) Thin layer chromatography – separation of nickel, manganese, cobalt and zinc, Determination of Rf values.

D. FLOW INJECTION ANALYSIS.

Determination of the following anions/cations in synthetic/real/ environmental samples.

(i) Ca^{2+}, Mg^{2+}, Al^{3+}, Mn^{2+}, Cr^{6+}, Fe^{3+}

(j) (ii) F^-, Cl^-, PO_4^{3-}, NO_2^-, NO_3^-, SO_4^{2-}, BO_3^{3-}.

E. ATOMIC ABSORPTION SPECTROPHOTOMETER

Determination of metal contents (Fe/Pb/As/Zn/Co/Ni etc.) in real and environmental samples.

F.MISCELLANEOUS

(i) Nutrient and micronutrient analysis in plant/soil/sediment.

(ii) Speciation of toxic metals i.e. As, Hg, Se, etc.

(iii) Analysis of clinical samples i.e. blood, urine, hair, etc.

Some advanced level sophisticated instrument based (FTIR, NMR, GC-MS, AAS,ϖ FLUORESCENCE SPECTROPHOTOMETER, TENSIOMETER etc) experiments may be given to the students.

SUGGESTED BOOK:

1. Quantitative Inorganic Analysis, A.I. Vogel.
2. Standard Methods of Water Analysis.
3. Colorimetric Determination of Traces of Metals, E.B. Sandell.
4. GBC, Manuals on AAS analysis, Austria.

OR

Projects

- Recent trends in chemical sciences
- Based on synthesis of organic compounds, characterization
- Kinetic, thermodynamic studies
- Analysis of chemical substances from environmental, biological, food and pharmaceutical samples with analytical techniques
- Ore, rocks, coal, cement analysis

Note: The Project work will be based on research facilities available in colleges, institutions or university

(Semester System)

एम.ए.–एप्लाईड फिलॉसफी एण्ड योग (अनुप्रयुक्त दर्शन एवं योग)

(शिक्षा सत्र 2020–21 से प्रभावी)

<u>प्रथम सेमेस्टर</u> **पूर्णांक : 80**

प्रथम प्रश्न पत्र : योग के आधारभूत–तत्व

इस प्रश्न पत्र के माध्यम से विद्यार्थियों को योग एवं योगियों के बारे में जानकारी दी जाएगी। इसके साथ भारतीय सांस्कृतिक वाड.मय यथा वेद, उपनिषद, गीता, बौद्ध, जैन तथा वेदांतिक दर्शनों से विद्यार्थियों को परिचित कराना इस प्रश्न पत्र का उद्देश्य है।

इकाई 1– अनुप्रयुक्त दर्शन–अर्थ, स्वरुप एवं महत्व, दर्शन एवं अनुप्रयुक्त दर्शन में संबंध। योग का अर्थ, परिभाषा, महत्व व उद्वेश्य, योग का उद्भव एवं विकास, योग में साधक एवं बाधक तत्व , योग कौशल विकास – अर्थ, परिभाषा, आवश्यकता एवं उद्वेश्य । योग कौशल विकास के विभिन्न आयाम ।

इकाई 2– वेद एवं उपनिषद, गीता एवं योग वाशिष्ठ, बौद्ध दर्शन तथा जैन दर्शन, सांख्य एवं वेदान्त दर्शन ।

इकाई 3– अष्टांग योग एवं कर्म योग, भक्ति योग एवं ज्ञान योग, हठ योग, मंत्र योग, लय योग एवं क्रिया योग ।

इकाई 4– महर्षि पतंजलि, गुरू गोरक्षनाथ , शंकराचार्य ।

इकाई 5– स्वामी विवेकानन्द, श्री अरविन्द, योगी श्यामाचरण लाहड़ी, स्वामी कुवल्यानन्द एवं स्वामी शिवानन्द

सहायक पुस्तकें–

1. भारतीय दर्शन	नंदकिशोर देवराज (संपादक)
2 भारतीय दर्शन का सर्वेक्षण	संगम लाल पाण्डेय
3. हठयोग प्रदीपिका	प्रकाशक कैवल्यधाम लोणावाला
4. आसन मीमांसा	स्वामी कुवल्यानन्द
5. प्राणायाम मीमांसा	स्वामी कुवल्यानन्द
6. गोरक्ष संहिता	गुरू गोरक्षनाथ

द्वितीय प्रश्न पत्र : योग की दार्शनिक पृष्ठभूमि पूर्णांक : 80

इस प्रश्न पत्र के माध्यम से विद्यार्थियों को विभिन्न भारतीय दर्शनों जैसे–सांख्य, योगादि और गीता में योग के दार्शनिक स्वरूप का परिचय कराना ही मूल उद्देश्य है।

इकाई 1–भारतीय दर्शन की सामान्य विशेषताऍं, भारतीय दर्शन में योग का महत्व।

इकाई 2–योग की दार्शनिक पृष्ठभूमि, सांख्य –दर्शन, सांख्य और योग में संबंध, पुरुष सिद्धि, बंधन।

इकाई 3–सांख्य प्रकृति सिध्दि, स्वरुप, विकासवाद एवं कैवल्य।

इकाई 4–योग सूत्र, अष्टांग योग परिचय।

इकाई 5–गीता में योग के विविध रुप, भक्ति, ज्ञान एवं कर्म।

सहायक पुस्तकें–

1. योगदर्शन	सम्पूर्णानंद
2. पांतजल योग–विमर्श	विजयपाल शास्त्री
3. भारतीय दर्शन की रुपरेखा	एम हिरियन्ना
4. सांख्यतत्व कौमुदी	वाचस्पति मिश्र
5 सरल योगासन	डॉ. ईश्वर भारद्वाज

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तृतीय प्रश्न पत्र : हठयोग सिद्वांत एवं साधना पूर्णांक : 80

इस प्रश्न पत्र के माध्यम से विद्यार्थियों को हठयोग के प्रमुख दो ग्रंथ हठयोग प्रदीपिका एवं घेरंड संहिता में वर्णित योग के सिद्धांतों एवं साधना पद्धतियों जैसे–षटकर्म, आसन, प्राणायाम मुद्रा व बंधादि की तकनीकी जानकारी से अवगत कराना प्रमुख उद्देश्य है।

इकाई 1–हठयोग की परिभाषा अभ्यास हेतु उचित स्थान, ऋतुकाल।

साधना में साधक व बाधक तत्व। हठ सिद्धि के लक्षण।

हठयोग की उपादेयता योगाभ्यास के लिए पथ्यापथ्य निर्देश।

इकाई 2–हठ योग प्रदीपिका में वर्णित आसनों की विधि व लाभ।

प्राणायाम की परिभाषा, प्रकार, विधि, प्राणायाम की उपयोगिता।

षट्कर्म वर्णन, धौति, वस्ति, नेति, नौलि त्राटक, कपाल–भाति की विधि व लाभ।

इकाई 3–कुंडलिनी का स्वरुप, चक्रों के स्वरूप, जागरण के उपाय।

बंध.मुद्रा वर्णन, महामुद्रा, महाबंध, महावेध, खेचरी, उडडीयान बंध, जालंधर, मूलबंध

विपरीतकरणी, बज्रोली, शक्तिचालिनी समाधि का वर्णन नादांनुसंधान।

इकाई 4–घेरण्ड संहिता में वर्णित षटकर्म–धौति, वस्ति, नेति, नौलि, त्राटक, कपालभाति की विधि सावधानियां व लाभ।

इकाई 5–घेरंड संहिता के आसन, प्राणायाम, मुद्राएँ, प्रत्याहार, ध्यान व समाधि का विवेचन।

घेरंड सहिता में वर्णित विविध आसनों एवं प्राणायामों की विधि, लाभ एवं सावधानियां ।

सहायक पुस्तकें–

1. हठयोग प्रदीपिका — प्रकाशक कैवल्यधाम लोणावाला
2. घेरण्ड संहिता — प्रकाशक कैवल्यधाम लोणावाला
3. योगांक–कल्याण विशेषांक — गीता प्रेस, गोरखपुर
4. हठयोग — स्वामी शिवानंद
5. योग विज्ञान — स्वामी विज्ञानानंद सरस्वती

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चतुर्थ प्रश्नपत्र (प्रायोगिक)

कियात्मक पूर्णांक : 75

इन्टर्नशिप पूर्णांक : 25

पवनमुक्तासन भाग–एक

भाग – दो

भाग – तीन

सूर्यनमस्कार।

<u>द्वितीय सेमेस्टर</u>

प्रथम प्रश्न पत्र : चेतना का अध्ययन पूर्णांक : 80

इस प्रश्न पत्र के माध्यम से विद्यार्थियों को विभिन्न भारतीय दार्शनिक सम्प्रदायों यथा उपनिषद, बौद्ध, जैन, सांख्य योग, मीमांसा एवं अद्वैत वेदांत में चेतना के स्वरूप की जानकारी दी जाएगी। इसके साथ ही विभिन्न भारतीय एवं पाश्चात्य दार्शनिकों के अनुसार चेतना के स्वरूप का बोध कराना इस प्रश्न पत्र का उद्देश्य है।

इकाई 1–चेतना का अर्थ, परिभाषा स्वरुप, अध्ययन की आवश्यकता

इकाई 2–उपनिषद, बौद्ध, जैन मतानुसार चेतना

इकाई 3–चेतना का स्वरुप, सांख्य–योग एवं मीमांसा एवं अद्वैत वेदांत मत में, आत्मा, ब्रहम, पुरुष, सिद्वि, पुरूष बहुत्व

इकाई 4–चेतना का स्वरुप, हुसर्ल, सार्त्र, श्री अरविंद, मानव का स्वरुप राधाकृष्णन, रवीन्द्रनाथ टैगोर

इकाई 5–मानव चेतना का स्वरूप, मानव चेतना के अध्ययन की आवश्यकता, मानव चेतना का वर्तमान संकट तथा सार्थक समाधान के उपाय, मानव चेतना के विविध रहस्य एवं तथ्य – जन्म और जीवन, भाग्य और पुरूषार्थ, कर्मफल सिद्धांत, संस्कार एवं पुर्नजन्म, भारतीय ऋषियों द्वारा विकसित मानव चेतना के विकास की विधियां ।

सहायक पुस्तकें–

1	समकालीन भारतीय दर्शन	बी के लाल
2	समकालीन पाश्चात्य दर्शन	बी के लाल
3	समकालीन पाश्चात्यदर्शन	लक्ष्मी सक्सेना
4.	भारतीय दर्शन में चेतना का स्वरूप	डॉ. श्रीकृष्ण सक्सेना
5.	मानव चेतना	डॉ. ईश्वर भारद्वाज

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द्वितीय प्रश्न पत्र : पातंजल–योगसूत्र पूर्णांक : 80

इस प्रश्न पत्र के माध्यम से विद्यार्थियों को पातंजल योग सूत्र में वर्णित चित्त, चित्तवृत्ति व चित्तवृत्ति निरोध के विभिन्न उपायों व अष्टांग योग की जानकारी प्रदान कराना तथा इसके साथ ही 'चतुर्व्यूहवाद, विवेकख्याति, सप्तधाप्रज्ञा, सिद्धि कर्म व समाधि के भेद तथा आधुनिक जीवन में यम–नियम व ध्यान की व्यावहारिक जानकारी प्रदान कराना ही मूल उद्देश्य है।

इकाई 1–योग की परिभाषा, चित्त, चित्त भूमियॉ, चित्त वृत्तियॉ।

अभ्यास और वैराग्य, समाधि के भेद, ईश्वरत्व, ईश्वर प्राणिधान, चित्त

प्रसादन के उपाय,. ऋतंभराप्रज्ञा।

इकाई 2–पंचक्लेश, दुःख का स्वरुप, चतुर्व्यूहवाद, विवेकख्याति, सप्तधाप्रज्ञा।

इकाई 3–योग के आठ अंग – यम, नियमादि : इनकी सिद्वि के फल

वितर्क–विवेचन, प्राणायाम का फल, प्रत्याहार का फल।

इकाई 4–धारणा, ध्यान और समाधि संयमचित्त का परिणाम, विभूति और उसके भेद, कैवल्य का स्वरुप।

इकाई 5–सिध्दि के पांच भेद, निर्माण चित्त कर्म के भेद, दृष्टा और दृश्य

धर्ममेध समाधि, आधुनिक जीवन में ध्यान की प्रासंगिकता।

सहायक पुस्तकें–

1. योग सूत्रतत्ववैशारदी — वाचस्पति मिश्र
2. योग सूत्र योग वर्तिका — विज्ञानभिक्षु
3. योग सूत्र राज मार्तंड — हरिहरानंद आरण्य
4. पातंजल योगप्रदीप — ओमानंद तीर्थ
5. पातंजल योग विमर्श — विजयपाल शास्त्री
6. ध्यान योग प्रकाश — लक्ष्मणानंद
7. योग दर्शन — राजवीर शास्त्री

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तृतीय प्रश्नपत्र : योग एवं स्वास्थ्य   पूर्णांक : 80

इस प्रश्न पत्र के माध्यम से विद्यार्थियों को स्वास्थ्य, स्वस्थ पुरुष के लक्षण, यौगिक दिनचर्या, रात्रिचर्या व ऋतुचर्या तथा आहार के गुण–कर्म, घटक आहार के विभिन्न प्रकार की जानकारी दी जाएगी। इसके साथ ही रोगों के लक्षण, कारण व यौगिक निदान तथा आधुनिक जीवन शैली में योग की उपादेयता से परिचय कराना इस प्रश्न पत्र का उद्देश्य है।

इकाई 1–स्वास्थ्य की परिभाषा, स्वस्थ पुरुष के लक्षण, दिनचर्या–मुखशोधन, व्यायाम की परिभाषा, योग्यायोग्य प्रकार, लाभ, स्नान के लाभ एवं हानि के अनुसार स्नान, संध्योपासना, योगाभ्यास । रात्रिचर्या –निद्रा एवं ब्रहमचर्य,. ऋतुचर्या, ऋतुविभाजन, ऋतु के अनुसार दोषों का संचय, प्रकोप व प्रशमन। सदवृत्त एवं आचार रसायन।

इकाई 2–आहार की परिभाषा, आहार के गुण व कर्म। आहार के घटक द्रव्य : कार्बोज, वसा, प्रोटिन ,खनिजपदार्थ, जीवनीय तत्व जल।
आहार की मात्रा व काल, संतुलित आहार। दुग्धाहार, फलाहार, अपक्वाहार, मिताहार उपवास। शाकाहार व मांसाहार के अवगुण। अंकुरित आहार के लाभ, योगाभ्यासी के लिए निषिद्व आहार।

इकाई 3–निम्नलिखित रोगों का लक्षण– कारण व यौगिक उपचार
अग्निमांद्य, अजीर्ण, पीलिया, कोष्ठबद्वता, अम्लपित्त, कोलाइटिस, दमा, उच्च व निम्न रक्तचाप, साइटिका, आमवात; अर्थराइटिस, वातरक्त; गठियाबद्व।

इकाई 4–नाभि टलना, चर्मरोग, कर्णबाधिर्य, नासांकुर वृद्वि, बाल झड़ना, दृष्टिक्षीणता, सर्वाइकल स्पॉडिलाइटिस, धातुदौर्बल्य, मधुमेह, बौनापन, श्वेतप्रदर, कटिशूल।

इकाई 5–आधुनिक जीवन शैली में योग की प्रासंगिकता, सावधानियॉ एवं निदान (खानपान व्यवस्था, भविष्य के प्रति अनिश्चितता, मानसिक अवसाद, द्रुत जीवन शैली आदि के विशेष संदर्भ में)।

सहायक पुस्तकें–

1. स्वस्थवृत विज्ञान	रामहर्ष सिंह
2. यौगिक चिकित्सा	कुवल्यानंद
3. योग से आरोग्य	कालिदास

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चतुर्थ प्रश्नपत्र (प्रायोगिक)

क्रियात्मक **पूर्णांक : 75**
इन्टर्नशिप **पूर्णांक : 25**

1 प्राणायाम, मुद्रा एवं बंध क्रिया

2. पवनमुक्तासन भाग–एक

भाग – दो

भाग – तीन

3. सूर्यनमस्कार।

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तृतीय सेमेस्टर   पूर्णांक : 80

प्रथम प्रश्न पत्र : श्रीमद्भगवद गीता : दर्शन एवं योग साधना के तत्व

इस प्रश्न पत्र के माध्यम से विद्यार्थियों को श्रीमद्भगवद्गीता के स्वरूप, रचनाकाल, तत्व विचार तथा गीता के दार्शनिक एवं आध्यात्मिक महत्व की जानकारी दी जाएगी। इसके साथ ही गीता के प्रमुख भाष्यकार आचार्य शंकर, रामानुज, लोकमान्य तिलक एवं गांधी जी के जीवन परिचय एवं गीता के कर्मयोग, ज्ञानयोग, भक्तियोग आदि से विद्यार्थियों को परिचित कराना इस प्रश्न पत्र का उद्देश्य है।

इकाई 1—श्रीमद् भगवद गीता का स्वरुप, रचनाकाल, श्रीमद् भगवदगीता का दार्शनिक एवं आध्यात्मिक महत्व। मानवीय चिंतन एवं जीवन पर विश्वव्यापी प्रभाव।

इकाई 2—श्रीमद् भगवदगीता के कुछ प्रमुख भाष्यकारो का जीवन परिचय उनकी योग साधनाएं एवं भाष्य की विशेषताएं, आचार्य शंकर, आचार्य रामानुज, लोकमान्य तिलक तथा गॉधी के संदर्भ में।

इकाई 3—श्रीमद् भगवदगीता का तत्व विचार, माया, प्रकृति, पुरुष, ईश्वर तथा अवतार तत्व का स्वरुप, श्रीमद्भगवद गीता का आचार शास्त्र।

इकाई 4—गीता में योग की प्रवृत्ति व स्वरुप। योग के भेद—कर्मयोग, भक्ति योग, ज्ञानयोग, ध्यान योग का स्वरुप। भक्त, कर्मयोगी व ज्ञानयोगी व ज्ञानी तत्व के लक्षण, स्थितप्रज्ञ का तत्व दर्शन।

इकाई 5—गीता का निष्काम कर्मयोग, ज्ञान भक्ति एवं कर्म योगों का समन्वय।

सहायक पुस्तकें—

1. श्रीमद्भगवदगीता	रामानुज भाष्य
2. गीतांक	गीताप्रेस गोरखपुर
3. गीतामाता	गॉधी
4. गीता प्रवचन संत	विनोवाभावे
5. श्रीमदभगवदगीता गीतारहस्यद्ध	लोकमान्य तिलक
6. श्रीमद्भगवदगीता	शांकरभाष्य

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द्वितीय प्रश्न पत्र : आसन और प्राणायाम का वैज्ञानिक अध्ययन **पूर्णांक : 80**

इस प्रश्न पत्र के माध्यम से विद्यार्थियों को आसन, प्राणायाम, बंध एवं षट्कर्म का परिचय व उसका वैज्ञानिक विवेचन तथा उनके क्रम में निहित वैज्ञानिकता संबंधी जानकारी प्रदान कराना ही इस प्रश्न पत्र का उद्देश्य है।

इकाई 1–आसन परिभाषा, उददेश्य, आसनों का वर्गीकरण आसन और व्यायाम में अंतर, बंधो का वैज्ञानिक विवेचन।

इकाई 2–ध्यानात्मक शरीर–सम्वर्धनात्मक एवं विश्रामात्मक आसनों का वैज्ञानिक विवेचन, शुद्विक्रियाओं, षठकर्मो का वैज्ञानिक विवेचन।

इकाई 3–प्राणायाम की परिभाषाएं प्राणायाम के गुण विशेष प्राणायाम की प्रक्रिया का वैज्ञानिक विवेचन, श्वसन तंत्रकी कियाविधि, प्राणायाम के संदर्भ में दीर्घश्वसन एवं प्राणायाम में अंतर।

इकाई 4–प्राणशक्ति के पॉच स्वरुप, विभिन्न रोगों के निदान में प्राणायाम की उपयोगिता, आधुनिक वैज्ञानिक अध्ययन कें संदर्भ में।

इकाई 5–प्राणायाम में ध्यानात्मक आसनों व बंधोकी अनिवार्यता का वैज्ञानिक विवेचन।

सहायक पुस्तकें–

1. प्राणशक्ति एक दिव्य विभूति — पं. श्री राम शर्मा आचार्य सम्पूर्ण वांड़मय
2. योगासन और स्वास्थ्य — लक्ष्मीनारायण अग्रवाल
3. आसन प्राणायाम से आधि — व्याधि निवारण्ण–ब्रम्हवर्चस
4. योग दीपिका — बी.के.एस. आयंगर
5. योग एवं यौगिक चिकित्सा — रामहर्ष सिंह

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तृतीय प्रश्न पत्र : योगिक आहार एवं पोषण पूर्णांक : 80

इस प्रश्न पत्र के माध्यम से विद्यार्थियों को स्वस्थ्यवृत्त (दिनचर्या, रात्रिचर्या व ऋतुचर्या) की विस्तृत जानकारी प्रदान करना तथा आहार एवं पोषण के विभिन्न घटकों का परिचय कराना तथा यौगिक आहार एवं पोषण आहार की जानकारी प्रदान करना इस प्रश्न पत्र का प्रमुख उद्देश्य है।

इकाई 1–स्वास्थ्य – अर्थ, परिभाषा, लक्षण एवं अंगों की विवेचना ।

स्वस्थवृत्त –अर्थ, परिभाषा, स्वरूप, प्रयोजन, अंग

दिनचर्या – प्रातः कालीन नित्यकर्म, व्यायाम की अवधारणा एवं उपयोगिता

अभ्यंग – अर्थ, परिभाषा एवं विधियां एवं उनके शरीरगत प्रभाव एवं चिकित्सकीय प्रयोग ।

इकाई 2–स्नान – अर्थ एवं परिभाषा, उद्वेश्य, स्नान के भेद व समय, संसाधन, निषेधात्मक स्थितियां व लाभ

निद्रा – परिभाषा, उद्वेश्य, प्रकार, कारणीय सिद्धांत व लाभ, अनिद्रा के लक्षण व उपाय ।

इकाई 3–ऋतुचर्या – अर्थ, परिभाषा, विभाजन एवं विशेषताएं । ऋतु के अनुसार दोषों का संचय, प्रकोप व प्रशमन – सद्वृत्त एवं आचार रसायन, अर्थ, परिभाषा एवं प्रकार आदि– व्याधि रोकथाम, निवारण एवं दीर्घ आयु के लिए इनकी उपयोगिता ।

इकाई 4–आहार एवं पोषण – अर्थ, परिभाषा, अंग, घटक, गुणवत्ता, मात्रा, समय, बारम्बारता, कार्य एवं उपयोगिता ।

आहार विविधता – दुग्धहार, फलाहार, अपक्वाहार । उपवास की अवधारणा एवं स्वास्थ्य संबंधी उपयोगिता । मांसाहार व शाकाहार की तुलनात्मक विवेचना ।

इकाई 5– संतुलित आहार – परिभाषा, घटक एवं वर्गीकरण ।

घटकों का रासायनिक वर्गीकरण –प्रोटीन, कार्बोहाइडेड, वसा, खनिज, लवण, विटामिन, जल, वर्गीकरण तथा शरीर में कार्य । आहार –चिकित्सा

सहायक पुस्तकें–

1. चरक संहिता	महर्षि चरक
2. सुश्रुत संहिता	महर्षि सुश्रुत
3. आयुर्वेद सिद्धांत रहस्य	आचार्य बालकृष्ण

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चतुर्थ प्रश्नपत्र (प्रायोगिक)

क्रियात्मक पूर्णांक : 75
इन्टर्नशिप पूर्णांक : 25

1. षटकर्म
2 प्राणायाम, मुद्रा एवं बंध क्रिया
3. पवनमुक्तासन भाग–एक
भाग – दो
भाग – तीन
4. सूर्यनमस्कार।

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चतुर्थ सेमेस्टर

प्रथम प्रश्नपत्र : योग–उपचार पूर्णांक : 80

इस प्रश्न पत्र के माध्यम से विद्यार्थियों को योग चिकित्सा के मूल सिद्धांत तथा स्वास्थ्य संवर्धन, रोगोपचार एवं दीर्घायु के लिए यौगिक चिकित्सा की जानकारी एवं उसके महत्व से परिचित कराया जायेगा। इसके साथ–साथ योग चिकित्सा द्वारा विभिन्न तंत्रों–जैसे कंकाल तंत्र, श्वसन तंत्र आदि से संबंधित रोग एवं मानसिक रोग के निदान की विधियों से विद्यार्थियों को अवगत कराना।

इकाई 1–योग चिकित्सा का अर्थ, परिभाषा, प्रयोजन, मूल सिद्धांत, स्वास्थ्य संवर्द्धन, रोकथाम, उपचार एवं दीर्घायु के लिये योग चिकित्सा का महत्व । योग चिकित्सक के गुण, योग चिकित्सा एवं एलोपैथिक चिकित्सा के बीच में अन्तर, योग चिकित्सा की समकालीन पद्धतियां एवं योग चिकित्सा की सीमाएं ।

इकाई 2–यौगिक विकृति निदान : 1 स्वर विज्ञान 2. प्राण एवं 3. श्वास का शारीरिक, मानसिक एवं मनोदैहिक दैनिक समस्याओं के साथ संबंध । सप्तचक्र का तंत्रिका तंत्र एवं अन्तस्रावी ग्रंथियों से संबंध । स्वास्थ्य एवं तन्दरूस्ती : अर्थ, परिभाषा, लक्षण एवं अंगों की विवेचना (योग एवं डब्ल्यू. एच.ओ. के संदर्भ में)

इकाई 3–सामान्य– व्याधियों के लिये योग चिकित्सा, अस्थि एवं मांशपेशी तंत्र के रोग – कमर दर्द, सायटिका, सरवाईकल स्पॉण्डलाइटिस, आमवात के कारण, लक्षण, निदान एवं योग चिकित्सा । श्वसन संबंधी रोग : दमा, निमोनिया, नजला के कारण, लक्षण, निदानएवं योग चिकित्सा ।

इकाई 4–पाचन तंत्र संबंधी रोग : कब्ज, अजीर्ण, अम्लपित्त, अल्सर, उदरवायु, पीलिया के कारण, लक्षण, निदान एवं योग चिकित्सा । रक्त परिवहन तंत्र संबंधी उच्च रक्तचाप, निम्न रक्तचार, हृदय धमनी अवरोधके कारण, लक्षण, निदान एवं योग चिकित्सा ।

इकाई 5–अन्तस्रावी ग्रंथियों संबंधित रोग :– मधुमेह, थायराइड हार्मोन वृद्धि व कमी, मोटापा, डायबिटीज, मानसिक शक्ति हास के कारण, संकेत, लक्षण, निदान एवं योग चिकित्सा ।

तंत्रिका तंत्र संबंधित रोग – सिर दर्द, अवसाद, चिन्ता, अनिद्रा, माइग्रेन, तनाव, धूम्रपान, मद्यपान के कारण, लक्षण, निदान एवं योग चिकित्सा ।

मानसिक रोग स्वास्थ्य : अर्थ, परिभाषा, कारण, लक्षण एवं उनका योग चिकित्सा द्वारा निदान

सहायक पुस्तकें–

1	चरक संहिता	महर्षि चरक
2	सुश्रुत संहिता	महर्षि सुश्रुत
3	आयुर्वेद सिद्धांत रहस्य	आचार्य बालकृष्ण
4	स्वस्थ्वृत्त विज्ञान	रामहर्ष सिंह

द्वितीय प्रश्न पत्र : शरीर एवं शरीर क्रिया–विज्ञान पूर्णांक : 80

इस प्रश्न पत्र के माध्यम से विद्यार्थियों को शरीर रचना तथा इसके विभिन्न तंत्रों की क्रियाविधि से परिचय कराना तथा इनकी कार्यप्रणाली पर योग के प्रभाव का अध्ययन कराना इस प्रश्नपत्र का उद्देश्य है।

इकाई 1–शरीर रचना का सामान्य परिचय चलन तंत्र रक्त वाहिका तंत्र पाचन तंत्र श्वसन तंत्र मूत्र –जनन तंत्र तंत्रिका तंत्र उत्सर्जन तंत्र तथा संतुलित आहार।

इकाई 2–कंकाल तंत्र उर्ध्व शाखा का कंकाल अधःशाखा का कंकाल ।

इकाई 3–परिसंचरण तंत्र हृदय हृदयचक हृदय संरोध के कारण एवं बचाव के उपाय यौगिक सावधानियां एव ंनिदान रक्त की संरचना।

इकाई 4–पाचन तंत्र रक्त वाहिका तंत्र तथा श्वसन तंत्र इनकी कार्य प्रणाली पर यौगिक क्रियाओं का प्रभाव।

इकाई 5–मूत्रजनन तंत्र, उत्सर्जन तंत्र तथा तंत्रिका तंत्र– इनकी कार्यप्रणाली पर योगिक।

सहायक पुस्तकें–

1. शरीर और शरीर क्रिया विज्ञान — मन्जु गुप्त
2. मानव–शरीर–रचना — मुकन्द स्वरूप वर्मा
3. मानव शरीर रचना एवं क्रिया विज्ञान — अनन्त प्रकाश गुप्ता

....

तृतीय प्रश्नपत्र : पूर्णांक : 100

यह प्रश्न पत्र दो भागों में विभक्त होगा

1. परियोजना कार्य 75 अंक
2. शैक्षिक भ्रमण/मौखिकी 25 अंक

....

चतुर्थ प्रश्न पत्र (प्रायोगिक)

क्रियात्मक पूर्णांक : 75
इन्टर्नशिप पूर्णांक : 25

1. **उच्च स्तरीय योगिक क्रियाएं**
2. शोधन क्रियाएं
3. ध्यान
4. षटकर्म
5 प्राणायाम, मुद्रा एवं बंध क्रिया
6. पवनमुक्तासन भाग–एक
   भाग – दो
   भाग – तीन
7. सूर्यनमस्कार।

P.G.Diploma in Yoga Education and Philosophy

Syllabus. (Effective from 2020-2021)

There shall be two theory papers and one Practical (Three parts) in each semester.

SEMESTER -I

Paper -1 Theoritical Yoga Vijnan **M.M.-50.**

The purpose of this paper is to share the knowledge about Yoga, kinds of Yoga & Yogis with the students. Besides this imparting introductory knowledge of Yogic Texts - Yoga Sutra & Hath Yoga Pradeepika is also the aim of the study of this paper.

Unit-I : Introductio to Yoga : The concept,meaning ,definition and tradition of Yoga, Guru-Shishya (types and meaning)

Unit-II : Basic texts of Yoga --Yoga Sutra(Samadhi and Sadhana Padas), Hathyoga Pradipika.

Unit-III : Kinds of yoga : Bhakti yoga ,Karma yoga, Mantra yoga and Raj yoga.

Unit-IV : Study of Ida,Pingala, Sushumna,Seven Chakras ,Five Koshas, and Five Pranas.

Unit-V : Contemporary Yogis --Shri Aurobindo,Satyananda and Shivananda.

Paper -2. Applied Yoga Vijnan. **M.M. 50.**

Unit-I : Meaning ,definition and importance of Yoga and Health in life. Theories of Health,Various exercises benefits of Yoga- asanas and their values vis-a-vis other systems.

Unit -2 : Practice of Yoga - Preparation . Food , Dress, Sequence , Climatic Changes daily routine Vratas for health,positive and negative factors.

Unit -3 : Life pattern and Yoga --Effects of yoga upon bodily functions,Role of yoga asanas in modern living.

Unit - 4 : Physiology- Constitution Nervous system , Respiratory system, Circulatory system and ESndocrine glands

Unit- 5 : Aspects of Mind (Topograficals and Dynamic) Id,Ego and Super Ego, Concious , Sub-concious and Un-concious . Yogic concept of mind and mental process.

Practicals

(A) (i) Practice Teaching (Indoor) **M.M. 25.**

(ii) Practice Teaching (Outdoor)/ INTERNSHIP **M.M. 25.**

Asanas, Kriyas, Pranayamas

Class arrangement, Meditation

(B) Practical (1-6) **M.M. 50.**

1. Pawanmuktasana Part-1,2 &3
2. Asanas :,Relaxation,Pre-meditative,backward and forward bending, Spinal Cord Twisting and balancing, Asanas of Vajrasana group & Standing pose
3. Nadishodhan and Pranayamas : Sheetali Pranayama, Sheetakari Pranayama, Ujjayi Pranayama & Bhramari Pranayama.
4. Mudra : Hastmudra, Manmudra and Kayamudra.
5 Bandha : Moolbandha & Jalandhar Bandha.
6. Shawaasana.

(C) Practical record : **M.M. 25**

Viva-Voce **:** **MM 25**

...

Total Marks of I- sem : **250.**

SEMESTER-II.

Paper -I Yoga Philosophy. **Max.Marks : 50**

The purpose of this paper is to provide comprehensive knowledge of Yoga as available in different schools of Philosophy especially Sankhya & Vedanta & different types of Yoga as described in Jainism, Buddhism, Sri Aurobindo, Yoga Sutra etc. along with Psychosomatic disorders.

Unit-I The subject matter of Yoga philosophy-
Samkhya: Prakriti,Purusha and Cosmology.
Vedanta :Brahman Soul and Maya.
Unit-II Different systems of philosophy :
Pancha Mahavrata -- Jainism.
Ashtang Marg -- Buddhism
Integral Yoiga -- Shri Aurobindo
Unit-III Yoga Sutra : Nature of Chitta, Chitta vrittis and Bhoomis
Unit-IV Kinds of Yoga : Hatha Yoga, Kundalini, Jnana,Laya.
Unit-V Psychosomatic disorders(meaning and types) their management through Yoga, Aging --Its problems and management through Yoga.

Paper II. Hatha Yoga. **M.M. - 50**
Unit-I Introduction to the HathPradipika and Gherand Samhita.
Unit-II Pranayama--Its meaning methods,kinds,Precaution and benifits.
Unit-III Shuddhi kriya--Shatkarma,its method and utility.
Unit-IV Bandha and Mudras --methods and benifits.
Unit-V Samadhi , Different systems of Meditation.
(A) (i) Practice Teaching (Indoor) **M.M. 25.**
(ii) Practice Teaching (Outdoor)/ INTERNSHIP **M.M. 25.**
Asanas, Kriyas, Pranayamas,
Class arrangement & Meditation.
(B) Practicals (1-8) **M.M.- 50**
1. Balancing Asanas.
2. Asanas of Higher group.
3. Surya Namaskar.
4. Pranayama : Suryabheda Pranayama, Bhastrika Pranayama, Kapalabhati Pranayama & Moorchha Pranayama.
5. Bandha : Uddiyaan Bandha & Mahaabandha.
6. Mudra : Bandha Mudrayen & Aadhaar Mudrayen.
7. Shatkarma.
8. Dhayana & Yoganidra.
(C) Practical records **M.M. 25**
Viva-voce **M.M. 25**
Total Marks of II Semester **250**
==
Grand Total of I & II Semester ------ **500**

Certificate Course in Yoga Education & Philosophy

PAPER -I - Fundamental Principles of Philosophy & Yoga

The purpose of teaching this paper is to impart basic knowledge of Philosophy & Yoga along with comparative out come of Indian & Western Philosophy. Besides, imparting introductive knowledge of Yogic Texts, different types of Yoga & their therapeutic uses to students is also the purpose of introducing this only paper.

Unit- (1) Introduction to Philosophy & Yoga- Meaning and Definition of Philosophy & Yoga;
Basics of Indian & Western Philosophy.

Unit- (II) Introduction to Yogic Texts :-
(i) Patanjal Yoga Sutra (ii) Hath Pradeepika
(iii) Bhagavat Geeta (iv) Gherand Sanhita

Unit-(III) Introduction to Different Types of Yoga :-
(i) Jnana Yoga (ii) Bhakti Yoga (iii) Karma Yoga
(iv) Raja Yoga (v) Mantra Yoga

Unit-(IV) Introduction to Yoga Therapy
(i) Yogic life style and diet
(ii) Asana, Pranayama & their Physiological effects
(iii) Satkarma - Benifits & Precautions

Unit-(V) Development of Yoga through Yoga Gurus & their contributions :
(i) Sri Aurobindo
(ii) Swami Vivekananda
(iii) S. Kuvalyananda
(iv) B.K.S. Iyengar
(v) Swami Satyanand Saraswati
(vi) Shriram Sharma Acharya

Reference Books :-

योग विज्ञान – स्वामी विद्यानंद सरस्वती
हठ प्रदीपिका – कैवल्यधाम लोनावाला
घेरण्ड संहिता – बिहार स्कूल ऑफ योग, मुंगेर
पातंजल योग सूत्र – गीता प्रेस, गोरखपुर
भारतीय दर्शन की रूपरेखा – हरेन्द्र प्रसाद सिन्हा
Integrated Yoga Theraphy - H.R. Nagendra

प्रमाण पत्र पाठ्यक्रम :– योग शिक्षा एवं दर्शन

द्वितीय प्रश्न पत्र – क्रियात्मक योग (Yogic Practices)

1. **पवन मुक्त आसन – भाग एक**

   गठिया निरोधक समूह (Anti - Rheumatic Group)

   – पादांगुलि नमन एवं गुल्फ नमन
   – गुल्फ चक्र
   – जानु नमन एवं जानु चक्र
   – अर्द्ध तितली आसन एवं पूर्ण तितली आसन
   – मुष्टिका बंध एवं मणिबंध नमन, मणिबंध चक्र
   – कोहनी नमन, कोहनी चक्र, स्कंध चक्र
   – ग्रीवा संचालन आसन

2. **पवन मुक्त आसन – भाग दो**

   वात निरोधक समूह (Digestive / Abdominal Group)

   – पादोत्थान आसन, पाद संचालन आसन, पाद चक्र आसन
   – सुप्त पवन मुक्त आसन
   – सुप्त उदराकर्षण आसन, शव उदराकर्षण आसन
   – नौका आसन

3. **पवन मुक्त आसन – भाग तीन**

   शक्तिबंध समूह (Energy Block Postures)

   – रज्जु कर्षण आसन
   – चक्की चालन आसन
   – नौका संचालन आसन
   – काष्ठातक्ष आसन
   – कौआ चालन आसन
   – उदराकर्षण आसन

4. **सूर्य नमस्कार**

5. **षटकर्म** – जलनेती, कपालभाति, कुन्जल क्रिया
6. **प्राणायाम** – नाड़ी शोधन (अनुलोम–विलोम), भ्रामरी
7. **योग निद्रा** – शवासन

SCHEME OF EXAMINATION
COURSE SRUCTURE & SYLLABUS

Choice based Credit System (CBCS)
with
Learning Outcomes based Curriculum Framework (LOCF)

for
M.Sc. (ELECTRONICS) PROGRAMME
(SEMESTER SYSTEM)
(Effective from Academic Year 2020-21)

FACULTY OF SCIENCE

For Approval of Board of Studies in Electronics

Effective from Academic Session JULY 2020

School of Studies in Electronics and Photonics
Pt. Ravishankar Shukla University
Amanaka, GE Road Raipur (C.G.) 492010
WEBSITE: -www.prsu.ac.in

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Preamble

The Pt. Ravishankar Shukla University is a pioneer institution that has contributed significantly to the Higher Education system of the Chhattisgarh State by providing equitable access to quality education. It has continuously striven to build a knowledge society by providing inclusive and lifelong education to learners across the state and country.

Keeping pace with the emerging ethos of institutionalizing an outcome-oriented higher education system and enhancing employability of graduates, it has adopted the UGC notified Scheme for development of Learning Outcomes-based Curriculum Framework (LOCF). Such initiatives are required for upgrading academic resources and learning environment, raising the quality of teaching and research across all programmes offered by the University. This is critical for enabling effective participation of the PRSU learners in knowledge production and contribution to the knowledge economy, by equipping the learners with skills relevant for global and national standards.

The objective of any programme at Higher Education Institute is to prepare their students for the society at large. The Pt. Ravishankar Shukla University, Raipur envisions all its programmes in the best interest of their students and in this endeavor it offers a new vision to all its Post-Graduate courses. It imbibes a Learning Outcome-based Curriculum Framework (LOCF) for all its Post Graduate programmes.

The LOCF approach is envisioned to provide a focused, outcome-based syllabus at the Postgraduate level with an agenda to structure the teaching-learning experiences in a more student-centric manner. The LOCF approach has been adopted to strengthen students 'experiences as they engage themselves in the programme of their choice. The Post-Graduate Programmes will prepare the students for both, academia and employability.

Each programme vividly elaborates its nature and promises the outcomes that are to be accomplished by studying the courses. The programmes also state the attributes that it offers to inculcate at the graduation level. The graduate attributes encompass values related to well-being, emotional stability, critical thinking, social justice and also skills for employability. In short, each programme prepares students for sustainability and life-long learning.

The new curriculum of M.Sc. Electronics offers the Postgraduates a complete package to have an in-depth understanding of basic to advance electronics. They can equip themselves to the fundamentals of electronics to a complete skill set compatible to industry 4.0 standards. The exhaustive curriculum will prepare them to pursue higher education as well compete in the job market.

The Pt. Ravishankar Shukla University, Raipur hopes the LOCF approach of the programme M.Sc. Electronics will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large.

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR

Scheme of Examination
M.Sc. (Electronics) Programme
(Semester System)

Effective from Academic Session JULY 2020

M.Sc. Electronics is a four semester course spread over the period of two years. Every semester course consists of four theory courses and two laboratory courses ,each theory course carrying weight-age of 100 marks (4 credits) and lab course of 100 marks (2 Credits). However, in the final semester, there will be one project in lieu of one practical.

The School of Studies in Electronics & Photonics, Pt Ravishankar Shukla University, Raipur offers this course on its campus. It is designed to offer in depth knowledge of the subject starting from its basic concepts to the state of art technologies in use today. Students are also provided extensive laboratory training on the course content and the current requirements of industries and R and D. In the final semester every student has to undertake a project. Moreover the course structure intends to inculcate strong laboratory skills so that the student can take up independent projects which will help to be an entrepreneur. The students passed out from the revised course will serve as quality human resource to take up the state of art research work of the Department. This course provides exposure to the students to the technologies in-vogue and trains them to take up projects relevant to the industrial needs, the R& D activities and self-employment opportunities. Advanced papers are offered to the students in the areas of Communications, Photonics, Nano and Opto Electronic Devices, Laser Technology Digital Signal Processing, Embedded Systems, Power Electronics and Microcontrollers. In addition, the course caters to the requirements of providing complete exposure to NET/SET syllabus for Electronics formed by the U.G.C. The student after passing the M.Sc. course has many opportunities of employment, self-employment and higher studies. Department of Higher Education, Govt. of Chhattisgarh has declared Electronics as allied subject of Physics for recruitment of Assistant Professor in colleges. The students may opt for UGC – AICTE approved M.Tech. in Optoelectronics & Laser Technology in the department after M.Sc.

Employment Opportunities: - − Electronics and Telecommunication Industries. − I.T. Industries (India and Abroad). − Process and Manufacturing Industries. − Research and Development Laboratories. − Employment in Academic and Other Govt. Organizations.

Educational Opportunities: - − Higher studies in I.I.T, I.I.Sc., and CERE Pilani. For M.Tech. and Ph.D. − Research in Pt. Ravishankar Shula University or any other University. M.Phil, M.Tech. and Ph.D. − M.Tech. /M.E courses of Various Universities in India and Abroad. −Higher Studies Like M.S. in relevant discipline and Research Opportunities in foreign universities. .

Eligibility Criteria: A student shall be held eligible to the admission to the M.Sc. course provided he/she has passed the B.Sc. examination with Electronics or Physics as one of the core subjects in all the three years. of this University or the degree of any other statutory University recognized as equivalent. A student with Bachelor in Vocation in Renewable Energy Technology & Management degree of the University is also eligible for admission to M.Sc Electronics course.

1. Introduction to Programme

The learning outcomes based curriculum framework (LOCF) for M.Sc. Electronics is intended to prepare a curriculum which enables the Postgraduates to respond to the current needs of the industry and equip them with skills relevant for national and global standards. The framework will assist in maintaining international standards to ensure global competitiveness and facilitate student/graduate mobility after completion of M.Sc. Electronics programme. The framework intends to allow for greater flexibility and innovation in curriculum design and syllabus development, teaching learning process, assessment of student learning levels.

The LOCF for M.Sc. Electronics is prepared on the contours and curricular structure of CBCS provided by the UGC, and may be modified without sacrificing the spirit of CBCS and LOCF.

Programme Duration:

The M.Sc. Electronics programme will be of two years duration. Each year will be called an academic year and will be divided into two semesters. Thus there will be a total of four semesters. Each semester will consist of sixteen weeks.

Learning Outcomes

The key learning outcomes of our course are: knowledge and understanding of the concepts, logical as well as abstract thinking and analytical approach, experimental and computational skills, research methodology, values and positive attitude.

Post Graduates should have developed following qualities

1. Understanding of basic and advanced concepts in Electronics
2. Theoretical and practical skills along with problem solving ability
3. Logical and abstract thinking and analytical approach
4. Ability to apply acquired knowledge and skills to the new and unknown situations in order to develop new theories, experiments and technology
5. Understand the nature in a better way
6. Understand and appreciate the nuances and beauties in science education
7. Tenacity, hardworking and ability to work against odds
8. A new perspective to look at everything from 'Electronics' point of view
9. Get introduced to work environment at industrial scale and at research level
10. Awareness of the impact of Electronics in social, economic and environmental issues

11. Willingness to take up responsibility in study and work; confidence in his/her capabilities; and motivation for life-long learning.

Design of Programme:

The various courses of the programme are designed to include classroom teaching and lectures, laboratory work, project work, viva, seminars and assignments. Twenty percent of the total marks for each course will be awarded through Internal Assessment. Final examinations for two and four credit courses will be of two and three hours duration respectively while examinations for each laboratory-based course will be held over one day of six hours each for two credit courses respectively.

The teaching-learning will involve theory classes (Lectures) of one hour duration, tutorials and practical classes. The curriculum will be delivered through various methods including chalk and talk, PowerPoint presentations, audio, video tools, E-learning/E-content, lab sessions, virtual labs, simulations, optional experiments, field trips/Industry visits, seminars (talks by experts), workshops, projects, models, class discussions and other listed suggestive ways. The assessment broadly will comprise of Internal Assessment (Continuous Evaluation) and End Semester Examination. Each theory paper will be of 100 marks with 20% marks for Internal Assessment and 80% for End Semester examination. The internal Assessment will be through class test, quizzes, assignment, oral presentation and other suggested methods. Each practical paper will be of 100 marks.

Programme Structure:

The programme will consist of six-credit courses and four-credit courses. All six credit courses with practicals will comprise of theory classes (four credits) and practicals (two credits) . For theory or tutorial classes, one credit indicates a one hour lecture per week while for practicals one credit indicates a two-hour session per week. Each practical or tutorial batch will be of 12-15 students.

2. Learning Outcome-based Curriculum Framework in M.Sc.Electronics

The learning outcomes based approach implies that when an academic programme is planned, desirable learning outcomes are identified and considered in formulation of the plans. Course contents, learning activities and assessment types are designed to be consistent with the achievement of desired learning outcomes. The learning outcomes are in terms of knowledge, Professional attitude, work ethics, critical thinking, self-managed learning, adaptability, problem solving skills, communication skills, interpersonal skills and group works. At the end of a particular course/program, assessment is carried out to determine whether the desired outcomes are being achieved. This outcome assessment provides feedback to ensure that element in the teaching and learning environment are acting in concert to facilitate the nurturing of the desired outcomes. The expected learning outcomes are used as reference points that would help formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn help not only in curriculum planning and development, but also in delivery and review of academic programmes.

The overall objectives of the learning outcomes based curriculum framework are:

- Help formulate student attributes, qualification descriptors, program learning outcomes and course learning outcomes that are expected to be demonstrated by the holders of qualification.
- Enable prospective students, parents, employers and others to understand the nature and level of learning outcomes or attributes a graduate of a programme should be capable of demonstrating on successful completion of the programme of study.
- Maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility.
- Provide higher education institutions an important point of reference for designing teaching-learning strategies, assessing student learning level, and periodic review of programme and academic research.

2.1 **Nature and extent of the Programme in M.Sc. Electronics**

M.Sc. Electronics is a professional program which needs to develop a specialized skill set among the Postgraduates to cater the need of industries. In recent years, Electronics has made unprecedented growth in terms of new technologies, new ideas and principles. The research organizations and industries that work in this frontier area are in need of highly skilled and scientifically oriented manpower. This manpower can be available only with flexible, adaptive and progressive training programs and a cohesive interaction among the research organizations, academicians and industries. The key areas of study within subject area of Electronics comprise: Semiconductor Devices, Photonics, analog and digital circuit design, optical electronics Microprocessors & Microcontroller systems, Communication techniques, IoT and computation techniques for Electronics, computer coding/programming in high level languages etc.

The Choice- Based Credit System provides a framework within which there is flexibility in the design of courses and their content, simultaneously also providing the student a choice of the courses he/she wishes to study. The courses have assigned credits on the basis of teaching hours, which in turn is linked to course content and structure.

2.2 Aims of Master's Degree Programme in Electronics

The overall aims of the M.Sc. Electronics are:

- Provide students with learning experiences that develop broad knowledge and understanding of key concepts of Electronics and equip students with advanced scientific/technological capabilities for analyzing and tackling the issues and problems in the field of electronics.
- Develop ability in student's to apply knowledge and skills they have acquired to the solution of specific theoretical and applied problems in electronics.
- Develop abilities in students to design and develop innovative solutions for benefits of society, by diligence, leadership, team work and lifelong learning.
- Provide students with skills that enable them to get employment in industries or pursue higher studies or research assignments or turn as entrepreneurs.

3. Postgraduates Attributes in M.Sc. Electronics

Postgraduates Attributes form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The Postgraduate Attributes of M.Sc. Electronics are listed below:

PGA1. Scholarship of Knowledge: Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

PGA2. Critical Thinking: Analyze complex scientific/technological problems critically; apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

PGA3. Problem Solving: Think laterally and originally, conceptualize and solve scientific/technological problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.

PGA4. Usage of modern tools: Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex scientific/technological activities with an Poststanding of the limitations. The proposed course is expected to develop digital literacy among the students for using ICT in different learning situations. The students should be able to equip themselves with in depth programming

PGA5. Collaborative and Multidisciplinary work: Possess knowledge and Post standing of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

PGA6. Communication Skills and Team Work: The students are expected to develop effective and confident Communication skill after completion of the course. They will have an ability to work in a team as well as in isolation. Communicate with the scientific/technological community, and with society at large, regarding complex scientific/technological activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

PGA7. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously. The proposed course is designed to develop independent, coherent and decisive thoughts among the students that will ultimately develop competency in their lives.

PGA8. Ethical Practices and Social Responsibility: Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and a Post standing of responsibility to contribute to the community for sustainable development of society. After completion of the course, the students are expected to develop ethical and social responsibility as well. As a result, the students will be able to identify ethical issues, avoid unethical behavior such as fabrication, falsification or misrepresentation and misinterpretation of data.

4.0 Qualification Descriptors for Postgraduates in M.Sc. Electronics

A qualification descriptor indicates the generic outcomes and attributes expected for the award of a particular type of qualification. The learning experiences and assessment procedures are expected to be designed to provide every student with the opportunity to achieve the intended programme learning outcomes. The qualification descriptors reflect followings:

1. Disciplinary knowledge and Post standing
2. Skills & Ability
3. Global competencies that all students in different academic fields of study should acquire/attain and demonstrate.

5. Program Learning Outcomes for M.Sc. Electronics

The following program outcomes have been identified for **M.Sc. Electronics**

PLO1	Ability to apply knowledge of mathematics & science in solving electronics related problems
PLO2	Ability to design and conduct electronics experiments, as well as to analyze and interpret data
PLO3	Ability to design and manage electronic systems or processes that conforms to a given specification within ethical and economic constraints
PLO4	Ability to identify, formulate, solve and analyze the problems in various disciplines of electronics
PLO5	Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility
PLO6	Ability to communicate effectively in term of oral and written communication skills
PLO7	Recognize the need for, and be able to engage in lifelong learning
PLO8	Ability to use techniques, skills and modern technological/scientific/engineering software/tools for professional practices

6.0. M.Sc. (Electronics) Programme Details:

6.1 Programme Objectives (POs):

At the time of completion of the programme the student will able to develop extensive knowledge in various areas of Electronics. Through the stimulus of scholarly progression and intellectual development, this programme aims to equip students with excellence in education and skills, thus enabling the student to pursue a career of his/her choice. By cultivating talents and promoting all round personality development through multi-dimensional education a spirit of self-confidence and self-reliance will be infused in the student. The student will be instilled with values of professional ethics and be made ready to contribute to society as responsible individual.

6.2 Programme Specific Outcomes (PSOs):

At the end of the two year programme, the student will understand and be able to explain different branches of Electronics such as Communication Electronics, Optical Electronics, Circuit Design, Control Systems, Electronic Materials and Semiconductor Devices, Microprocessors, Digital Signal Processing, RF & Microwaves. The student will be able to execute a short research project incorporating techniques of Basic and Advanced Electronics under supervision. The student will be equipped to take up a suitable position in industry/academia.

These are given with each course in detail in Section IV.

7. Programme Structure:

The M.Sc. (Electronics) programme is a two-year course divided into four-semester. A student is required to complete 96 credits for the completion of course and the award of degree.

		Semester	*Semester*
Part-I	First Year	Semester I	Semester II
Part-II	Second Year	Semester III	Semester IV

8.0 Courses for Programme M.Sc. Electronics

Semester – I

The following shall be the scheme of examination for the course:

Code	Theory	Marks			Credits
		Theory	Internal	Total	
ELT 101	Paper I : Analog Integrated Electronics and Physics of Electronic Materials	80	20	100	4
ELT 102	Paper II : Digital Design and Applications	80	20	100	4
ELT 103	Paper III : Signals, Mathematical and Computational Methods in Electronics	80	20	100	4
ELT 104	Paper IV : Optical , Quantum and Organic Electronics	80	20	100	4

Code	Practical	Experiment	Viva	Internal	Max	Credits
ELP 105	1. Lab course "A" Analog Electronics"	60	20	20	100	2
ELP 106	2. Lab course "B" Digital Electronics"	60	20	20	100	2
	Total (Theory & Lab)				600	20

Total Marks for Semester I =600 & Credit = 20

Semester – II

Code	Theory	Marks			Credits
		Theory	Internal	Total	
ELT 201	Paper I Network Analysis and Synthesis	80	20	100	4
ELT 202	Paper II Microprocessor and C++ Programming	80	20	100	4

ELT 203	**Paper III** **Analog and Digital Communication Systems**	**80**	**20**	**100**	**4**
ELT 204	**Paper IV** **Electromagnetic Plane wave, Transmission lines and Microwave Devices**	**80**	**20**	**100**	**4**

Paper Code	**Practical**	**Experiment**	**Viva**	**Internal**	**Max**	**Credits**
ELP 205	**1. Lab course "C"** **Analog and Digital Communication Lab**	**60**	**20**	**20**	**100**	**2**
ELP 206	**2. Lab course "D" – 8085 Microprocessor Programming, Study Cards and Interfacing Lab**	**60**	**20**	**20**	**100**	**2**
	Total (Theory & Practical)				**600**	**20**

Total Marks for Semester II=600 & Credits=20

Semester – III

Code	**Theory**	**Marks**			**Credits**
		Theory	**Internal**	**Total**	
ELT 301	**Paper I (Code)** **Advance Microprocessors and Microcontroller (AMM)**	**80**	**20**	**100**	**4**
ELT 302	**Paper II** **Data Communication, Mobile and Wireless Communication**	**80**	**20**	**100**	**4**
ELT 303	**Paper III Photonics**	**80**	**20**	**100**	**4**
ELT 304	**Paper IV** **Power Electronics, Information Theory and Coding**	**80**	**20**	**100**	**4**

Code	**Practical**	**Experiment**	**Viva Voce**	**Internal**	**Max**	**Credits**

ELP 305	**Lab course "E" - - Optical Electronics, Transducer and Instrumentation Lab**	**60**	**20**	**20**	**100**	**2**
ELP 306	**2. Lab course "F" – 8086 Microprocessor Programming, Interfacing and "C++" Programming Lab**	**60**	**20**	**20**	**100**	**2**
	Total [Theory & lab]				**600**	**20**

Total Marks for Semester III = 600 & Credits=20

Semester IV

Code	**Theory**	**Marks**			**Credits**
		Theory	**Internal**	**Total**	
ELT 401	**Paper I Digital Signal Processing**	**80**	**20**	**100**	**4**
ELT 402	**Paper II (Code EL 402) Optical and Satellite Communication**	**80**	**20**	**100**	**4**
ELT 403	**Paper III (Code EL 403) Automatic Control System and Artificial Neural Network**	**80**	**20**	**100**	**4**
ELT 404	**Paper IV (Code EL 404). Embedded Systems , Microcontrollers and Advanced Instrumentation**	**80**	**20**	**100**	**4**

Code	**Practical**	**Experiment**	**Viva**	**Internal**	**Max**	**Credits**
ELP 405	**1. Lab course "G" - Optical Communication and 8051 Programming Lab**	**60**	**20**	**20**	**100**	**2**

ELP 406	**2. Project & Seminar**	**80**	**20**	**-**	**100**	**2**
	Total [Theory & lab]				**600**	**20**

Total Marks for Semester IV = 600 & Credits=20

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SYLLABUS PRESCRIBED FOR THE EXAMINATION OF

M. Sc. Electronics (Semester System)

July - Dec 2020

Semester – I

Electronic devices play a crucial role in today's societies and in the physical sciences where they originated. Contemplating that in just a few decades, technology guiding electrons and photons has emerged that makes possible oral and visual communication between peoples on opposite sides of the planet is truly a triumph of science and technology. Present day information technology is based on the physical properties of semiconductors, in particular the functioning of the transistor. The intension of this paper is to take the students from the principles of quantum mechanics through the quantum theory of metals and semiconductors all the way to how devices are used to perform their duties in electric circuits

ELT 101 Paper 1 - Analog Integrated Electronics and Physics of Electronic Materials
Max. Marks: 80, Min. Marks: 16

Course Objective:

1. To provide basic knowledge and concepts of Semiconductor materials and devices.
2. The students will be able to comprehend the drift and diffusion mode of electrical transport through semiconductor devices.
3. To understand the basic crystal structure and different types of semiconductor materials and physics of semiconductor devices
4. To be able to plot the current voltage characteristics of Diode, Transistors and MOSFETs
5. The student should be able to explain and calculate small signal parameters of semiconductor devices.
6. To develop understanding of Analog Devices starting with ideal Op Amp model and assessing the practical device limitations covering the direct and cascading approach and understand not only linear applications but also design of non-linear applications

Course Outcomes: At the end of the course, a student will be enable to

1. Ability to apply basic concepts of Inorganic and Organic Semiconductor materials for electronic device application in modern electronic industry.
2. Describe the behavior of semiconductor materials
3. Understand and appreciate the synergy between quantum mechanics and semiconductor materials, which will eventually lead to a general framework of concepts applicable across a variety of semiconductor devices.

4. Detailed knowledge of various classifications and applications of **Multistage and Feedback Amplifiers**
5. Explain the concepts of feedback and construct feedback amplifiers and oscillators.
6. Holistic view of the Integrated circuit fabrication
7. Understand the fundamentals and areas of applications for the Integrated Circuits.
8. Analyze important types of integrated circuits of day-to-day requirements.
9. Emphasis on Operational amplifier and its applications such as integrator, differentiator Multivibrator, Schmitt trigger and Triangular wave generator.

Student should be allowed to use Programmable Scientific Calculator in Examination hall

Unit I – Physics of Electronic Materials

Crystal structures, classification of crystals, lattices, reciprocal lattice, Miller indices, amorphous materials. Lattice Vibration and Phonons, Bloch theorem, Phonons, Nearly Free electron theory. Dielectric properties, electronic polarisability, Clausius Mossotti relation, dielectric Constant static and frequency dependent. Introduction to Fermi Dirac and Bose Einstein Statistics.

Semiconductors: Direct and indirect band gap methods to determine the Forbidden gap, mobility and conductivity, intrinsic and extrinsic semiconductor, Impurities, carrier concentration, electrical properties of Ge and Si, experimental methods to study the electrical parameters, Drift and Diffusion, Hall effect, electrons and phonons in semiconductors.

Unit II –Quantum Electronics and Transistor model

Uncertainty principle, Experiments on duality, Schrodinger's equation and its applications to square well potential, square potential barrier (1D).

Infinite array of potential wells, Kronig-Penny model, Barrier penetration, applications to tunnel diode, Josephson effect, Perturbation theory and its applications, Scattering.

Transistor at low frequency - Analysis of a transistor amplifier circuit using h- parameter, Emitter follower, comparison of transistor amplifier configurations, Miller's Theorem and its dual, cascading transistor amplifiers, High Electron Mobility Transistor (HEMT). Basics of Transistor biasing and stabilization

Unit III – Multistage and Feedback Amplifiers Analysis

Transistor at high frequencies, Hybrid – pi model, gain bandwidth product.

Multistage Amplifiers Analysis - Introduction, frequency response of an amplifier, band pass of cascaded stages, Coupling scheme - RC coupled, transformer coupled and direct coupled amplifiers, low frequency response of RC coupled stage, effect of emitter bypass capacitor on low frequency response, high frequency response of two cascaded CE transistor stages.

Feedback Amplifiers – Basic concept, types of feedback method of analysis of a feedback amplifier.

Unit IV – Operational Amplifier, Characteristics and Applications

Basic operational amplifier and its characteristics, characteristics of ideal and practical operation amplifier, parameters of operational amplifier, measurement of operational amplifier parameters, frequency response of operational amplifier,

Linear and Nonlinear Circuits analysis using operational amplifier - Inverting and Non inverting Amplifiers, Differentiator, Integrator, Voltage to current converter, Instrumentation amplifier, Sine wave Oscillator, Low pass and band – pass filters, Comparator, Multivibrator and Schmitt trigger, Triangular wave generator, Log and Antilog amplifiers

Unit V - Integrated Circuit Fabrication and Characteristics

IC fabrication – crystal growth, epitaxy, oxidation, lithography, doping, etching, isolation methods, metallization, bonding, MOS technology and VLSI, scaling of MOS devices, NMOS and CMOS structures and fabrication, Characteristics of MOS transistors and threshold voltage, NMOS and CMOS inverters, Charge-Coupled Device (CCD) – structure, charge storage and transfer, Basics of VLSI design, stick diagrams, Layout design rules.

TEXT BOOKS

1. Physics of Electronic Materials: Principles and Applications Jørgen Rammer Cambridge University Press,
2. Electronic Devices and Circuit Theory, 9th ed. Boylestad & Nashelsky PHI
3. Microelectronics - Jacob Millman, Arvin Grabel, Tata Macgraw-Hill
4. Physics of Semiconductor Devices: Shur PHI
5. A Textbook of Applied Electronics (M.E.) Sedha R S, S. Chand Pub.
6. Physics of Semiconductor Devices: Sze
7. Ramakant A.Gayakwad, 'OP-AMP and Linear IC's', Prentice Hall
8. Introduction to Quantum Mechanics J. Griffiths David Pearson
9. Quantum Mechanics Statistical Mechanics & Solid State Chattopadhyay D. and Rakshit P.C. S Chand & Company
10. Integrated electronics – Analog and digital circuits and systems Jacob Millman, Cristos, C. Halkias, Tata Macgraw-Hill

ELT-102 Paper 2 - Digital Design and Applications

Max. Marks: 80, Min. Marks: 16

Max. Marks: 80, Min. Marks: 16

Student should be allowed to use Programmable Scientific Calculator in Examination hall

Course Objective:

The course offers students to learn how to minimize the Boolean expression by advanced digital design techniques, programmable logic devices; to understand analysis, designing and reduction techniques for combinational and sequential circuits and introduce to the memory organization and programmable logic devices.

Course Outcomes: After successful completion of the course student will be able

1. To learn how to design digital systems, from specification and simulation to construction and debugging.
2. Develop a digital logic and apply it to solve real life problems.
3. Analyze, design and implement combinational and sequential logic circuits.
4. Classify different semiconductor memories.
5. Analyze, design and implement sequential logic circuits.
6. To learn techniques and tools for programmable logic design.
7. To understand the limitations and difficulties in modern digital design, including wiring constraints, high-speed, etc.
8. Understand IC characteristics, digital logic families and able to optimize the logic functions using K-map.
9. Able to design and analyze the shift registers, counters and A/D & D/A converters, digital semiconductor memories and programmable logic devices
10. Through the practical assignments, experience will be achieved from both using tools as well as designing their own system.

Unit I - Basic Logic Circuit

Introduction of basic gates, universal gates, number systems and codes, Boolean algebra, switching characteristics of semiconductor devices, logic gate characteristics - speed of operation, power dissipation , figure of merit, fan in, fan out, noise margin. Logic families - RTL, DTL, TTL, ECL interfacing, ECL and TTL, MOS logic - MOSFET NAND and NOR gates, CMOS inverters, CMOS - NAND and NOR gates, interfacing CMOS and TTL, inter facing CMOS and ECL, comparison of logic families.

Unit II - Combinational Logic Design

Simplification of Boolean algebra using K-map, minterm and maxterm, design of binary adder, subtractor , digital comparator, parity generator/checkers, priority encoder, BCD to 7 - segments decoder, multiplexer , multiplexer tree, demultiplexer and demultiplexer tree.

Unit III - Sequential Circuit Design

Excitation table of flip flops – S - R, J-K, Master-Slave – JK, D and T flip-flops, clocked flip flop design – conversion of one form of flip flop to another type.

Analysis of clocked sequential circuits - State equation, state table, state diagram, state input equations, analysis with - flip flops, JK flip flops and T flip flops.

State reduction and assignment, design procedure – synthesis using D flip flops, JK Flip flops and T flip flops.

Unit IV - Registers, Counters and A/D, D/A converters

Registers - Shift registers, application of shift registers, serial to parallel converter, parallel to serial converter.

Counters - Ring counter, modulo-n-counter, synchronous counter –ripple counter (binary, BCD) and up-down counter, asynchronous counters - ripple counter (binary , BCD) and up-down counter. Other counters – counter with unused states, ring counter, Johnson counter.

A/D, D/A Converters – D/A weighted register type, R/2R ladder type, D/A converter specifications, A/D converters - successive approximation type, parallel comparator, dual slop ADC using voltage to frequency conversion and frequency to time conversion.

Unit V - Memory and Programmable Logic

General Memory Operation; CPU-Memory Connections; ROM: Architecture, Timing, Types: MROM PROM, EPROM, EEPROM, Flash Memory;

RAM: Architecture & Operation of SRAM, DRAM; Memory Expansion; Introduction to Programmable Logic Devices (PLDs): PLA, PAL, GAL, CPLD, FPGA. Analysis and Design of digital circuits using HDL.

TEXT BOOKS

1. T. L. Floyd & R. P. Jain, Digital fundamentals, Pearson Education India, New Delhi.
2. M. Moris Mano, Digital Design, PHI Learning Pvt. Ltd. New Delhi.
3. A. P. Malvino & D. P. Leach, Digital Principals and Applications, Tata McGraw Hill, New Delhi.
4. A. P. Malvino & J. A. Brown, Digital Computer Electronics, Tata McGraw Hill, New Delhi.
5. A. Anand Kumar, Fundamentals of Digital Circuits, PHI Pvt. Ltd. New Delhi.
6. R. J. Tocci & N. S. Widmer, Digital Systems, Pearson Education India, New Delhi.
7. John. M. Yarbough, Digital Logic: Applications and Design, Thomson Brooks/Cole, Boston.
8. John F. Wakerly, Digital Design Principles and Practices, Pearson Education India, New Delhi.
9. M. Moris Mano, Computer System Architecture, PHI Pvt. Ltd. New Delhi.

ELT 103 PAPER 3 – Signals, Mathematical and Computational Methods in Electronics

Max. Marks: 80, Min. Marks: 16

Course Objectives:

1. To improve and summarized the Signals, mathematical and computational techniques among the students.
2. To familiarize the students with the classification of continuous time signals and systems and their analysis
3. To enable the students to understand the concepts of Fourier series and Fourier transform probability theory, and state variable approach
4. To introduce mathematical and computational methods used in Electronics.

Course Outcomes: On completion of this course, student will be able to

1. Use mathematics as a tool for solving/modeling systems in electronics
2. Understand about various types of signals and systems, classify them, analyze them, and perform various operations on them,
3. Understand use of transforms in analysis of signals and system in continuous and discrete time domain.
4. Understand basic concept of probability theory; differentiate between discrete and continuous random variables, Random and Markov processes
5. Able to solve ordinary differential equations using Laplace Transform, special function and numerical methods; numerical differentiation and integration.
6. Understand different techniques for simulation & modeling of electronic circuits

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Student should be allowed to use Programmable Scientific Calculator in Examination hall.

UNIT I - Signal Analysis

Introduction – Classification of signals and systems, some ideal signals, energy signal, Power signals, energy and power spectral densities.

Fourier Series, Complex Fourier Spectrum, The Fourier Transform, Continuous Spectrum, Fourier Transform involving Impulse Function, Properties of Fourier Transform, Fourier Transform of Periodic Functions, Convolution, Sampling Theorem.

UNIT II – Linear Systems and State Variables Techniques

Introduction, System Function (Transfer Function), Distortion less Transmission, Paley-Wiener criterion, Correlation, Autocorrelation

State Variables Techniques - State variable concepts, form of the state equations, time domain and frequency domain solution of state equations, state transition matrix, state equations for networks, state equations from transfer functions.

UNIT- III- Probability and Random Signal Theory
Introduction, set theory, Introduction to Probability, Conditional Probability Statistical Impedance, Baye's Theorem, Random variables, Discrete and Continuous Random Variables, Joint Distributions, Characteristics of Random Variables, Binomial, Poisson and normal Distributions, Uniform and other Distributions, Random and Markov Processes.

UNIT IV - Mathematical Methods
Laplace Transform – Definition, transform of elementary function, properties of Laplace transform, convolution theorem, application to differential equation, simultaneous Linear equations with constant coefficients, unit step and unit impulse function
Special Function - Bessel equations, recurrence formula, expansion for Jo and J1, values of J1/2, generating function for Jn(x), equation reducible to Bessel equation

UNIT V – Computational Methods
Numerical Differentiation and Integration
Finite Differences, Derivatives using Forward, Backward and Central Difference Formulae, Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's rules, Weddle's rule.
Numerical methods for Solution of Ordinary Differential Equation-Picards Method ,Taylor Series Method , Eulers and Modified Eulers methods, Runge and Runge Kutta Methods , Newton- Raphson Method, Gauss Elimination Method Predictor and Corrector Method.

TEXT BOOKS
1. Communication System- Analog and Digital - R.P.Singh & S.D. Sapre TMH.
2. Signal and System - Nagrath, Sharan and Ranjan. Mcgraw hill Publishing
3. Signal and Systems - Rodger E. Ziemer. Continuous and Discrete 2nd ed.Maxwell Macmillan Int. Edition,
4. Higher Engineering Mathematics - B.S. Grewal, Khanna Publications
5. Numerical Methods - Kandaswami,Thilagavathi and Gunavathi, S.Chand & Co.
6. An introduction to Numerical methods: A MATLAB approach by Abde/Wahab Kharab, Ronald B Guenther
7. Optoelectronics and Photonics Engineering Dutta, Partha S. Springer

ELT 104 Paper 4-Optical, Quantum and Organic Electronics

Max. Marks: 80, Min. Marks: 16

Course Objectives
1. Introduction: how light is generated, outline and need for the laser, scope of course.
2. Interaction of EM Radiation with Matter: two-level system, spectral line-shapes, finite lifetime, Doppler effects, absorption and decay processes, spontaneous and stimulated emission.
3. Amplification Criteria: amplification conditions, Lorentzian line-shapes, Gaussian line-shapes, simple cavity model.

4. laser use of Fabry-Perot, laser gain conditions, laser modes, homogeneous broadening, inhomogeneous broadening, control of modes, examples of lasers.
5. to study light sources, photo-detectors, and organic materials. Laser namely Ruby Laser, He-Ne laser, Ar-ion laser, Co2 laser, Solid State Laser, and Nd-YAG laser.
6. To introduce Plasma, LED and LCD devices.
7. To get acquainted with the Electro-Optic Effect, Acousto-Optic Effect, and Magneto-Optic Effect

Course Outcomes

On completion of this course a student should be able to demonstrate understanding of and be able to solve problems on:

1. absorption and spontaneous and stimulated emission in two level system, the effects of homogeneous and inhomogeneous line broadening, and the conditions for laser amplification,
2. operations of the Fabry-Perot cavity including mode separation and line-widths, laser gain conditions, gain clamping in both homogeneous and inhomogeneous line broadened media,
3. the four-level laser system, the simple homogeneous laser and its output behaviour and optimal operating conditions,
4. spectral properties of a single longitudinal mode, mode locked laser operation, schemes for active and passive mode locking in real laser system,
5. operations and basic properties of the most common laser types, He-Ne, Argon-ion, and carbon-dioxide, ruby, titanium sapphire, neodymium YAG and glass, knowledge of other main laser types,
6. Develop the ability to understand the working principle of display devices.
7. Comprehend and analyse the light sources and detectors.
8. To learn various optical sources, LED/LASER structures, receivers (PIN, APD), and noise performance.
9. Understand the basic concept of Organic electronics.

Student should be allowed to use Programmable Scientific Calculator in Examination hall

Unit I - Quantum Electronics

Coherent light sources, basic principle of lasers, laser pumping, stimulated emission, light amplification, threshold condition, Einstein's coefficient, laser rate equations for two, three and four level laser systems, variation of power around threshold, rectangular cavity, open plane resonator, mode locking and Q-switching of lasers.

Unit II - Applications of Quantum Electronics

Types of Lasers - Ruby Laser, He-Ne laser, Ar-ion laser, Co2 laser, Solid State Laser: Host material and its characteristics, doped ions Nd:YAG laser,
Liquid laser: Dye laser, Semiconductor laser
Laser Applications - Laser in manufacturing, laser cutting of material, laser marking, laser transmitter, measurement of distance through Laser

Unit III - Optical Display Devices

Optical Display Devices - LED- Basic principle of operation, radiative recombination process, the spectrum of recombination process, the internal quantum efficiency, double hetrostructure, response time of LED, carrier configuration and modulation bandwidth, edge emitting LED, LED design. Liquid Crystal Display - construction, basic principle of emission, Plasma Display- construction, basic principle of emission

Unit IV - Photo Detectors and Organic Electronics

Photodiodes- General Principles, quantum efficiency, silicon P-N photodiodes, hetrojuncton photodiodes, Schottkey barrier diode, P-I-N photodiodes, avalanche photodiodes, and phototransistors.

Introduction to Organic Electronics, Organic versus Inorganic solids, Molecular materials, Organic Semiconductors, Electronic states in conjugated molecules, Conjugated polymers, Basics of OLED

Unit V - Electro-Optical Devices

Nonlinear Optics: Origin of nonlinearity, susceptibility tensor, phase matching, second harmonic generation, methods of enhancement, frequency mixing processes, nonlinear optical materials.

Electro-Optic Effect - Kerr effect, Pockels effect, Farady effect, Electro-Optic Modulator- Electro-optic phase modulator, electro-optic amplitude modulator, kerr modulator

Acousto-Optic Effect - Raman-Nath and Bragg Diffraction, Raman-Nath acousto optic Modulator, bragg modulator, acousto-optic modulator.

Magneto-Optic Effect - Faradays effect, magneto-optic modulator

TEXT BOOKS

1. Optical Electronics - Ghatak Thyagarajan, University Press
2. Optoelectronics - An Introduction - J.Wilson and J.F.B. Hawkes, PHI Publication.
5. Semiconductor Optoelectronic Devices, 2nd ed. **Bhattacharya PHI**
6. Pope and Swenburg, Electronic Processes in organic crystals and polymers, 2 nd Ed., Oxford
7. Optoelectronics & Photonics Principles and Practices S.O. Kasap Pearson
9. Optical Processes in Solids Mark Fox Oxford Press
10. Optoelectronics and Optical Fiber Sensors A B Maity PHI

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SYLLABUS PRESCRIBED FOR THE EXAMINATION OF
M. Sc. Electronics
Jan-June 2021
Semester-II
Course Code: ELT 201 Paper - I
Course Name: Network Analysis and Synthesis
(Credits: Theory-04, Practicals-02)
Max. Marks: 80, Min. Marks: 16

Paper 1-Network Analysis and Synthesis

Course Objectives:

1. To equip the students with rigorous theoretical and practical knowledge to analyze and synthesize networks.
2. To analyze the given electronics circuit/network problems using mesh/ loop methods, network theorems and graph theory.
3. To introduce the basic knowledge of network analysis with initial conditions, magnetically coupled circuits, Waveform synthesis and network transfer functions.
4. To analyze the one port, two-port networks.
5. To introduce basic concept of network synthesis.

Course Outcomes:

1. Apply the knowledge of basic circuital law and simplify the network using reduction technique.
2. Analyze the circuit using Kirchoff's law and network theorem.
3. Apply the knowledge of various circuit/network analysis techniques such as mesh analysis, nodal analysis, and network theorems to investigate the given network.
4. Able to solve the networks using graphical approach.
5. Able to analyze the given network by transforming from time domain to S domain.
6. Express the periodic sources using waveform synthesis and analyze the network.
7. Design and analyze one port, two-port networks.
8. Comprehend the basic concepts and synthesis the RL, RC and LC networks using Foster and Cauer forms.

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Programmable Scientific Calculator in Examination hall.

2. Special graph paper viz. Polar graph & Semi log graph papers should be provided to the students in the examination hall.

Unit I - Mesh and Node Analysis and Network Theorems

Mesh and Node Analysis - Kirchhoff's laws , Star and Delta conversion, source transformation, mesh and node analysis of electric circuits, response of the network by differential equation and Laplace transform method ,initial conditions in the network.
Network Theorems - Thevenin's theorem, Norton's Theorem, Superposition, Millman theorem, Maximum power transfer theorem, and Reciprocity theorem, Tellegen theorem and Substitutions theorem .

Unit II – Coupled Circuit, Waveform Synthesis and Graph Theory Coupled Circuit – Dot convention and magnetic coupling
Waveform Synthesis – Standard signals, unit step function, ramp function, impulse function, initial and final value of f(t) from F(s), the convolution integral.
Graph Theory - Concept of a network graph, twigs and links, trees, co trees ,formation of incidence matrix ,cut-set matrix, tie-set matrix and loop currents, analysis of networks ,network equilibrium equation ,duality, network transformation

Unit III - Network Function and Frequency Response Plots
Network Function - Network function for one port and two port, the calculation of network functions - ladder networks and general networks, pole and zero of network functions, restrictions on pole and zero locations for driving point functions ,restrictions on pole zero locations ,time domain behavior from the pole and zero plot, stability of active networks.

Frequency Response Plots- Magnitude and Phase plots, Root Loci, Bode Diagrams, Nyquist- Stability Criterion

Unit IV -Two Port Network Analysis
Relationship of two port variable , Z-parameters, Y- parameters, Hybrid parameters, ABCD parameters, conditions of reciprocity and symmetry, inter-relationship between parameter of two port network, different types of interconnections of two port networks.

Unit V- Network Synthesis
Concept, Procedure of Synthesis, Reactive Networks, Properties of Expressions of Driving point Admittances of L-C Networks, Pole-Zero Interpretations in L-C Networks. L-C Networks Synthesis-Foster's Canonic Form (First and Second Foster form), Significance of Elements in the Foster form, Cauer Canonic form of Reactive Networks-First and Second form of Cauer Networks, Applicability of Foster and Cauer forms, R-L & R-C Network Synthesis by Foster form, Identification of foster form , Identification of Admittance, R- L& R-C Network Synthesis by Cauer form, Identification of Admittance Function in Cauer form, Determination of end elements in Foster and Cauer R-L & R-C Networks.

TEXT BOOKS
1. Networks and System - D. Roy Choudhary, New Age International
2. Network Analysis: M.E. Van Valkenburg.PHI
3. Circuit theory (analysis and synthesis) - A. Chakrabarti, Dhanpat Rai and co.
2. Network Synthesis: M.E. Van Valkenburg.PHI

Course Code: ELT 202 Paper II:
Course Name: Microprocessor and C++ Programming
(Credits: Theory-04, Practicals-02)
Max. Marks: 80, Min. Marks: 16

Course Objectives:

1. To introduce the basic idea about architecture and the working principle of microprocessor 8085.
2. Students will get acquainted with the assembly language programming using the instruction set of microprocessor 8085.
3. To introduce Programmable peripheral interfacing devices such as Programmable keyboard /display interface 8279, Programmable peripheral interface 8255,Programmable interval timer - 8253, Programmable interrupt controller - 8259,Synchronous data communication device - 8251, DMA Controller 8257 with microprocessor 8085.
4. Understand the basic concepts of object-oriented programming with C++.

Course Outcomes

1. Comprehend and analyze architecture of 8085 microprocessor, its addressing modes, and instruction set.
2. Comprehend the memory organization of 8085 microprocessor.
3. Showcase the skill, knowledge and ability of programming using instruction set.
4. Work with microcontroller and interfaces including general purpose input/ output and timers, interrupt controller, DMA controller, Keyboard/display.
5. Comprehend and use peripheral serial communication and the concepts of interrupts in 8085
6. Understand the object oriented programming language C++ and apply the programming skills.

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

Unit I - Micro-Computer System & 8085 Microprocessor Architecture

Microcomputer System & its operation- Overview of a basic Microcomputer structure and operation, Ideal microprocessor, Microprocessor evolution and types, Microprocessor initiated operation & Bus organization, internal data operation & registers, peripheral initiated operation.

Memory- Memory organization, memory map, memory & instruction fetch, types of memory. Interfacing Devices - Tri-state devices, buffer, decoder, encoder, latch.

Microprocessor Architecture - Introduction to 8085 Microprocessor, pin diagram & its function, bus timing, Demultiplexing of address & data Bus, generation of control signals, microprocessor architecture of 8085, decoding & execution of an instruction, memory interfacing, timing diagram of memory, read & write cycle.

Unit II - Instruction Set & Programming of 8085, Stack & Subroutines

Instruction classification, instruction format, addressing modes, basic instructions and simple programming ,Additional Instructions - DAA, DAD, LHLD.SHLD, PCHL, STC, XCHG,

XTHL and programming, Code Conversion - BCD to Binary, Binary to BCD, Binary to ASCII, ASCII to Binary.
Stack & Subroutines - Concept of stack, PUSH/POP instruction, illustrative example, Concept of subroutines, call & return instruction, conditional call & return instruction, advanced subroutines concept.

Unit III - Counters, Time Delay, Interrupts & Interrupt Controller
Counters and Time Delay -Time delay using one register, Time delay using a register pair, flow chart & program for a hexadecimal counter and modulo 10 counter, delay calculations.
Interrupts - Interrupts of Intel 8085, hardware and software interrupts, vectored/non vectored interrupts, maskable/non- maskable interrupts, Interrupts priority concept, DI,EI, RIM, SIM instructions, pending interrupts.
Programmable Interrupt Controller - Architecture of 8259, initialization command words (ICW's), operational command words (OCW's), 8259 interrupts mode, simple initialization program for 8259.

Unit IV - Data Transfer & Peripheral Interfacing Devices, Co-processor

Format of data transfer, modes of data transfer, microprocessor controlled data transfer, peripheral control data transfer, peripheral I/O instruction, serial I/O lines, SOD and SID.
Programmable Peripheral Interfacing Devices - Programmable keyboard / display interface – 8279, Programmable peripheral interface – 8255, Programmable interval timer – 8253, Programmable Interrupt controller – 8259, Synchronous data communication device – 8251, DMA Controller 8257, RS 232 interface. Numeric co-processor 8087

Unit V- Object Oriented Programming
Principles and Basic concepts, OOPs languages, Application of OOPs, Simple programming in C++, Tokens, expressions and control structures - Tokens, keyword, identifiers and constants, declaration of variables, operators in C++, manipulators, control structure.
Functions in C++ - main function, function references, return references, default arguments and constant arguments. Classes and Objects- C structures revisited, specifying class, C++ program with classes, arrays within Classes, memory allocation of objects, arrays of objects,
returning objects, pointer to members, local classes.

TEXT BOOKS

1. Microprocessor Architecture Programming - Ramesh S. Gaonkar & Application with 8085/8080 Penram Int. Pub2

2. 0000 to 8085: Introduction to Microprocessors for Engineers and Scientists,

2nd ed. Ghosh & Sridhar PHI

3. Fundamentals of Microcomputer & Microprocessor r - B.Ram, Dhanpat Roy Pub.

4. Object Oriented Programming E - Balaguruswamy with C++ Second Edition

5. PROGRAMMING IN C++ P.B.MAHAPATRA, S Chand & Co

Course Code: ELT 203 Paper III
Course Name: -Analog and Digital Communication Systems
(Credits: Theory-04, Practicals-02)
Max. Marks: 80, Min. Marks: 16

Aim and objective: This course will help students to get familiarize with core fundamental communication concepts relevant in field of Analog and Digital arena. . It will also help to gain good understanding of application of communications in day to day real world with following objectives:.

1. The fundamentals of basic communication system, types of noise affecting communication system and noise parameters.
2. To help to understand the principle of analog and digital communication. Need of modulation, modulation processes and different analog and digital modulation techniques with generation and detection methods, transmitter, and receiver systems in detail.
3. Need of sampling and different sampling techniques.
4. Generation and detection of pulse modulation techniques and multiplexing.
5. To introduce the knowledge of the Monochrome and Colour Television system.

Learning Outcomes

After successful completion of the course student will be able to

1. Understand different blocks in communication system and how noise affects communication using different parameters.
2. Distinguish between different amplitude modulation schemes with their advantages, disadvantages and applications.
3. Analyze generation and detection of FM signal and comparison between amplitude and angle modulation schemes.
4. Identify different radio receiver circuits and role of AGC.
5. Sample analog signal and recover original
6. Compare and contrast advantages, disadvantages and limitations of analog and digital communication systems
7. Understand the fundamental concepts of television transmitter and receiver systems, the transmission of video signals and importance of television standards to effectively work with broadcasting applications, trouble shooting of television systems.
8. Understand different color television systems used worldwide and its compatibility.

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

Unit I Radiation and Propagation of Waves - Electromagnetic Radiation –Effect of environment, Propagation of waves –Ground Wave and Sky-wave Propagation – The ionosphere – Space waves – Tropospheric scatter propagation – Extraterrestrial communications

Introduction to Communication Systems -Block diagram of communication system –

Transmitter, Receiver, Modulation, Bandwidth requirements

Noise - Source of Noise, External Noise –Atmospheric Noise, Extra Terrestrial Noise, Industrial Noise, Internal Noise-Shot Noise, Resister or Johnson Noise ,Calculation of noise in Linear Systems, Noise Bandwidth, Power, Noise Temperature, Noise in Two Port Networks, Noise Figure, Cascaded stages, Measurement of Noise Figure, Signal in presence of Noise, Narrowband Noise.

Unit II – Amplitude Modulation System

Amplitude Modulation - Frequency spectrum of AM wave, Representation of AM wave, Power relation in AM wave, Single side band techniques – Suppression of carrier, suppression of side bands, vestigial side band,

Transmitters - Classification of radio transmitter, AM radio transmitter, Generation of AM -Transistor as AM Generator, balanced modulator, filter method, phase shift method, third method.

Receivers – Classification of radio receiver, basic function of AM receiver, tuned radio frequency receiver, super heterodyne receiver, AM demodulation – RC demodulator, square law demodulator. Noise in Amplitude Modulated Systems, Comparison of various AM systems,

Unit III – Angle Modulation System

Angle Modulation – Frequency modulation, analysis of FM waveform, frequency spectrum, Bessel function, Narrowband FM and Wide Band FM, Phase modulation

FM Modulators and Transmitters - Method of frequency modulation – Direct method – reactance modulator (FET and varactor diode method), Indirect Method, pre-emphasis and de-emphasis

FM Demodulators and Receivers – Super heterodyne FM receiver – block diagram, amplitude limiter, FM demodulator –phase discriminator, ratio detector, PLL demodulator. Comparison of AM, FM and PM, , frequency division multiplexing(FDM).

Unit IV - Pulse Modulation System

Pulse Amplitude Modulation - Natural Sampling, flat top sampling, equalization signal recovery to holding, PAM modulator and demodulator. Pulse time modulation (PTM)-Generation of PTM signals, PTM modulator and Demodulator, time division multiplexing (TDM).

Pulse Code Modulation- Quantization of signals, quantization error, pulse code modulation (PCM), companding, Bandwidth of PCM System, Noise in PCM System, Differential pulse code modulation, Delta modulation, Adaptive Delta modulation.

Digital Modulation Techniques - Introduction, Binary Phase Shift Keying (BPSK), Differential Phase Shift Keying (DPSK), Quadrature Phase Shift Keying (QPSK), Quadrature Amplitude Shift Keying (QASK) and Binary Frequency Shift Keying (BFSK).

Unit V – Monochrome and Colour Television

Elements of a TV System - Concept of Picture and sound transmission and reception, Flicker, Composite Video Signal, signal transmission and Channel bandwidth, Monochrome picture tube, Television Camera tube - Vidicon and CCD. Monochrome TV transmitter and receiver (Block Diagram), Essentials of Colour TV - Three Colour theory, Luminance, Hue and saturation, Triniton Colour Picture tube, Block diagram of Colour TV transmitter and receiver, PAL Colour TV System. CCTV, HDTV, CATV and DTH, Concepts of Home Theatre

TEXT BOOKS

1. Principles of Communication Systems - Taub & Schilling, TMH
2. Principles of Communication Systems - George Kennedy, TMH
3, Communication System- Analog and Digital - R.P.Singh & S.D. Sapre TMH
4. Radio Engineering - G. K. Mithal G.K. Pub.
5. Monochrome and Colour Television - R.L. Gulati, New Age International, Wiley Eastern Ltd. New Delhi.
8. Advanced Electronic Communication Systems: Tomasi PHI
9. Television Engineering – A.M. Dhake, TMH
10. Electronic communication, Roddy and Coolen, PHI, New Delhi,

Course Code: ELT 204 Paper IV

Course Name: Electromagnetic Plane Wave, Transmission Lines and Microwave Devices

(Credits: Theory-04, Practicals-02)

Max. Marks: 80, Min. Marks: 16

Aim and objective

1. To introduce the basic concepts of electromagnetic plane wave, transmission lines and antennas
2. To teach different types of waveguide, components and understand the distribution of electromagnetic fields within waveguides using Maxwell's equations.
3. To understand the importance of microwave components, circuits and applications.
4. To comprehend operational principles of microwave sources and to characterize microwave networks.
3. To design and analyze various passive and active microwave devices and circuits.

Learning Outcomes

1. Understand the uniform plane wave, its reflection and propagation in free space, lossless and lossy dielectric
2. Obtain solutions to transmission line equations with characteristic impedance, input impedance and propagation constant.
2. Able to solve the numerical problems of lossy, lossless and distortion less transmission line.
3. Design and interpret the impedance matching transmission line sections using single stub, double stub and LC sections using Smith Chart.
5. Analyze the field components of different waveguides and planar transmission lines based on various modes of E and H field.
6. Understand the working principle of operation of microwave sources like Klystron, Magnetron and microwave measurement techniques
7. Developed understanding of Microwave semiconducting and avalanche transit time devices.

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

UNIT I - Electromagnetic Plane Wave

Electromagnetic Plane Wave - Electron motion in electric field , electron motion in magnetic field , electron motion in electromagnetic field, electric and magnetic wave equations, Maxwell equation, Poynting theorem, uniform plane wave and reflection, uniform plane wave propagation in free space and lossless dielectric, plane wave propagation in lossy media, Ionospheric propagation, conductors and dielectrics, skin depth, polarization, phase velocity and group velocity.

UNIT II - Transmission Lines and Antennas

Transmission Line - Basic equation , reflection and transmission coefficient , standing wave and standing wave ratio , line impedance and admittance, Determination of characteristics impedance, Fundamental of Smith Chart, Impedance Matching: Single and Double Stub Matching, microwave Coaxial Connectors.

Antennas – The Radiation mechanism, Current and Voltage distribution, Antennas gain, Antenna resistance, Bandwidth, Beam width and Polarization, effects of Antenna height, Dipole arrays, Folded dipole. Microwave Antennas - Parabolic reflector, Horn and Lens antenna, Special purpose antennas - Yagi, Log periodic and Loop antennas.

Radar– block diagram of Radar, frequencies and power used, Radar range equation.

UNIT III – Microwave Waveguides and Components

Waveguides - Rectangular Wave guide **–** TE and TM modes , power transmission, excitation in rectangular wave guide , circular wave guides – TE,TM and TEM mode, **Microwave Components** - Waveguide Tee - E-plane tee, H-plane tee, Hybrid tee, scattering parameters (s-matrix), circulators, isolators , directional couplers.

UNIT IV – Microwave Sources and Measurements

Microwave Sources - Reflex Klystron - principle of operation of velocity modulation, power output and efficiency, electronic admittance, Cylindrical Magnetron – principle of operation, equation of electron motions, cyclotron angular frequency , power output and efficiency.

Microwave measurement techniques, - Microwave bench, precautions, power measurement, bolometric method, attenuation, VSWR, impedance, frequency and Q of the cavity, standing wave measurements, impedance measurement, cavity resonator, dielectric measurements.

UNIT V - Microwave Semiconducting and Avalanche Transit -Time Devices

Microwave Semiconducting Devices

Microwave Transistor **–** Microwave Bipolar Transistor – principle and amplification phenomenon, power frequency limitation, Microwave Tunnel Diode **–** principle and characteristics of microwave tunnel diodes, JFET operation and characteristics. Microwave integrated circuit design, introduction, hybrid microwave integrated circuits (HMIC),

monolithic microwave integrated circuit (MMIC), MIC materials, substrate material, conductor material, dielectric materials, resistive films, types of MIC’S, microwave monolithic integrated circuits (MMIC'S).
Transferred Electron Devices **–** Gunn Effect Diodes, GaAs diode Ridley Watkins Hilsum (RWH) theory – Differential negative resistance
Avalanche Transit -Time Devices - Read Diode - Avalanche multiplication, carrier current and external current, output power and quality factor. IMPATT Diodes and TRAPATT Diodes- Principles of operation, power output and efficiency

TEXT BOOKS

1. Microwave Devices and Circuits – Samuel Y. Liao, PHI Pub
2. Microwave Engineering – Annapurna Das, Sisir K. Das, Tata Mc Graw Hill.
3. Microwave and Radar Engineering - M. Kulkarni, Umesh Publication
4. Electronic Communication Systems - George Kennedy, 3rd Edition TMH
5. Introduction to electrodynamics by David J. Griffithe , PHI
6. Elements of engineering electromagnetics by Narayaaa Rao, PHI

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SYLLABUS PRESCRIBED FOR THE EXAMINATION OF

M. Sc. Electronics

July-Dec 2021

Semester III

ELT 301 Paper - 1 Advance Microprocessors and Microcontroller (AMM)

Aim and objective

1. To introduce the architectures of 16 bit microprocessors, assembly language programming and interfacing with commonly used peripheral devices.
2. To familiarize the students with architecture of 8051 microcontroller, assembly language programming in 8051 microcontroller.
3. To design the interfacing of peripherals with the 8051 microcontroller

Learning Outcomes

1. Comprehend and analyze the architectures of 16 bit microprocessors and 8 bit microcontroller
2. Understand and implement the assembly language programming of 8086 microprocessor and 8051 microcontroller
3. Comprehend the memory organization of 8086 microprocessor and 8051 microcontroller
4. Showcase the skill, knowledge and ability of programming using instruction set of 8086 microprocessor and 8051 microcontroller

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Non-Programmable Scientific Calculator in Examination hall

UNIT I *16-bit microprocessors*

8086 internal architecture; memory organization, 8086 basic configurations: minimum mode, maximum mode, 8284 clock generator, 8288 bus controller, system bus timings for minimum and maximum modes. Introduction to 8088, 80186, 80286, 80386, 80486

UNIT II *Programming of 8086*

8086 addressing modes, Instruction formats, instruction set: data transfer instructions, arithmetic instructions: binary, packed and unpacked arithmetic; branch instructions: conditional and unconditional branch instructions; loop instructions, flag manipulation instructions, shift and rotate instructions, byte and string; assembler directives; programming examples.

UNIT III *Interfacing*

Basic interfacing concepts; Interfacing memories: I/O mapped I/O, memory mapped I/O, 8086 memory interface, I/O operations: programmed I/O, Interrupt I/O, Direct memory access, Programming and interfacing of peripheral devices: programmable peripheral interface (8255), Interrupt controller (8259), DMA controller (8257); Co-processor (8087): architecture, data types, and interfacing.

UNIT IV *Microcontroller 8051*

8051 architecture: oscillator and clock, PC and data pointers, CPU registers, flags, and PSW; internal RAM; stack and stack pointer, SFRs, internal ROM, I/O ports; external memory; Counters and timers: timer counter interrupts, timing, timer modes of operation, counting, Serial Data I/O: serial data interrupts, data transmission, data reception, serial data transmission modes, Interrupts: timer flag interrupt, serial port interrupt, external interrupts, reset, interrupt control, interrupt priority, interrupt destinations, software generated interrupts.

UNIT V *Programming of Microcontroller 8051*

Instruction set: Moving data: addressing modes, external data moves, code memory read-only data moves, push and pop opcodes; Logical operations: byte and bit level logical operations, rotate and swap operations; Arithmetic operations: flags, incrementing and decrementing, addition, subtraction, multiplication and division, decimal arithmetic; Jump and call instructions: jump and call program range, jumps, calls and subroutines, interrupts and returns; simple programming examples.

TEXT BOOKS

1. Yu Cheng Liu, Glenn A. Gibson, **Microcomputer systems: The 8086/8088 family architecture**, **programming and design**, Prentice Hall of India, New Delhi.
2. Douglas V. Hall, **Microprocessors and interfacing**, Tata McGraw-Hill Company Limited, New Delhi.
3. Bhupinder Singh Chabra, **The Intel 8086/8088 microprocessor architecture programming design and interfacing**, Dhanpat Rai Publishing Company Limited, New Delhi.
4. Ramesh S. Gaonkar, **Microprocessor architecture, programming and application with 8085/8080A**, Wiley Eastern Limited, New York.
5. Kenneth J. Ayala, **The 8051 Microcontroller architecture, programming, and applications**, Penram International Publishing, India.
6. Barry B. Brey, **The Intel Microprocessors 8086/8088, 80186,80286, 80386 and 80486 Architecture, programming and interfacing,** Prentice Hall of India, New Delhi.
7. N. Senthil Kumar, M. Saravanan, S. Jeevananthan, S.K. Shah, **Microprocessors and Interfacing 8086,8051,8096 and advanced processors,** Oxford university press.

ELT 302 Paper 2-Data Communications, Mobile and Wireless Communication

Aim and objective

1. This paper aims to learn the basics of Data Communication, Mobile, and Wireless Communication.
2. To introduce analysis and design of computer and communication networks.
3. To understand the network layered architecture and the protocol stack.
4. To understand the concept of mobile and broadcast systems, cellular systems, GSM models and satellite systems
5. To understand the infrastructure and ad-hoc networks, GPRS, Bluetooth, 3G technologies like UMTS, and mobile network and transport layers protocols.

Learning Outcomes

The student will be able to

1. Understand the types of communication modes, switching circuits, Network protocols and detailed knowledge of the network topology.
2. Describe the phases of planning and design of mobile wireless networks
3. Know modern multiple access schemes, the concept of frequency reuse, channel assignment strategies and estimate trucking and GOS.
4. Understand GSM, CDMA concepts, architecture, frame structure, system capacity
5. Understand evolution of mobile communication generations 2G, 2.5G, and 3G with their characteristics and limitations.
6. Understand emerging technologies required for fourth generation mobile system such as SDR, MIMO etc.
7. Students will also able to build the basic concepts and ideas need to realize the working of 3G, Bluetooth, GPRS, and various network protocols.

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

Unit I- Data Communication

Data Signal, Signaling & Data Transmission Media, Communication Mode-Half Duplex/Full Duplex, Data Communication System-Synchronous/Asynchronous Transmission, Serial/Parallel Data, Switching & Multiplexing-Circuit Switching, Message Switching, Packet Switching, Network Topology-Bus/Star/Ring/Mesh Topology, LAN, OSI Reference Model, Network Protocol(TCP/IP).

Unit II- Introduction to Mobile and Wireless Devices

Mobile and wireless devices, history, applications wireless transmission, frequencies for radio transmission, regulations, signals, antennas, signal propagation, multiplexing, modulation, wireless LANs and wireless WANs, spread spectrum, FHSS and DSSS spread spectrum technology, cellular systems, medium access control, specialized MAC.

Unit III- Telecommunications and Broadcast Systems
GSM, mobile services, system architecture, GSM subsystems, GSM communication frame, localization and calling, handover, security, new data services, satellite systems applications, GEO, LEO. MEO, routing, localization, broadcast systems, cyclic repletion of data.

Unit IV- Wireless Networks and others 3G Technologies
Wireless LAN, infrared v/s radio transmission, infrastructure and adhoc networks, IEEE 802.11, architecture (details of protocol not required), DFWMAC schemes, MAC frames, MAC management, roaming, HIPERLAN (just basics, frame and protocol details not required), Bluetooth, applications, physical layer, modes MAC layer, packet format, networking security, link management, brief discussions (frame details and protocols not required) on GPRS, DECT, TETRA, UMTS, IMT-2000, CDPD.

Unit V- Mobile Network and Transport Layers
Mobile network layer, requirements, entities, IP packet delivery, agent advertisement and discovery, registration, encapsulation and tunneling, optimization, messages, reverse tunneling, IPv6, DHCP, Mobile IP, DHCP, ad-hoc networks, mobile transport layer, traditional TCP, indirect TCP, snooping TCP, mobile TCP, fast transmit/fast recovery, transmission/time out freezing, selective retransmission, transaction oriented TCP.

TEXT BOOKS
1. Data Communication & Networking - Behrouz A Foruzon.
2. Wireless communications and networking" William Stallings, PHI
3. Data and Computer Communications – By William Stalling., 7th Ed., PHI
4. Mobile communications"-by Johan schiller, PEA, 2nd ED
5. Mobile and personal communications systems and services" Rajpandya, PHI
6. Computer Networks - Tanenbaum, PHI.
7 Data Communications and Distributed Networks, 3rd ed. Black PHI
8 Computer Networks: Protocols, Standards and Interfaces, 2nd ed. Black PHI

ELT 303 Photonics

Aim and objective

1. To understand photonic devices which have emerged as the key technology for optical communications, environmental sensing, and biomedical diagnostics in the life sciences, energy-efficient lighting, and solar energy harvesting.
2. To understand light as an electromagnetic wave and various Interaction between a photon and electron and its relevance to laser and various other optoelectronic devices.
3. To understand optical radiation, radiometry & photometry, photovoltaic devices. Advanced photonics phenomena like Raman scattering, photorefractive effect, Photothermal deflection effect, and Ultra-fast phenomena
4. To understand Solar Photovoltaic Technology and its generations.
5. To understand the Nonlinear optical processes

Course Learning Outcomes At the end of this course, students will be able to

1. Describe the optics and simple optical systems.

2. Understand the concept of light as a wave and the relevance of this to optical effects such as interference and diffraction and hence to lasers and optical fibers.
3. Understand the area of silicon photonics which is an upcoming area of photonic integration with Electronics.
4. understand nonlinear optical processes and their applications
5. to understand the physical principles of the photovoltaic (PV) solar cell and what are its sources of losses.
6. to understand and apply the basic concepts of solar radiation necessary for dimensioning (sizing) PV systems installations.
7. to know the electrical (current-voltage and power-voltage) characteristics of solar cell, panel or generator and how the environment parameters influence it
8. Understand the concept, functioning and design of most photonic devices in use.

Max. Marks: 80, Min. Marks: 16
Student should be allowed to use Programmable Scientific Calculator in Examination hall

Unit I- Theory of Light, Light as Electromagnetic wave, Polarization of Light, Principle of superposition, Interference, Diffraction, Scattering, Photon nature of light, Light wave in homogeneous medium, Plane Electromagnetic Wave, Maxwell's Wave equation and Diverging Waves.
Basics of LED, and flexible display devices. Thin film deposition and characterization Techniques: XRD, TEM, SEM, EDX, Thin film active and passive devices,

Unit II -
Guide Wave Integrated Optic Devices: Planar and channel waveguides, Waveguide platforms on various materials and their fabrication techniques. Waveguide directional couplers, tapered waveguides and Y-junction splitters/combiners, Ring resonators, Mach-Zehnder interferometers/modulators. Sagnac interferometer/gyroscope. Coupling in and out of Photonic Integrated Circuits: Optical mode converters, prism and grating couplers. Wavelength-division multiplexing components: Mulitplexers, Demultiplexers, Multimode interferometers, Arrayed waveguide gratings.

Unit III - Solar Photovoltaics: Solar cell materials and their properties. Solar cell research: technology (silicon, organic, Dye sensitized, peroviakites), applications and limitations.Characterization and analysis: ideal cell under illumination- solar cell parameters,optical losses; electrical losses, surface recombination velocity, quantum efficiency - measurements of solar cell parameters; I-V curve & L-I-V characteristics, internal quantum yield measurements – effects of series and parallel resistance and temperature - loss analysis. Solar photovoltaic(PV) modules from solar cells, series and parallel connections, design and structure of PV modules.

Unit IV- Non Linear Optical processes
Introduction, Second Harmonic Generation,, susceptibility tensor, phase matching, propagation of EMW through second order nonlinear media, experimental technique in study second order non linearity Self Focussing and Defocussing, Optical Parametric

Interactions, Chirped pulse amplifier, parametric oscillations, Optical Mixing, Four Wave Mixing, Multiphoton Absorption.

Unit V -Advances in Photonics and photonic Materials

Emerging materials for future Devices: Graphene, Carbon Nano tubes (CNT), ZnO, SiC etc.
Low dimensional semiconductor devices – quantum wells, quantum wires, quantum dots
Silicon Photonics: Motivation towards silicon photonics, Silicon on Insulator (SOI) waveguides or nanowires .Optical fiber to silicon waveguide: edge, grating, evanescent coupling, spot-size converters. III-V integration with silicon photonics. Photonic modulators: electro-optical and thermo-optical effects.
Raman Scattering, Photrefractive effect, Photothermal Deflection effect, Photorefraction in diffusing medium, Squeezed state, Optical Solitons, Optical Bistability, Optical interconnect, Photonic switches, Optical Computers, Ultrafast phenomena

TEXT BOOKS

1. Optical Electronics - Ghatak Thyagarajan, University Press
2. Optoelectronics An Introduction: Wilson & Hawkes PHI
3. Optoelectronics & Photonics S.O.Kasap, Pearson
4. Optoelectronics Devices & Systems - S.C. Gupta, PHI Publication
5. Photonics Sasi Kumar PHI

ELT 304 Paper 4- Power Electronics, Information Theory and Coding

Course Objectives

1. To introduce the students with the working of thyristor family.
2. To introduce the controlled rectifiers, AC Voltage Controllers, DC Choppers, inverters, UPS, AC motor, DC motor, and power conditioners.
3. To acquaint students with the basics of probability, information and its properties
4. To familiarize students with different channel models and their capacity
5. To teach different types of source and channel coding techniques

Course Outcomes

1. Able to understand the vital requirement of solid-state power electronics components.
2. Get acquainted with the working of thyristors, their characteristics and applications.
3. Learned about the working of the controlled rectifiers, AC Voltage Controllers, DC Choppers, Inverters, UPS, AC motor, DC motor, and power conditioners.
4. Comprehend and analyze the basics of probability, information and its properties
5. Examine different types of channels and determine their capacity
6. Understand the requirement of Shannon-Fano-Coding, Huffman Coding, Error-Control Coding.

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination Hall

Unit I- Thyristors, Controlled Rectifiers and Commutation Techniques

Thyristors – Thyristor Characteristics, Two- transistor model of Thyristor, Turn ON and Turn OFF of Thyristor, di/dt protection, dv/dt protection, Type of Thyristors, Series operation and Parallel operation of Thyristors, Thyristor Firing Circuits, Unijunction Transistor. Controlled Rectifiers – Single Phase semiconverter with RL load, Single Phase full converter with RL load

Thyristor Commutation Techniques – Natural Commutation, Forced Commutation, Self Commutation, Complementary Commutation, External Pulse Commutation,

Unit II- AC Voltage Controllers, DC Choppers and Inverters

AC Voltage Controllers –Introduction, Principle of ON-OFF control, Principle of Phase control, Single Phase bi-directional controllers with inductive loads, Cycloconverters.

C Choppers – Principle of operation, Classification of Choppers – Class A, Class B, Class C, Class D and Class E Choppers.

Inverters-Introduction, classification of Invertors, Single phase, full bridge Voltage source inverter with RL load,

Unit III- Power Drives- DC Motor and AC Motor

DC Motor – Basic Characteristics, Speed control of DC motors – Armature voltage, Armature Resistance and Field flux controls, Solid state speed control of DC motor – Single Phase half wave converter, Single phase full wave converter.

AC Motor (Induction Motor) – Construction & Principle, Speed control of Induction motor – Stator voltage, Stator frequency, Pole changing, Rotor resistance and Slip power recovery control, Basic Construction and principle of Stepper motor

Unit IV – Power conditioners:

EMI/ RFI filter, CVT, Voltage regulators, Solid state regulators, UPS online & OFF line, reliability of UPS system. Batteries used for UPS, Important terms related to the UPS System & comparison of UPS system.

Applications of Power Electronics: Electronic ballast, Power factor correction, Induction heating, Dielectric heating.

Unit V – Information Theory : Introduction, Unit of Information, Entropy, Rate of Information, Joint Entropy and Conditional Entropy, Mutual Information, Channel Capacity-noise-free channel, symmetric channel, Binary Symmetric channel & cascaded channel, Shannon's Theorem, Continuous Channel, Capacity of a Gaussian Channel: Shannon Hartley Theorem, Bandwidth S/N Trade-off.

Coding – Introduction, Coding Efficiency, Shannon-Fano Coding, Huffman Coding, Error-Control Coding, Block Codes, Convolution Codes.

TEXT BOOKS

1. Power Electronics - Muhammad H. Rashid, Prentice Hall of India, Second Edition, New Delhi
2. Power Electronics - A.K. Gupta & L.N. Singh, Dhanpat Rai Publishing Company, 1st Edition
3. Power Electronics - J. Asger, PHI Publication.
4. Communication System - R.P.Singh & S.D. Sapre TMH Analog and Digital

5. Power Electronics - R.M. Jalnekar & N.B. Pasalkar
6. Pspice Simulation of Power Electronic Circuits: Raymond Ramshaw
8. Communication Systems-Simon Haykin, John Wiley & sons, NY, 4th Edition
9. Information theory- F.M Reza, McGraw Hill
10. A Text book of Electrical Technology (Volume –II) - B. L. Thereja & A K Theraja, S Chand & Co. Ltd (2006)
11. Principles of Electrical Machines- V K Mehta & Mehta,S Chand & Co. Ltd (2006)
12. Elecrtrical Machines – A Hussain, Dhanpat Rai & Co

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR
SYLLABUS PRESCRIBED FOR THE EXAMINATION OF
M. Sc. Electronics
Semester-4
(Jan-June 2022)

ELT 401 Paper 1 -Digital Signal Processing

ELT-401 Paper - I: Digital Signal Processing

Aim and objective

1. To learn and understand the impact of digital signal processing (DSP).
2. Analyze the concepts of discrete time signals and systems in time and frequency domain with corresponding transformations.
3. To introduce the diverse structures for realizing FIR and IIR digital filters.
4. To introduce the digital of IIR, FIR filters with given specifications.
5. To understand the application of DSP in Speech analysis.

Learning Outcomes

1. Comprehend, classify and analyze the discrete time signals and systems, also transform the time domain signals to frequency domain for analyzing system response
2. Able to understand and simplify DTFT,DFS, DFT and FFT computations .
3. Comprehend the various mapping techniques for IIR filter design and their digitization.
4. Able to design FIR digital filters.
5. Able to realize digital filters using delay elements, summer, etc.
6. Able to analyze and exploit the speech signal processing applications

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

Unit I- Discrete Time Signals, Systems and Z-Transform

Discrete Time Signals, Systems-An introduction to analog signal processing, Discrete time signals & systems- discrete time signals (sequences), Linear shift, Invariant systems, Stability & Casuality, linear constant coefficient Differential equations, Frequency domain representation of discrete time systems & signals, Sampling of continuous time signals.
Z-Transform- Introduction, Z-transforms (of finite length sequences, Right sided, left sided & two sided sequences) Inverse Z-transform, Z-transform theorems & properties – Region of convergence of rational Z-transform, Linearity, Shift of a sequence, multiplication by an exponential sequence, Initial value theorem, Convolution of sequences, system functions.

Unit II-Discrete Fourier Transform
Discrete time fourier transform (DTFT), Representation of periodic sequence - Discrete Fourier series(DFS), Properties of the Discrete Fourier series- Linearity, Shift of a sequence, symmetry properties, periodic convolution; Fourier representation of finite duration sequences- The Discrete Fourier transform(DFT), Properties of discrete Fourier transform - Linearity, Circular shift of a sequence, Symmetry Properties, Circular convolution, Linear Convolution using the Discrete Fourier Transform.

Unit III- Fast Fourier Transform and Network Structures
Fast Fourier Transform (FFT), Inverse DFT, Radix FFT.
Signal Flow Graph Representation of Digital Network, Matrix Representation of digital Networks, Basic network structures for IIR systems (Direct form, cascaded form, and parallel form) Transposed forms, Basic network structures for FIR systems (direct form, cascaded form).

Unit IV- Digital IIR filter
Digital filter design techniques- design of IIR digital filters from analog filters, impulse invariance, Bilinear Transformation, Design examples: Analog-Digital Transformation – Digital Butterworth Filters (impulse invariance, bilinear transformation), Digital Chebyshev filters (impulse invariance, bilinear transformation), Comparison of IIR and FIR Digital Filters.

Unit V- Digital FIR filter
Finite impulse response (FIR) Filter Design, Rectangular, Triangular, Hanning, Hamming, Blackman and Kaiser Window, Linear phase and Optimal Filter .
Application Digital Signal Processing-speech processing, speech analysis- short term Fourier analysis, cepstral analysis & linear predictive analysis, speech coding, channel vocoder

TEXT BOOKS
1. Digital Signal Processing - A.V. Oppenheim & Schafer. PHI
2. Discrete Time Signal Processing - A.V. Oppenheim & Schafer. PHI
3. Digital Signal Processing - Johny Jonson, Pearson PHI
4. Digital Signal Processing - Proakis
5. Digital Signal Processing -Vallavaraj, Salivahanan, Ghanapriya, THM

ELT 402 Paper 2-Optical Communication and Satellite Communication
This course enables the students to:

1. Apply the fundamental principles of optics and light wave to design optical fiber communication systems.
2. Fabrication process of fiber optic cables
3. Design optical fiber communication links using appropriate optical fibers light sources, detectors.
4. To learn the basic elements of optical fibre transmission link, fiberglass modes configurations and structures
5. To understand different kinds of losses, signal attenuation in optical fibres & other dispersion factor.
6. To learn various optical sources, LED/LASER structures, receivers (PIN, APD), and noise performance
7. To provide an in-depth understanding of different concepts used in a satellite communication system

Learning Outcomes: The course enables the students to

1. Apply the fundamental principles of optics and light wave to design optical fiber communication systems.
2. Understand the types and fabrication process of fiber optic cable, calculation of losses during transmission in fiber, optical source, and detector require for optical communication.
3. Differentiate losses in optical fiber link and state transmission characteristics of optical fiber.
4. Explore concept of designing and operating principles of modern optical systems and networks
5. Learn about some passive and active components required for optical communication
6. Students will be able to design Satellite Link, calculate the satellite's Look Angles and Antenna parameters like Gain, Resistance, Bandwidth, Beam-width. Explain and analyzes link budget of satellite signal for proper communication
7. Use the different application of satellite communication

Max. Marks: 80, Min. Marks: 16
1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

Unit I-Optical Fibers Optical fiber theory and applications, ages and disadvantages, parameters and types of optical fibers, Propagation of light through optical fiber ,single mode step index fiber, multimode step index fibers, multimode graded index fibers, Comparison of Three types of Optical fibers, Acceptance angle and acceptance cone, Numerical Aperture, , construction of optical fiber cables,

Transmission Characteristics of Optical Fiber: Attenuation in Optical Fibers, loss mechanisms - absorption and Rayleigh scattering, Radiation losses, Wavelength dispersion, intermodal and intramodal, Bending losses, Coupling losses: misalignment and mismatch losses

Unit II- Principle of Optical Communication
Optical Fiber Communication System Block Diagram
Optical sources: Heterojunction LED, Edge emitting LEDs, Injection Laser LEDs
Light Detectors: PIN Diode and Avalanche Photodiode, Structure of In, GaAs APDs Characteristics of Light Detectors, Connector types and splices, Optical Fiber System Link Budget, Optical fiber manufacturing processes. Optical fiber testing and parameter (cut off Wavelength, loss per unit length, numerical aperture, bending loss, connector/spliceloss) measurement

Unit III- Optical Fiber Communication Systems and Applications
Typical Fiber Optic Communication System, Optical Transmitter, Optical Receiver, Optical Repeaters, Optical Amplifiers, semiconductor optical amplifiers, EDFA, Raman Amplifier. Basic idea of WDM and DWDM systems, System Architecture: Point to point link, Distributed Network, AN Fiber Optic Sensors in Health care, Optical Computing, Optical Logic Gates

Unit IV-Satellite Communication - I
Satellite Communication – Introduction, Kepler's laws, orbit, Power systems, Satellite Frequency Allocations and Band Spectrum, Elements of a Satellite Communication System, Active and Passive Satellites, Modem and Codec, Communication Satellite Link Design – General Link Design Equations, Effective Isolated Radiated Power (EIRP), System Noise Temperature, C/N and G/T ratio, Atmospheric and Ionosphere Effects on Link Design, Uplink Design, Complete Link Design, Interference Effects on complete link design, Earth Station parameters.

Unit V- Satellite Communication - II
Satellite orbits – synchronous orbit, orbital parameters, Satellite location with respect to the earth, Look Angles, Earth coverage and Slant range. Satellite Transponder model, Satellite RF Front End, Satellite Carrier Processing, Antenna – Antenna parameters, Gain, Resistance, Bandwidth, Beam-width and polarization, Parabolic antenna, Application of Satellite Communication in Television - Direct Home Broadcast, Telephone services and Data Communication.

TEXT BOOKS
1. Optical Fiber Communication -G. Keiser, Mc. Graw Hill
2. Fiber Optics Communication -D. C. Agrawal
3. Satellite Communication -D.C. Agrawal, Khanna Pub.
4. Satellite Communication -R.M. Gagliardi
5. Fundamentals of Optical Fibre Communication: Satish Kumar PHI
6. Optical fibre and Laser Anuradha De New Age International Publishers
7. Optical Fiber Communication: V.S.Bagad Technical Publications
8. Optical Fiber Communications', John Senior: PHI.
9 Electronic communications, Roddy and Coolen, PHI, New Delhi,

ELT 403 Paper 3- Automatic Control System and Artificial Neural Network

Aim and objective

1. To understand the use of transfer function models for the analysis of physical systems and to introduce the components of control system.
2. To provide adequate knowledge in the time response of systems and steady state error analysis along with the understanding of closed loop and open loop in frequency domain.
3. To understand the concept of feedback controllers
4. To introduce state variable representation of physical systems and study the effect of state feedback
5. To summarize basic learning laws and architectures of neural networks.
6. To describe supervised and unsupervised learning laws of Neural Networks.
7. To introduce single-layered- feed-forward and multi-layered feed-forward neural network, multi-layered perceptions model with the back-propagation algorithm

Learning Outcomes

1. Differentiate real-time applications as open loop or closed loop systems.
2. Analyze the system from the transfer function.
3. Design of controllers and find the stability of these control systems.
4. Ability to compute steady state and transient response of the different order of the system and also to analyze its error coefficients.
5. Analyze the frequency domain response of the control systems.
6. Apply various control systems concepts to analyze and find the stability of control systems.
7. Analyze the controllability and observability of the system in state modeling.
8. Ability to translate biological motivations into various characteristics of artificial neural networks
9. To comprehend and analyze basic learning laws of neural networks and activation functions
10. To learn supervised and unsupervised learning algorithms .

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination Hall

2. Special graph paper viz. Polar graph & Semi log graph papers should be provided to the students in the examination hall.

Unit I - Fundamental of Control System

Basic Definition, Classification of Control System, Open Loop & Closed loops System, Effect of feedback on System response, Impulse Response & Transfer Function, Block diagram, Block Diagram Reduction Techniques. Signal Flow Graph-Basic Definition in SFG, Rule for SFG, Properties of SFG, Masons Gain Formula.

Unit II -Time Domain analysis and Stability of Linear Control System

Time Response of Continuous Data system, test Signal ,Steady State Errors and error constants, Unit Step response, Time Domain specifications, time Response of first order

System, Transient Response of Prototype second order System, effect of adding a zero to the system, Stability of Linear Control System-Absolute Stability, Relative Stability, Routh-Hurwitz Criterion-Ruth Tabulation, Special Cases.

Unit III- Frequency Domain Analysis and Frequency Response Plots

Frequency Domain Analysis - Frequency Response of closed loop control System, Frequency Domain Specifications of prototype Second Order System, Nyquist Stability Criterion and plot, Root Loci- basic properties, Relative Stability-Gain Margin & Phase Margin, Correlation Between Time & Frequency response, Polar Plot, Bode Plot.

Unit IV-State Variable Analysis and Controllors

State Variable Analysis and Design – Concept of state variables, state model, state model for linear continuous time system, diagonalization, solution of state equations, concept of controllability and observability, PID Controller, Theory of lag, lead and lag-lead compensators.

Unit V- Artificial Neural Network

Introduction to ANS Technology-Models of a neuron, neural networks, viewed as directed graph, feedback from neurons to ANS, **Learning and training**- Hebbian, memory based, competitive, error-correction and learning. **Assignment problem** supervised and unsupervised learning. **Network architectures-Single layered**- feed forward networks, multi-layered feed forward networks, Activation and Synaptic Dynamic. **Stability and convergence-** single layered perception - least mean square algorithm, multilayered perceptions - backpropogation algorithm

TEXT BOOKS

1. Control systems Theory & Application - Samarajit Ghosh (Pearson Edu)
2. Control System Engineering - B.C.Kuo(PHI)
3. Control Systems Engineering - I.J. Nagrath, M. Gopal
4. Artificial Neural networks - B. Yagna Narayan
5. Neural Computing -Philips D. Wasserman

Theory and practice -Vannostrand Reinhold

ELT 404 Paper 4 – Embedded Systems, Microcontrollers and Advanced Instrumentation

Course objective

1. To develop ability to understand microcontroller
2. To introduce the architectures of embedded systems, PIC microcontrollers, FPGA and ARM processor
3. To familiarize the students with fundamentals of the IoT
4. To introduce the basic concept of electronic instrumentation and measurement
5. To familiarize the students with transducer, Digital Storage Oscilloscope, Spectrum analysers and different types of sensors
5. To introduce the basics of biomedical instrumentation and measurement

Learning Outcomes

1. Understand the requirement of the embedded system, ARM processor, and IoT
2. Understand general-purpose processing and principles of PIC microcontrollers, FPGA and ARM processor
3. Developed the ability to work with different types of sensors
4. Understand working of basic electronics instrumentation and develop the ability to handle instrument like digital multimeter, Digital Storage Oscilloscope, Spectrum analysers, and impedance analysers.
5. Understand functioning of biomedical Electronic Instrumentation like electrocardiography, plethysmography.

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

Unit I- Introduction to Embedded systems:

Introduction, Application Areas, Categories of embedded systems, Overview of embedded systems architecture, Specialties of embedded systems, challenges and issues in embedded software development Recent Trends, hardware architecture, Software architecture, core platform development, boot sequence, development/testing tools.

Fundamentals of Internet of Things (IoT) for communication and Cloud Computing.

Unit – II

FPGA Architecture Introduction to Programmable logic, Basic Components of FPGA (LUT, CLB, Switch Matrix, IOB), Basic FPGA Architecture

PIC Microcontrollers – Introduction to PIC 16C6x/7x family microcontrollers, Architecture, Registers, Register File Structure, Addressing Modes, Instruction set. Interrupt Structure, Timers, Counters, I/O Port Concepts, Peripheral Interfacing and Applications,

Basics of ARM Architecture: Introduction to ARM microprocessor and its features, Architecture, Programming model.

CISC and RISC architecture comparison, advantages of RISC, Power saving methods

Unit III

Concept of Measurement & Transducers

Basic concept of Measurement, Performance & Static Characteristics, Error in Measurement, Types of Errors-Gross, Systematic & Random,

Fundamental Concept Transducers – Resistance, Inductance, Capacitance, Piezoelectric, Thermoelectric, Hall effect, Photoelectric, Measurement of displacement, velocity, acceleration, force, torque, strain, temperature, pressure, flow, humidity, thickness, pH. Measuring Equipment – Measurement of R, L and C, Bridge and Potentiometers, voltage, current, power, energy, frequency/time, phase,

Unit IV- Instrumentation Electronics

Instrumentation Amplifiers, Basic Characteristics, D.C. Amplifiers, Isolation Amplifiers, Feedback Transducers system, feedback Fundamentals, Inverse Transducers, Temperature Balance System. Digital Multimeters, CRO, Digital Storage Oscilloscope, Spectrum Analyzer., Impedance analyzer

Advanced Instrumentation Systems

Semiconductor sensors; smart sensors; micro sensors; IR radiation sensors; ultrasonic sensors; fibre optic sensors; chemical sensors; bio sensors; thermometry and thermography; nano instrumentation; environmental pollution monitoring;

Unit V-Biomedical Electronic Instrumentation and Measurements

Introduction to biomedical instrumentation, sources of bioelectric potentials, electrodes- electrode theory, biopotential electrodes, biochemical transducers, cardiovascular measurements- electrocardiography, measurement of blood pressure, blood flow and heart sound, plethysmography, the elements of intensive care monitoring; calibration and reparability of patient monitoring equipment, pace makers. MEMS and its applications Sensors for IoT applications.

TEXT BOOKS

1. Embedded systems - Raj Kamal, TMH
2. Embedded/Real Time Systems – Dr.K.V.K.K.Prasad, dreamtech Press.
3. FPGA based System design by Wayne Wolf
4. 2. Digital Systems Design With FPGAs And CPLDs By Ian Grout, Elsevier(2008)
5. Unleash the System On Chip Using FPGAs and Handel C By Rajanish K. Kamat, Santosh A. Shinde, Vinod G Shelake, Springer (2010)
6. Design with PIC Microcontrollers – John B.Peatman, Pearson Education Asia
7. PIC Microcontrollers: An Introduction to Microelectronics, Martin P. Bates, Elsevier.
8. D.V.S. Murti, **Transducers and Instrumentation**, PHI Learning Pvt Ltd, New Delhi.
9. Douglas A. Skoog, F. james Holler, and Stanley R. Crouch, **Instrumental Analysis**, CENGAGE Learning, Indian Edition.

7. Internet of Things (IoT) – Jeeva Jose, Khanna Publishers, Delhi

BOOK FOR REFERENCE:

1. Intel Embedded Microcontrollers and Processors Vol. I

ELP 105 LAB COURSE "A"- ANALOG ELECTRONICS LAB

M.Sc. Electronics

July-Dec 2020

Semester I

Course Objective:

1. To illustrate the students different electronic circuit and their application in practice.
2. To impart knowledge on assessing performance of electronic circuit through monitoring of sensitive parameters.
3. To evaluate the use of computer-based analysis tools to review performance of Semiconductor device circuit.

At the end of this course, students will be able to

1. Understand the non-ideal behavior by parameter measurement of Op-amp.
2. Design application-oriented circuits using Op-amp ICs.
3. Generate square wave using different modes of 555 timer IC.
4. Study of Hall effect and four probe methods.
5. Prepare the technical report on the experiments carried.

Course outcomes:

1. Identify relevant information to supplement to the Analog Electronic Circuits
2. Set up testing strategies and select proper instruments to evaluate performance characteristics of electronic circuit.
3. Choose testing and experimental procedures on different types of electronic circuit and analyze their operation different operating conditions.
4. Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.
5. Practice different types of wiring and instruments connections keeping in mind technical, Economical, safety issues.
6. Prepare professional quality textual and graphical presentations of laboratory data and Computational results, incorporating accepted data analysis and synthesis methods, Mathematical software and word-processing tools.

Max. Marks: 100, Min. Marks: 20

1. Study of op-amp characteristics: CMRR and Slew rate.
2. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an opamp.
3. Designing of analog adder and subtractor circuit.
4. Designing of an integrator using op-amp for a given specification and study its frequency response.
5. Designing of a differentiator using op-amp for a given specification and study its frequency response.
6. Designing of a First Order Low-pass filter using op-amp.
7. Designing of a First Order High-pass filter using op-amp.
8. Designing of a RC Phase Shift Oscillator using op-amp.
9. Study of IC 555 as an astable multivibrator.
10. Study of IC 555 as monostable multivibrator.

11. Designing of Fixed voltage power supply using IC regulators using 78 series and 79 series.
12. To study the Astable and Monostable Multivibrator using IC741.
13. To study the RC Phase Shift Oscillator by determining its frequency of oscillation and Compare calculated and observed frequency.
14. To study the Schmitt Trigger using transistor and IC7413 by observing the output Waveform.
15. To study the Colpit Oscillator, determine its frequency of oscillation and compare the Calculated and observed frequency.
16. To study the Negative Feedback Amplifier by measuring closed loop gain and gain bandwidth product.
17. Calculation of barrier height and ideality factor at room temperature (for Si and GaAs devices) from the I-V characteristics.
18. Calculation of diode parameters at varying frequency from the C-V characteristics.
19. Calculation of semiconductor conductivity type and carrier concentration using Hall Effect.
20. Calculation of semiconductor resistivity and band gap using Four-Probe method.
21. Calculation of carrier mobility and drift velocity using an experimental setup.
22. Verification of following network theorems (1) Superposition (2) Thevenin`s (3) Nortan`s theorem.
23. To study and plot the MOSFET characteristics.
24. To study the Active Band pass filter and calculate its (1) Bandwidth: - Lower cutoff & upper cutoff frequency. (2) Quality factor.
25. Construct a Wein Bridge Oscillator and determine its frequency of oscillation and compare calculated and observed frequency.
26. To study the Active Low pass filter and to evaluate: -(1) Cutoff frequency, (2) Band pass gain, and (3) Plot the frequency response.
27. To study the Clipping circuits as positive and negative logic.
28. To study the Clamping circuits as positive and negative logic.
29. To Study the phototransistor characteristics.
30. To study the comparison of Schmitt trigger and phototransistor.
31. Verification of the Maximum Power Transfer theorem.
32. . To study the characteristics of JFET (Junction field effect transistor) in common source configuration & evaluate— 1. AC drain resistance, 2. Amplification factor and 3. Drain Resistance.
33. To study the operation of Class B Amplifier.
34. To study the Z parameter of a passive Two Port Network.

35. To study the Op – Amp as voltage to current converter.
36. To study of characteristics of NPN transistor in common emitter configuration and evaluate— 1. Input resistance, 2. Output resistance and 3.Current gain.
37. To study the Active High pass filter and to evaluate:--
    a. Low cutoff frequency, (2) Bandpass gain, and (3) Plot the frequency response.
38. To study, identify and testing the electronic components using Physical and electronic equipments (CRO, Digital Multi Meter).
39. To study the Clipping and Clamping circuits as positive and negative logic using expEYES-17 kit.
40. To study transfer characteristic and functional verification of a Weighted Resistor D/A Converter.
41. To study transfer characteristic and functional verification of a Integrated D/A Converter.
42. To study transfer characteristic and functional verification of a Ladder Network D/A Converter.
43. To study and testing the working of a counter A/D converter.
44. To study and testing the working of a monolithic A/D converter.
45. To study and analysis of comparator operational amplifier.
46. To study of operational amplifier as Integrator and Differentiator.
47. To study of operational amplifier as Square Wave Generator.
48. To study and observe buffer operational amplifier.
49. To study and observe operational amplifier as Adder and Subtractor.

Note : Each student has to perform at least fifteen experiments. The teacher in-charge may add or delete experiments as per the availability of the equipment and need of the course.

Reference Books

1 .Laboratory Experiments and PSPICE Simulations in Analog Electronics Maheshwari & Anand PHI
2 Laboratory Manual for Operational Amplifiers and Linear ICs, 2nd ed. Bell PHI
3. Student Reference Manual for Electronics Instrumentation Lab Wolf & Smith PHI

4. ELECTRONIC LAB PRIMER By B. Sasikala, S. Poorna Chandra S.Chand Pub

ELP 106 LAB COURSE "B"- DIGITAL ELECTRONICS LAB
M.Sc. Electronics
July -Dec 2020
Semester I

Course Objectives

- To know the concepts of Combinational and sequential circuits.
- To understand the concepts of flipflops, registers and counters

Course Outcomes:

CO1 Learn the basics of gates.
CO2 Construct basic combinational circuits and verify their functionalities
CO3 Apply the design procedures to design basic sequential circuits
CO4 Learn about counters CO5 Learn about Shift registers
CO6 To understand the basic digital circuits and to verify their operation
Max. Marks: 100, Min. Marks: 20

List of Experiments: -

1. Verify the following Boolean expressions--
   i) $A + A'B = A + B$ ii) $AB + AB' = A$
   iii) $AB + A'C + BC = AB + A'C$ iv) $AB + A'C = (A + C)(A' + B)$.
2. To study the operation of 4 bit binary full adder and subtractor (IC 7483) having input and output carry bits. Add and subtract any two binary numbers of four bits.
3. To study the characteristics of C-MOS integrated circuits, verify the operation of C-MOS Inverter/NAND gate ICs and study the voltage level of C-MOS for proper ON/OFF (logic 1 or logic 0) condition.
4. To study the interfacing of C-MOS to TTL IC's and vice-versa. Different TTL logic gates and C-MOS logic gates with pull up resistance are provided for interfacing.
5. To study the master slave J-K flip-flop and verify truth table.
6. To study R-S/D/T flip-flops using NAND ICs and verify truth table.
7. To study the operation of shift register as serial in parallel and parallel in serial mode.
8. To study the operation of shift register as parallel in parallel and serial in serial mode.

9. To study write/read operation of digital data into semiconductor memory using IC 7489. Store and retrieve some set of data. (RAM)

10. To study the operation and application of a modern LSI D/A converter. Parallel binary Inputs from switches are applied to DAC, which in turn converts the binary number into a proportional output voltage.

11. To study the operation of modulo-n-counter as MOD 3 & MOD 4 and verify the Truth Table.

12. To study the operation of modulo-n-counter as MOD 8 & MOD 9 and verify the Truth Table.

13. To study the operation of a Presetable Divide by N Counter and verify its truth table.

14. To study the operation of Multiplexer IC having 16: 1 channels.

15. To study the operation of Demultiplexer IC having 1:16 channels and 4 select inputs.

16. To study the operation of BCD Up-Down Counter.

17. To study the operation of Memory programming with seven segment display.

18. To study the operation of comparison of JK flip-flops and verify the difference with Timing diagram.

19. To study and verify the truth table of Parity Generator and Checker.

20. Verification of operation of IC 74190 as mod- N programmable counter.

21. To study the Binary to BCD converter.

22. To study the BCD to Decimal converter.

23. To study the Binary to Gray code converter and Gray to Binary code converter.

24. To study the 4- bit Synchronous binary up/down counter.

25. To study the 4- bit Asynchronous binary up/down counter.

Any other experiment of equal standard relevant to syllabus can also be set.

Note: -Students have to perform at least 15 experiments from the above list.

Books:

1. Laboratory Manual for Operational Amplifiers and Linear ICs, 2nd ed. **Bell PHI**
2. Student Reference Manual for Electronics Instrumentation Lab Wolf & Smith **PHI**

ELP 205 LAB COURSE "C"- ANALOG AND DIGITAL COMMUNICATION LAB
M.Sc. Electronics
Jan-June 2021
Semester II

Max. Marks: 100, Min. Marks: 20

Course Learning Outcomes: At the end of this course, students will be able to

1. **Familiarize the students with basic analog & digital communication systems. Integrate theory with experiments so that the students appreciate the knowledge gained from the theory course, e.g., amplitude and frequency modulation, pulse modulation, PCM etc**
2. **Understand the functioning of various analog and digital communication techniques**
3. **Calculate the performance parameters involved in electronic communication systems**
4. **Prepare the technical report on the experiments carried.**

Course Outcomes
After studying this course the students shall be able to:

1. Design analog modulation circuits as amplitude and frequency modulation.
2. Design various pulse modulation techniques as PAM, PPM, PWM.
3. Design the circuit to sample an analog signal.
4. Use of different modulation and demodulation techniques used in analog communication
5. Identify and solve basic communication problems
6. Analyze transmitter and receiver circuits
7. Compare and contrast design issues, advantages, disadvantages and limitations of analog communication systems

List of Experiments :-

Analog Communication

1. To Generate the DSB-SC Modulated wave and to Observe the Phase Reversal at the Zero Crossing of the Modulating Signal [MOD-13]
2. To study the operation of balanced modulator DSBSC using IC 1496.
3. To study the phase modulation using IC 2206 and calculate the modulation index.
4. To study amplitude modulation and demodulation and construct and AM generator and a diode detector and observe its operations under various conditions.

5. To demonstrate (i) use of 4046 PLL as an FM modulator. (ii) Use of 4046 PLL IC as an FM demodulator

Digital communication-

1. Study of signal sampling and reconstruction techniques and to verify Nyquist criteria and tracing.
2. To Generate the SSB-SC Modulation and Demodulation
3. To Generate Pulse Amplitude Modulated (PAM) Signal and Demodulate it
4. To generate Pulse Width Modulated (PWM/PTM/PLM/PDM) Signal and Demodulate it.
5. To Generate the DSB-SC Modulated wave and to Observe the Phase Reversal at the Zero Crossing of the Modulating Signal
6. To Generate Pulse Position Modulated (PPM) Signal and Demodulate it
7. Study of TDM pulse amplitude modulation and demodulation.
8. Study of pulse code modulation and demodulation techniques.
9. Study of delta and adaptive-delta modulation methods.
10. Study of Phase Shift Keying Modulation and Demodulation Technique.
11. Study of Amplitude Shift Keying Modulation and Demodulation Technique.
12. Study of Frequency Division Multiplexing and Demultiplexing.
13. Study of Frequency Shift Keying (FSK) modulation.
14. Study of DPSK modulation.

Miscellaneous

1. To study the characteristics and testing methods if TT attenuators.
2. To study the Carrier Wave (CW) operation of Klystron tube and determine its operating frequency.
3. To study the Square Wave operation of Klystron tube and determine its operating frequency.
4. To study the modes of Klystron tube.
5. To determine the frequency and wavelength of rectangular waveguide, working on TE10 mode.

6. 10. To determine the standing wave ratio (SWR) of Klystron tube.
7. 11. To determine the Reflection Coefficient of Klystron tube.

Any other experiment of equal standard relevant to syllabus can also be set.
Note: -Students have to perform at least 10 experiments from the above list.

Books: Laboratory Experiments and PSPICE Simulations in Analog Electronics Maheshwari & Anand PHI

ELP 206 LAB COURSE "D"- 8085 MICROPROCESSOR PROGRAMMING, STUDY CARDS AND INTERFACING LAB

M.Sc. Electronics
Jan-June 2021
Semester II

At the end of this course, Students will be able to

1. Simple programs to understand the instruction set of 8085 microprocessors.
2. Simple programs to understand the study cards.
3. Interface various I/O devices with microprocessor and microcontroller.
4. Prepare the technical report on the experiments carried.

Max. Marks: 100, Min. Marks: 20

List of Experiments:-

1. Program of 8085 to add 8-bit numbers from memory & display result to C060H memory location & carry in C061 H.

2. Program of 8085 of 8085 to transfer the data of 16 consecutive locations into other 16 Consecutive locations in forward order and vice versa

3. Program of 8085 to search the memory location that contained 05 H data in a string of length of 16 byte and display it to memory location to C060 H.

4. Program of 8085 to search number of 05 H data in a string of length of 16 byte and display it to memory location to C060 H.

5. Program of 8085 to multiply two 8-bit numbers.

6. Program of 8085 to divide two 8-bit numbers.

7. Program of 8085 to solve a Boolean Equation which rep. Combinational logic as follows:-
   X= A' (B+C). D' + A.B. (D+C), A.B.C. & D are four independent variables.
8. Program of 8085 to convert BCD into its equivalent binary number.
9. Program of 8085 to convert Binary number into its equivalent unpacked BCD number.
10. Program of 8085 to count the number of Zeros, positive and negative number in a series of 16 bytes.
11. Program of 8085 to convert Binary number into its equivalent ASCII number.
12. Program of 8085 to convert ASCII into its equivalent binary number.
13. Program of 8085 to find the largest and smallest number in a data array.
14. Program of 8085 to arrange the data array in ascending and descending order.
15. Program of 8085 to add a series of data of 16 consecutive memory location and display the result in C060 H and carry in C061 H memory location using subroutine.
16. Program of 8085 to subtract two 8-bit data from memory location using 2's complement method and display the result in C060 H and borrow in C061 H.

Note: -Students have to perform at least 15 Programs of 8085 from the above list.
*** STUDY OF 8255 CARD ***

1. Program 8255 in mode-O; i.e. simples I/O mode Program Port-A, Port-B, Port-C in O/P mode, transmit data from keyboard to all the ports.
2. Repeat program no.(1), with all ports in I/P mode. Store data to M.P.U.'s registers
3. Program 8255 in B.S.R. mode. Set port-C in O/P mode Using appropriate delay set/reset PC.
4. Program 8255 in mode-1; i.e. strobe I/O mode Program Port-A, Port-B is in mode-1 and Port-A is in O/P mode and Port-B is in I/P mode and Port-C is used in control signal.
5. Program 8255 in mode 0 i.e. simple I/O mode. Program Port A in I/P mode and Prot B in output mode.
6. Program 8255 in mode 0 i.e. simple I/O mode/ Program Port B in I/P mode and Port A in output mode.
7. Program 8255 in mode 0 i.e. simple I/O mode. Program Port A in I/P mode, Port B in input mode. Read data from Port A&B, add it & display

*** STUDY OF 8253 CARD ***

8. Program 8253 in mode-0 i.e. interrupts on terminal count. Select counter c; Read/load lower 8-bits & then higher bits. Draw and explain the function of Gate, Out & Clock Signals.
9. Program 8253 in mode 1. Draw and explain the function of GATE, OUT and CLOCK Signals.
10. Program 8253 in mode 2. Draw and explain the function of GATE OUT and CLOCK Signals.
11. Program 8253 in mode 3 to generate square wave. Draw and explain the function of GATE, OUT and CLOCK Signals.

*** STUDY OF LBDR CARD ***

12. Study of Buffer IC-74L8245 on L.B.D.R. Card using 8085 M.P.U. kit.
13. Study of Latch IC-74L8245 on L.B.D.R. Card using 8085 M.P.U. kit.
14. Study of LBDR as 2 & 4 decoder.
15. To access memory locations (RAM) specified by generation control signals on L.B.D.R. card using 8085 M.P.U.

*** STUDY OF 8259 CARD ***

16. Study of master 8259 in stand-alone mode. Generate and interrupt request-using 8259 and display the respective interrupt in address field.
17. Study of 8259 in cascaded mode i.e. in 8259 as master and the other as slave. Generate an interrupt request using 8259 and display the respective interrupt in address field.

*** STUDY OF 8251 CARD ***

18. Interface 8251 with 8085 M.P.U. and program it in asynchronous transmitter mode, use 8251 Group A.
19. Interface 8251 with 8085 M.P.U. and program it in asynchronous receiver mode, use 8251 Group A.
20. Interface 8251 with 8085 M.P.U. and program it in synchronous transmitter mode, use 8251 Group A.

21. Interface 8251 with 8085 M.P.U. and program 8251 Group A is in synchronous transmitter mode and 8251 B is in synchronous receiver mode.

***STUDY OF 8237/57 CARD ***

22. Interface 8237 IC with 8085 M.P.U. memory to I/O transfer (Read Mode)

23. Interface 8237 IC with 8085 M.P.U. and Study memory to I/O transfer in block transfer mode (write mode).

24. Interface 8237 IC with 8085 M.P.U. and study I/O to memory transfer in single transfer mode (write mode)

25. Interface 8237 IC with 8085 M.P.U. and study I/O to memory transfer. In this mode data stored at 4150H to 415AH

Note: -Students have to perform at least 5 Study Cards from the above list.
PIO Card

***STUDY OF DAC CARDS ***

26. Program to demonstrate DAC as positive going staircase (or ramp) generator.

27. Program to demonstrate DAC as triangular wave generator.

28. Program to demonstrate DAC as exponential binary staircase generator.

29. Program to demonstrate DAC as R-C charging and discharging waveform.

***STUDY OF DYNA THUMBWHEEL CARDS ***

30. To study interfacing of Thumbwheel with microprocessor based system as Dyna-85.

***STUDY OF SERIAL DISPLAY INTERFACE CARDS ***

31. To study interfacing of Serial Display Interface Card with microprocessor based system as Dyna-85.

Note: -Students have to perform at least 2 PIO Cards from the above list

Any other experiment of equal standard relevant to syllabus can also be set.

ELP 305 LAB COURSE "E"- OPTICAL ELECTRONICS AND PHOTONICS
M.Sc Electronics
July-Dec 2021
Semester III

Max. Marks: 100, Min. Marks: 20

Course Objectives: Students will try to learn:
1. .To learn the basic elements of optical fibre transmission link, fiberglass modes configuration s and structures
2. To understand different kinds of losses, signal attenuation in optical fibres & other dispersion factor.
3. To learn various optical sources, LED/LASER structures, receivers (PIN, APD), and noise performance.

Course Outcomes: At the end of this course, students will be able to
1. Perform experiments based on the phenomenon of light/photons.
2. Measure the parameters such as wavelength, resolving power, numerical aperture etc. using the appropriate photonic/optical technique.
3. Prepare the technical report on the experiments carried.
4. Apply the fundamental principles of optics and light wave to design optical fiber communication systems.
5. Differentiate losses in optical fiber link and state transmission characteristics of optical fiber.
6. Design optical fiber communication links using appropriate optical fibers light sources, detectors.

List of Experiments: -

1- Laser Diode Intensity Modulation And Demodulation

To calculate the diameter of a pinhole using Laser.

2- To observe the diffraction pattern and calculate the slit width using single slit.

3- To determine the Grating pitch of transmission Grating.

4- To study the output characteristic of Phototransistor.

5- To study the I-V characteristic of Photodiode.

6- To study the characteristic of LED.

7- To determine the I-V characteristics of PV module with varying radiation and temperature level.

8- To determine the P-V characteristics of PV module with varying radiation and temperature level.

9- To determine the I-V and P-V characteristics of series combination of PV module.

10- To determine the I-V and P-V characteristics of parallel combination of PV module.

11- To show the effect of variation in tilt angle on PV module power.

12- To study the V-I characteristics of DIAC with positive and negative biasing.

13- To study the Optical transducer in Optically Controlled Switching System.

14 To study the Optical transducer characteristics of photovoltaic cell.

15- To study the Optical transducer characteristics of photoconductive cell.

16- To study the Optical transducer characteristics of filament Lamp.

17- To study the characteristics of phototransistor.

18- To study the characteristics of PIN photodiode.

19- To study the effect of variation in tilt angle on PV module power.

20- To determine the Planck's constant.

21- To study the I-V characteristic of LED using expEYES-17 kit.

22- To study the characteristic of LDR using expEYES-17 kit.

23- To calculate velocity of sound using expEYES-17 kit.

For Optional Paper Instrumentation Lab

Transducer control system Trainer kit

1. To study the characteristics of a 3 wire RTD and to observe the change in resistance as Temperature increases (Wheatstone bridge).
2. To study the application of 2 wire RTD in a potentiometer circuit.
3. To study the application of 3 wires RTD in a Wheatstone bridge circuit.
4. To study the characteristics of thermocouple and observe the change in output voltage with the change in temperature.

5. To study semiconductor diode as a temperature sensor.
6. To study transistor as a temperature sensor.
7. To study the application of thermistor in a DC whetstones bridge circuit.
8. To study the application of thermistor in a non- inverting Op – Amp circuit.

Thyristor Application trainer

1. To study & plot the SCR characteristics.
2. To study & plot the UJT characteristics.
3. To study & plot the DIAC characteristics.
4. To study & plot the TRIAC characteristics.

Virtual Instrumentation Using National Instrument LabView Software

1. Design a Virtual Instrument of Half adder digital circuit using LabView.
2. Design a Virtual Instrument of Full adder digital circuit using LabView.
3. Design a Virtual Instrument of Half subtractor digital circuit using LabView.
4. Design a Virtual Instrument of Full subtractor digital circuit using LabView.
5. Design a Virtual Instrument. to find maximum & minimum amplitude of given waveform using LabView.
6. Design a Virtual Instrument to convert Analog waveform to Digital waveform using LabView.
7. Design a Virtual Instrument to generate multitone waveform (sine & square) using LabView.
8. Design a Virtual Instrument to convert Celcius into equivalent Fahrenheit using LabView.

ELP 306 LAB Course "F"- 8086 MICROPROCESSOR PROGRAMMING INTERFACING AND "C" PROGRAMMING LAB

M.Sc Electronics
July-Dec 2021
Semester III

Max. Marks: 100, Min. Marks: 20

List of Experiments:-

8086 ASSEMBLY LANGUAGE PROGRAMMING

1. Write a program to transfer an 8-bit data from register to C060H memory location.
2. Write a program to transfer an 16-bit data from register to C060H memory location.
3. Write a program to add two 8-bit data and result is stored in C060H.
4. Write a program to add two 16-bit data and result is stored in C060H.
5. Write a program to subtract two 8-bit data and result is stored in C060H.
6. Write a program to subtract two 16-bit data and result is stored in C060H.
7. Write a program to multiply two 8-bit data and result is stored in C060H.
8. Write a program to multiply two 16-bit data and result is stored in C060H.
9. Write a program to divide 16-bit data by 8-bit and result is stored in C060H.
10. Write a program to divide 32-bit data by 16-bit and result is stored in C060H.

*** STUDY OF 8255 CARD ***

Study the Interfacing of 8255 Study card with 8086 Microprocessor.

*** STUDY OF 8259 CARD ***

Study the Interfacing of 8259 Study card with 8086 Microprocessor.

List of C Programming

1. Write a program to calculate the roots of quadratic equation Ax2+Bx+C=0.
2. Write a program to calculate the average of a set of n numbers including zero and negative numbers.

3. Write a program to sort an array element in ascending order using bubble sort technique.
4. Write a program to sort and array element in descending order using bubble sort technique.
5. Write a program to plot a sin (X).
6. Write a program to read and print a single dimension array A and B each having 10 elements write a program that prints out an array C having elements, which are sum of the elements of array A and B.
7. Write a program to find a row sum and column sum of a given matrix and built a new matrix with the help of row sum and column sum and previous matrix.
8. Write a program to read and print two-dimensional matrix of order nxm. Find the sum of diagonals.
9. Write a program that calculate and prints out the maximum and minimum of array.
10. Write a program for sorting names in alphabetical order.
11. Write a program to plot and exponential series.
12. Write a program to print the terms in the exponential series, till the term is equal to 0.00001 also compute the exponential series of x,

    ex=1+x+x2/2!+x3/3!+………..+0.00001.
13. Write a program for matrix multiplication.
14. Write a program for matrix addition.
15. Write a program for the operation of (a) addition (b) subtraction (c) multiplication (d) Division, using switch command
16. Write a program to find the factorial of a given number and Fibonacci series using switch command
17. Write a program to find the sum of natural numbers using function

Any other experiment of equal standard relevant to syllabus can also be set

ELP 405 LAB COURSE "G"- OPTICAL COMMUNICATION AND 8051 PROGRAMMING LAB

M.Sc. Electronics
Jan-June 2022
Semester IV

Max. Marks: 100, Min. Marks: 20

List of Experiments: -

Fiber Optics Communication kit

1. Study of setting up a fiber Optic Analog Link.
2. Study of setting up a fiber Optic Digital Link.
3. Study of Losses in Optical Fiber.
4. Measurement of Numerical aperture of a optical fiber.
5. Study of Manchester Coding & Decoding of optical signal.
6. Study of Time Division Demultiplexing through fiber optic link –B .
7. Measurement of Bit Error Rate of an optical signal through fiber optic link -B.
8. Study of Eye Pattern of fiber through fiber optic ling –B.
9. Forming PC to PC Communication Link using Optical Fiber & RS-232Interface.

ExpEYES-17 Kit:

11. To Study and Analyze the Half wave Rectifier (HWR) using ExpEYES-17 Kit.
12. To Study and Analyze the Full wave Rectifier (FWR) using ExpEYES-17 Kit.
13. To Study and Analyze the Clipper circuit using ExpEYES-17 Kit.
14. To Study and Analyze the Clamper circuit using ExpEYES-17 Kit.
15. To Study and Analyze the Op-Amp as Inverting Amplifier using ExpEYES-17 Kit.
16. To Study and Analyze the Op-Amp as Non-inverting Amplifier using ExpEYES-17 I(it.

8051 Programming: -

Any 10 Basic programming in 8051 Microcontroller

General Programming Practical of 8051

1. Write a program to find the addition of two 8- Bit Numbers.
2. Write a Program to subtract Two 8 – Bit Numbers.
3. Write a Program to find Multiplication of Two 8- Bit Numbers.
4. Write a Program to find Division of Two 8- Bit Numbers.
5. Write a Program to find the Factorial of a given numbers.

6. Write a Program to transfer the Data block in Forward order.

7. Write a Program to transfer Data Block in Reverse order.

8. Write a Program to find Addition of Series of numbers.

9. Write a program for searching no. of (05H) in a given Memory Location.

10. Write a Program to find out no. of Even & Odd no. in a given Data Series.

11. Write a Program to count Zero, Positive, Negative no. in a given Data Series.

12. Write a program to count the numbers which are divisible by 3 in a given Data Series

13. Write a Program to find the largest number in a given Data Series.

14. Write a Program to find the smallest number in a given Data Series.

15. Write a Program to arrange the Data in ascending order.

16. Write a Program to arrange the Data in descending order.

17. Write a program to convert Binary Number to BCD Number.

18. Write a program to convert Binary Number to ASCII Number

Interfacing Practical of 8051

1. To Study & Analyze the Interfacing of 16×2 LCD.
2. To Study & Analyze the Interfacing of 5×7 LED Matrix.
3. To Study & Analyze the Interfacing of Seven Segment Display.
4. To Study & Analyze the Interfacing of ADC & DAC Module.
5. To Study & Analyze the Interfacing of DC Motor.
6. To Study & Analyze the Interfacing of Stepper Motor.
7. To Study & Analyze the Interfacing of LEDs.

Any other experiment of equal standard relevant to syllabus can also be set.

ELP 406 Project & Seminar

Course Learning Objectives The course is designed to facilitate the student to acquire special/advanced knowledge, such as supplement study/support study/ solving / analyzing /exploring a real life situation / difficult problem into a project work. The candidate studies this course on his own with an advisory support by a teacher/faculty member.

Course Learning Outcomes: At the end of this course, Students will be able to

1. Survey and study of published literature on the assigned topic

2. Working out a preliminary Approach to the Problem relating to the assigned topic
3. Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility
4. Preparing a Written Report on the Study conducted for presentation to the Department Final Seminar, as oral Presentation before a departmental committee

Max. Marks: 100, Min. Marks: 20

Project

This course provides quality education to students on professional grounds. Apart from classroom lectures and Practical's, the students are also required to undertake a project in the fourth semester. This provides them with an opportunity to interact with the industry. Seminars are organized where eminent professionals from various organizations are invited.

Syllabus Contents The objective of Dissertation/Project Work is to enable the student to take up investigative study in the broad field of Electronics, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor.

Execution and documentation of a project on a specific topic with one of the following aspects

o Part of ongoing research projects in the department
o Developmental work related to industry requirements
o State of the art new technological studies
o Theoretical and experimental studies
o Development of prototypes in the finished product form
o Technical Writing and Project Documentation
o Presentation and Appreciation.

Contents:

1. Identification of research problem
2. Survey of literature
3. Formulation of hypothesis, design and methodology
4. Analysis of data and interpretation of results
5. Discussion and conclusion
6. Writing a project report

Note: Project work will involve investigative work and the student will have to do this in the time after their regular theory and practical classes. The final evaluation of the project work will be through a committee involving internal and external examiners. Guidelines provided by University for executing and evaluation of project work will be final.

Seminar

Each student shall present a seminar in the Fourth semester on a topic relevant to Electronics for about 30 minutes. The topic should not be a replica of what is contained in the syllabus. The topic shall be approved by the Seminar Evaluation Committee of the

Department. The committee shall evaluate the presentation of students. A seminar report in the prescribed form shall be submitted to the department after the approval from the committee.
The topics of current relevance covering following aspects should be chosen
o Collection of reference material
o Assimilation of concepts and preparing document
o Communication skills
o Presentation styles and use of projection aids
o Appraisal and evaluation of delivered seminars

M. Tech in Optoelectronics and Laser Technology

SCHEME OF EXAMINATION, COURSE STRUCTURE
& SYLLABUS

M.Tech. in Optoelectronics & Laser Technology

Choice based Credit System (CBCS)
with
Learning Outcomes based Curriculum Framework (LOCF)

FACULTY OF SCIENCE

Approved by Joint Board of Studies in Electronics & Physics

EFFECTIVE FROM ACADEMIC SESSION

JULY – 2020

Joint Program of
School of Studies in
Electronics and Photonics
&
School of Studies in
Physics and Astro-Physics

Pt. Ravishankar Shukla University
Raipur (C.G.) 492010
WEBSITE: www. prsu.ac.in

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR (C.G.)

School of Studies in Electronics and Photonics &
School of Studies in Physics and Astro-Physics

SCHEME & SYLLABUS

M. Tech in Optoelectronics and Laser Technology (UGC & AICTE Approved)

SESSION – 2020-2021

Programme Objectives: The Master of Technology (M.Tech.) program in Optoelectronics and Laser Technology is designed to prepare students for technically demanding careers in industry as well as for post-master's graduate studies in photonics or related fields. The program is designed to equip motivated students who are willing to contribute to R&D activity towards the advancement of Optoelectronics technology. They shall (i) Engage in professional practice to promote the development of innovative systems and optimized solutions for Optoelectronics technologies in real life applications, (ii) Adapt to different roles and responsibilities in multidisciplinary working environment by respecting professionalism and ethical practices within an institution/organization at national and international levels, (iii) Enhancing skills and adopt existing and emerging technologies for innovations, professional excellence and research activity.

It requires students to build depth in a photonics specialization selected from areas such as lasers and applications, photonics materials and devices, and fiber optics and optical communications. It has a practicum requirement that is satisfied by doing a Minor Project and Industrial training and taking two project-intensive courses Dissertation Phase –I and Phase-II.

The main goal of the master degree program is to prepare professionals with a high level of expertise in cutting-edge photonics technologies and being able to innovate using them, with a practical vision, providing sustainable solutions in different environments, having the proper tools to get involved in an industry demanding experts on those technologies, for creating starts-up or researching in that field.

Optoelectronics & Laser Technology is a highly interdisciplinary Masters programme concerned with fundamental physics of light and optical components as well as a wide range of applications which are essential to our high-tech society, for example our ability to communicate using IT technology.

The field of photonics covers all technical applications of light over the entire spectrum from ultraviolet through visible to near, mid, and far infrared light—and from lasers in CD players through the development of new, energy-saving light sources to integrated light wave circuits and optical fibers. Moreover, photonics plays an increasing role in biology and medicine, for instance in connection with food control or medical therapy, measurement methods for efficiency improvement of wind farms, and technologies capable of measuring the efficiency of combustion processes or carbon dioxide levels in the atmosphere.

This master program aims at giving an extensive two-year teaching program from fundamentals to advanced research topics in Photonics and its interdisciplinary applications. Master students benefiting from this program will be able to work on today's new challenges in their academic or applied research carriers: understanding and control matter and optical phenomena at the ultimate nanometric scale, providing new imaging tools for the most complex biological processes from cells and tissues to clinical applications, bringing original tools in line with future optical devices.

It is worth-mentioning that in our country the number of postgraduate programmes on modern optics is a few, and in Chhattisgarh state, none of institutes and universities has M.Tech programme in Optoelectronics and Laser Technology. It is one of the programme in the country where Organic Electronics course was introduced after IIT, Kanpur This M.Tech. program is approved and supported by University Grants commission, New Delhi under its innovative Programme for Teaching and Research in Interdisciplinary and Emerging Areas and All India Council for Technical Education.

The interdisciplinary M. Tech Programme in Opto-Electronics and Laser Technology at PRSU, Raipur is offered jointly by S.O.S. in Electronics & Photonics and S.o.S. in Physics & Astro Physics, which has been running since 2008.. The main objective of the Programme is to generate trained professionals in the broad area of Opto-Electronics, Optical Communication and laser Technology with a strong background of engineering and science. Students who graduated in earlier batches are immensely contributing to growth of various industries and R&D organizations involved in the area of telecommunication, optical communication & networks, semiconductor technology, fiber integrated optics, Opto-Electronics, software etc.

Pt. Ravishankar Shukla University is one of the few Universities/ Institutions in India that have facilities for R & D activities and man Power training in Photonics and related areas. The department have collaboration with premier R & D institutes of national importance and students have an opportunity for one year project at BARC, Mumbai, RRCAT- Indore, CSIO-Chandigarh, CEERI –Pilani, IIT Mumbai, ISRO, RRI -Bangalore, PRL- Ahmadabad, IICT Hyderabad, , Raman Research Institute, Bangalore NPL New Delhi and other research centers of National & International reputation. They are getting placement in multinational companies, Industries, Academics and other private and Govt. Organizations.

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M. Tech in Optoelectronics and Laser Technology

1. Course Aim : The aim of the course is to train postgraduates with advanced knowledge and understanding of optoelectronics with higher order critical, analytical, problem solving and research skills; ability to think rigorously and independently, to meet higher level expectations of academia and research with sufficient transferrable skills.

2. Course Objectives : The course objectives of M.Tech. in Optoelectronics & laser Technology are to:

1. Impart higher level knowledge and understanding of optoelectronics & laser technology
2. Apply the principles of optoelectronics for newer applications
3. Enable students to analyse mathematical models of physical systems for enhancement of system performance and arrive at limitations of physical systems
4. Enhance students' ability to develop mathematical models of defined physical systems
5. Prepare students to evaluate the soundness of concepts proposed
6. Hone students' skills to pursue physics as a teaching and research career
7. Train students in team work and in lifelong learning for continuous professional development

	COURSE DESCRIPTION	
	Course Objectives:	▪ understanding basic laws and phenomena in the area of Optoelectronics and Lasers ▪ theoretical and practical preparation of students to acquire and apply knowledge and skills in Optoelectronics and Lasers ▪ Conducting experiments in laboratory and industrial environment.
	Learning outcomes: On successful completion of this course, student should be able to	1. explain fundamental physical and technical base of Optoelectronic systems, 2. describe basic laws and phenomena that define behaviour of optoelectronic systems, 3. analyse various premises, approaches procedures and results related to optoelectronic systems, 4. use optical fibre equipment, and data transfer using optical fiber. 5. conduct experiments and measurements in laboratory and on real components, devices and equipment of optoelectronic systems, 6. interpret the acquired data and measured

		results, 7. describe development and application of optoelectronic systems 8. take part in team work and be able to independently present various professional materials. 9. Understand fundamental properties of light and operation principles of basic optical components. 10. Demonstrate a mastery of basic mechanisms of light generation (including lasers) through detailed understanding and analysis of operation principles, characteristics, design architectures and trade-offs of semiconductor lasers. 11. Understand and compare operation principles, characteristics, design architectures and trade-offs of optical detectors and modulators of light. 12. Understand basic system design of fiber optic communication link and fundamental theory of fiber optics. 13. Hands-on testing, measurement and development of optical systems in a range of areas spanning the course

3. Program outcomes for M.Tech program suggested by NBA

PO1. Engineering knowledge: Apply the knowledge of mathematics, science,engineering fundamentals, and an engineering specialization to thesolution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyzecomplex Engineering problems reaching substantiated conclusions usingfirst principles of mathematics, natural sciences, and engineering sciences.

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

PO4. Conduct investigations of complex problems: Use research-basedknowledge and Research methods including design of experiments,analysis and interpretation of data, and Synthesis of the information toprovide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques,resources, and

Modern engineering and IT tools including prediction andmodeling to complex engineering activities with an understanding of thelimitations.

PO6. The engineer and society: Apply reasoning informed by the contextualknowledge to Assess societal, health, safety, legal and cultural issues andthe consequent responsibilities relevant to the professional engineeringpractice.

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

PO8. Ethics: Apply ethical principles and commit to professional ethics andresponsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as amember or leader in diverse teams, and in multidisciplinary settings.

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

PO11. Project management and finance: Demonstrate knowledgeunderstanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manageprojects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation andability to engage in independent and life-long learning in the broadestcontext of technological change.

4. Intended Learning Outcomes of the Course

The intended learning outcomes are listed under four headings:

1. Knowledge and Understanding,
2. Cognitive Skills
3. Practical Skills and
4. Capability/ Transferable Skills.

1 **Knowledge and Understanding** After undergoing this course, a student will be able to:

KU1: Describe the functioning of lasers and optoelectronic devices

KU2: Explain working of a fiber optic communication system

KU3: Acquire a knowledge of optical networks

KU4: Select appropriate tools of nano-optics for desired applications

2 **Cognitive Skills** After undergoing this course, a student will be able to:

CS1: Explore new materials for optoelectronic applications

CS2: Design and simulate fiber optic communication systems

CS3: Design and characterize optical networks

CS4: Apply the techniques for optical engineering to fabricate novel devices

3 **Practical Skills** After undergoing this course, a student will be able to:
PS1: Perform measurements related to lasers and fiber optic communication system
PS2: Conduct experiments with a variety of scientific equipment with minimum guidance
PS3: Design PC based instrumentation
PS4: Use Scilab/MATLAB /MOEMS Software
4 **Capability /Transferable Skills** After undergoing the course, a student will be able to
TS1: Communicate and present ideas clearly and concisely
TS2: Perform under constraints to meet the desired objectives
TS3: Build, work and lead teams effectively
TS4: Adopt a reflective approach to personal development and embrace the philosophy of continual professional development

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR (C.G.)

SYLLABUS

M. Tech. in Optoelectronics and Laser Technology

SEMESTER – I

JULY – DECEMBER, 2020

Course Code	Subject	Core/Elective	Marks			Credits
			Theory	Internal	Total	
OE-11	Modern Optics	C	80	20	100	4
OE-12	Laser Technology	C	80	20	100	4
OE-13	Optoelectronics	C	80	20	100	4
OE-14	Optical Communication	C	80	20	100	4
OE-15	Seminar	C	-	-	50	1
OE-16	Comprehensive Viva voce	C	-	-	Grade	
OE-17	Photonics Lab-I	C	External	Internal	150	3
			120	30		
OE-18	Quantum Optics	E	80	20	100	3
Total for Semester-I					700	23

M. Tech in Optoelectronics and Laser Technology

SEMESTER – II

JANUARY - JUNE, 2021

Course Code	Subject	Core/ Elective	Marks			Credits
			Theory	Interna l	Total	
OE-21	Physics of Advanced Materials	C	80	20	100	4
OE-22	Fiber Optics & Laser Instrumentation and Solar Photovoltaic Technologies	C	80	20	100	4
OE-23	Optical Networks	C	80	20	100	4
OE-24	Advance Optical Communication	C	80	20	100	4
OE-25	Seminar		-	-	50	1
OE-26	Comprehensive Viva Voce		-	-	Grade	
OE-27	Photonics Lab-II	C	External	Internal	150	3
			120	30		
OE 28	Theory-V	E	80	20	100	3
Total for Semester-II					**700**	**23**

Semester III
JULY – DECEMBER, 2021

Course Code	Subject	Core/Elective	Marks	Credits
OE-32	**Major Project Phase -I**	**C**	**400**	**18**

Semester IV

JANUARY - JUNE, 2022

Course Code	Subject	Marks	Credits
OE-41	**Major Project Phase -II**	400	18
OE-42	Comprehensive Viva- Voce	GRADE	
TOTAL CREDITS ALL SEMESTERS		**2200**	**82**

M. Tech in Optoelectronics and Laser Technology

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR (C.G.)
SYLLABUS

SEMESTER – I
July-Dec. 2020

Course Code: OE-11
Course Title: MODERN OPTICS
Credits: 4

OE-11-MODERN OPTICS

Course Objectives :

1. To learn the basic phenomena in Optics.
2. To help the student to develop a thorough understanding of the underlying physical principles of various modern optical phenomena and their applications.

OBJECTIVE:

Course Outcomes :

On successful completion of this course, students should be able to:

1. explain the propagation of light in conducting and non-conducting media (understand level)
2. understand reflection/transmission behaviour of light interacting with a dielectric interface (under (understand level)
3. analyze the polarization state of a beam of light (analyze level)
4. use the principles of wave motion and superposition to explain the physics of polarization, dispersion, interference and diffraction. (apply level)
5. describe the operation of optical devices, including, polarisers, retarders, modulators, inteferometers, difraction gratings. (understand level)
6. have an understanding of light coherence, the coherent properties of light from various sources, and the measurement of degrees of coherence (understand level)
7. use Fourier transform theory to predict and interpret imaging under various Fourier transform filtering conditions.(apply level)

Unit I

Classification of optical processes, optical coefficients, complex refractive index and dielectric constant.

Optical materials : Crystalline insulators and semiconductor, glasses, metal, molecular materials, doped glass and insulator characteristics, Optical Physics in the Solid state, crystal symmetry, electronics bands, vibronic band, the density of state, delocalized states and collective excitation

Light propagation: Propagation of light in dense optical medium, Atomic oscillator, vibration oscillator, free electron oscillation, the Kramers – Kronig relationship, Dispersion, Optical anisotropy, birefringence. Matrix representation of polarization, Jones vector, Jones matrices, Jones calculus, orthogonal polarization. Reflection and refraction at a plane boundary, fresnel's equations.

Unit II

Excitons : Basic concept, free excitons in external electric and magnetic fields, Free Excitons at light densities, Frenkel excitons.

Luminescence: Light emission in solids, Interband luminescence, Direct and indirect gap materials, photoluminescence : Excitation and relaxation, degeneracy Photoluminescence spectroscopy.

Electroluminescence: General Principles of electroluminescence, light emitting diodes, diode laser.

Unit III

Electromagnetism in dielectrics, Electromagnetism fields and Maxwell equation.

Electromagnetism waves, Quantum theory of radiative absorption and emission. Einstein coefficients, Quantum transition rates, selection rules. Basic concept of phonons, Polaritons and polarons.

Laser Plasma Interaction: Basic concepts and two-fluid description of plasmas, electromagnetic wave propagation in plasmas.

Unit IV

Nonlinear optics : Non linear optics : Physical origin of optical nonlinearities, Non resonant and resonant nonlinearities, second order nonlinearities, Non liner frequency mixing, Crystal symmetry, Phase matching, Third order non linear media. Harmonic generation, mixing and parametric effects. multiphonon processes Two-photon absorption, saturated absorption, Spectroscopy Rayleigh, and Raman scattering. Stimulated Raman effect, Hyper Raman effect, Coherent Antistoke Raman scattering Self-focusing and self-phase modulation. Self-induced transparency. Solitons.

Unit V

Optical Design, Fourier Optics & Holography : Revision of geometrical optics. Fourier transforms. impulse response transfer function. Scalar diffraction, spatial and temporal coherence.

Holography: Image forming systems, The wavefront reconstruction process: Inline hologram, the off axis hologram, Fourier hologram, the lens less Fourier hologram. The reconstructed image: Image of a point, image magnification, orthoscopic and pseudoscopic images, effect of source size and spectral bandwidth. Thin hologram, volume hologram, volume transmission hologram and volume refraction holograms. Materials for recording holograms, holograms for displays, colour holography, holographic optical elements. Holographic interferometry: Real time holographic interferometry, double exposure holographic interferometry image hologram, Image forming systems, coherent and incoherent imaging. Spatial filtering. Holography (Fresnel, Fraunhofer, Fourier). Holographic techniques and applications. Fourier transforming property of thin lens.

REFERENCE BOOKS

1. Optical Electronics, A. Yariv Saunders
2. Optical Electronics, Ghatak & Thyagarajan, Cambridge U.K. 3.Essentials of Optoelectronics, A. Rogers (Chapman Hall) 4.Optical Properties of Solids Mark Fox
3. Jasprit Singh, Semi conductor Optoelectronics, McGraw Hill, 1995
4. P. Hariharan, Optical holography, (Cambridge University Press, 1984)

Course Code: OE-12
Course Title: LASER TECHNOLOGY
Credits: 4

OE-12 -LASER TECHNOLOGY

Course Ojectives:

1. To study the principle, construction and working of different lasers.
2. To provide a deeper knowledge about the theory, working and applications of lasers.

Course Outcomes :

On successful completion of the course, the student will be able to:

1. describe Einstein's treatment of absorption and emission of radiation (understand level)
2. describe the conditions required for laser action(understand level)
3. describe laser media with rate equations and solve them(evaluate level)
4. predict the stability of laser cavity (apply level)
5. identify the behavior and functionality of different lasers(analyze level)
6. identify a laser for a particular application(analyze level)
7. review the safety requirements of lasers(understand level)

Unit I

Einstein Coefficients and Light Amplification

Introduction: The Einstein's coefficients, Quantum Theory for the Evaluation of the Transition Rates and Einstein Coefficients, Interaction with radiation having a broad spectrum, Introduction of a near monochromatic wave with an atom having a broad frequency response, More accurate solution for the two level system, Line broadening mechanisms, Saturation Behavior of homogeneously and homogeneously broadening transitions.

Unit II

Laser Rate Equations : Introduction, The three Level System, The Four level System, Variation of Laser Power around Threshold, Optimum Output coupling. Laser spiking.

Semi classical Theory of Laser: Introduction, Cavity Modes, Polarization of cavity medium : First order & Higher order theory.

Unit III

Optical Resonators: Introduction, modes of a rectangular cavity and the open planar resonator, The Quality factor, the ultimate line width of the laser, Transverse and longitudinal mode selection switching. Mode locking in Lasers Co focal Resonator system, Planar resonators, General Spherical Resonator.

Optical Pumping: Laser pumping requirement and techniques, Optical Pumping and Electrical discharge pumping. Introduction of Flash Lamp, Optically and diode pumped solid state lasers.

Unit IV

Properties of Laser Beams and laser Structures

Coherence properties of Laser Light : Temporal Coherence, Spatial Coherence, Directionality

Semiconductor: Interaction of photons with electrons and holes in semiconductors. Optical joint density of states, Structure and properties, operating principle, Threshold condition, Power output.

Heterojunction Laser: Principle and structure, Losses in heterostructure laser, Heterostructure laser materials.

Distributed feedback lasers: Principle of working, Coupled mode theory.

Quantum well laser, Gain in quantum well lasers, Multiquantum well lasers, Strained quantum well laser, Vertical cavity surface emitting lasers.

Free Electron Lasers: Basic Concepts.

Unit V

Types and Some important applications of laser:

Properties of solid state laser materials, Ruby, Nd:YAG lasers, Er:lasers, Ti: Saphire laser, Excimer lasers. Gas dynamic CO_2 lasers, High Power Laser. Laser induced fusion: Introduction, The fusion process, laser energy requirements. The laser induced Fusion Reactors.

Lasers in Science: Harmonic Generation, Stimulated Raman Emission, Self-focusing, Lasers in Chemistry, Rotation of the Earth, Lasers in isotope Separation. Laser in light detection and ranging (LIDAR)

TEXT BOOKS

1. Lasers Theory and Applications : K. Thyagrajan and A.K. Ghatak, Macmillan Publication
2. Laser Fundmentals - Willaim T Selfvast, Cambridge Univ-Press, 2nd edn (2008). (Text)
3. Optical Electronics, Ghatak & Thyagarajan, Cambridge U.P. 0-521-31408-9
4. Laser Physics, P W Milonni and J H Eberly, John Wiley and Sons, 2010
5. Lasers - Anthony E Siegman, University Science Books, USA, 1986
6. Essentials of Optoelectronic, A Rogers (Chapman Hall), 0-412-40890-2

REFERENCE BOOKS

1. Fowles G.R., Introduction to Modem Optics, 2nd Edition, Holt, Rienhart and Winston
2. Lasers and nonlinear optics, BB Laud, Wiley Eastern, 3rd edition (2004)
3. Optical Electronics – A Yariv (4th Ed. Saunders College Pub. (1991).

4. Principles of lasers - Svelto and DC Hanna, 4th edn, Plenum Press (1998)
5. Solid State Laser Engineering - Koechonar (Springer Verlag. 1991
6. Lasers, principles, types and applications-K R Nambiar, New Age International, Delhi (2004)
7. Free Electron Lasers by T.C. Marshall

Course Code: OE-13
Course Title: OPTOELECTRONICS
Credits: 4

OE-13- OPTOELECTRONICS

COURSE OBJECTIVE::

1. To give a deeper understanding of the fundamental theories, fabrication, integration, characterization and applications of novel optoelectronic devices.
2. To introduce the theory, working and applications of various optoelectronic devices.

Course Outcomes :On successful completion of the course the students will be able to
1.recall the properties of Photons and Electrons and recognise their applications in optoelectronic devices. (Remember level)
2.classify LED and laser diode structures and their applications (Understand level)
3.differentiate the types of optical modulators and their applications (Analyze level)
4.categorise different luminescence mechanisms involved in the modern display devices (Analyze level)
5.compare the modes of operations and characteristics of different optoelectronic detectors. (Evaluate level)

Unit I

Optical process in Semiconductors

Electron hole pair formation and recombination, absorption in semiconductor, effect of electric field on Absorption, Franz-keldysh and stark effects, Absorption in Quantum wells and Quantum confined stark effect, relation between Absorption and emission spectra, Stokes shift in optical transition, Deep level transitions, Measurement of absorption and luminescence Spectra, Time resolved Photoluminescence.

Unit II

Materials Growth & Fabrication Growth of optoelectronics materials by MBE, MOCVD, Plasma CVD, photochemical deposition. Epitaxy, interfaces and junctions (advantages/disadvantages of growth methods on interface quality, interdiffusion and doping. Quantum wells and band gap engineering

Equipments for Thin Film Deposition: Working principle of Vacuum Coating Unit , Spin Coating Unit, Dip coating unit, Basics of Ellipsometer and Spray pyrolysis apparatus and their specifications and features.

Unit III

Organic Electronics

Molecular materials, Electronic state in conjugated molecules, Optical spectra of molecules, Electronic vibration transitions, the Franck Condon principle hydrocarbons, conjugated polymer, Conductivity and Mobility of nearly-fee Charge Carriers, Charge Carriers in Organic Semiconductors: Polarons, Shallow Traps and Deep Traps, Generation of Charge Carriers and Charge Transport: Experimental Methods. The TOF Method: Gaussian Transport. Space-Charge Limited Currents. Band or Hopping Conductivity, Electric-field Dependence, Charge Transport in Disordered Organic Semiconductors. The Bassler Model

Unit IV

Organic Optoelectronic Devices:

Organic Light-Emitting Diodes (OLEDs). The Principle of the OLED, Multilayer OLEDs. Structure, Fundamental processes Efficiency, Characterization of OLEDs

Organic photovoltaic diodes (OPVDs): Fundamental process, Exciton absorption, Exciton dissociation, Charge collection characterization of OPVDs, Relevant performance parameters.

Unit V

Introduction to Semiconductor Device Simulation: Need of Simulation, Process Simulation, Device Simulation device simulation sequence, hierarchy of transport models, DD Model, Relationship between various transport regimes and significant length-scales.

Numerical Solution Methods - finite difference scheme, discretization of Poisson's and current continuity equations.

TEXT BOOKS

1. Organic Molecular Solids Markus Schwoerer (Author), Hans Christoph Wolf, Wiley-VCH; 1 edition (March 27, 2007)
2. Semiconductor Devices Modeling and Technology" by Nandita Das Gupta and Amitava Das Gupta, Prentice Hall of India Pvt.Ltd.
3. Fibre Optics and Opto-electronics, R P Khare (Oxford University Press, 2004)
4. Computational Electronics :Dragica Vasileska and Stephen M. Goodnick, CRC Press
5. Semiconductor Optoelectronics Devices: Pallabh Bhattacharya. Pearson Education
6. Optical Electronics, A. Yariv Saunders.
7. Optical Electronics, Ghatak & Thyagarajan, Cambridge U.P. 0-521-31408-9
8. Essentials of Electronic & Optoelectronics properties of semiconductor, Jasprit Singh, Cambridge University Press

REFERENCE BOOKS

1. Organic Electronics: Materials, Manufacturing, and Applications Hagen Klauk Wiley-VCH; 1 edition
2. Hand book of thin film technology, by L. I. Maissel and R. Glang
3. Thin film phenomena, By K. L. Chopra

4. Opto electronics -An introduction - J Wilson and J F B J iS Hawkers.(Prentice-Hall India, 1996)
5. Optical fibre communication - J M Senior (Prentice Hall India (1994)
6. Optical fibre communication systems - J Gowar (Prentice Hall 1995)
7. Introduction to optical electronics - J Palais (Prentice Hall, 1988)
8. Semiconductor opto electronics - J asprit Singh (McGraW-Hill, Inc, 1995)
9. Opto electronics-Thyagaraj an and Ghatak, Cambridge Uni, Press (1997)

Course Code: OE-14
Course Title: OPTICAL COMMUNICATION
Credits: 4

OE-14- OPTICAL COMMUNICATION

Course Objectives :

1. To enable the students to understand the principles and design considerations of different optical communication systems.
2. To provide basic understanding and knowledge about various types of optical fiber communication systems**.**
3. To equip students with understanding of Optical fiber communication systems, their analysis and design. Issues in advanced DWDM system, Impairments in optical system, etc.

Course Outcomes: On successful completion of this course students should be able to
1. describe the properties and advantages of optical guided communication (knowledge level)
2. identify the various components of optical fiber communication system (understand level)
3. describe the operation of optical receivers including the types of preamplifiers (understand level)
4. classify various multiplexing schemes and operation principles of wavelength division multiplexing (understand level)
5. distinguish semiconductor optical amplifier and erbium doped fiber amplifier and calculate its gain and power conversion efficiency (understand level)
6. describe various optical network topologies and its performance (understand level)
7. design and prepare optical power loss/gain budget with various line coding(application level)

Unit I

Need for fiber optic Communication, evolution of light wave systems and its components. Optical Fiber **–** their classification, essentials of electromagnetic theory – total internal reflection, Goos Hanchen shifts Dispersion in Single mode fiber, fiber losses, Non liner optical effects and polarization effect. Analysis of Optical fiber waveguides, electromagnetic mode. Theory for optical propagation attenuation and single distortion in optical waveguide. Characteristic equation of step-index fiber, modes and their cut-off frequencies, single-mode fibers, weakly guiding fibers, linearly polarized modes, power distribution. Graded-index fibers- WKB and other analysis, propagation constant, leaky modes, power profiles, dispersions – material, modal & waveguide, impulse response.

Unit II

Physics and Technology of Optical Fiber

Passive photonic components: FO cables, Splices, Connectors, Couplers, Optical filter, Isolator, Circulator and Attenuator, switches.

Fabrication of optical fibers: MOCVD, OVD, VAD, PCVD; measurement of RI, attenuation. Etc. Fiber devices, fiber Bragg gratings, long period gratings, fiber amplifiers and lasers. Application of optical fibers in science, industry, medicine and defense.

Unit III

Optical fiber systems, modulation schemes, Digital and analog fiber communication system, system design consideration, fiber choice, wavelength conversion, switching and cross connect Semiconductor Optical amplifier (SOA), characteristics, advantages and drawback of SOA, Raman amplifier, erbium doped fiber amplifier, gain and noise in EDFA, Brillion fiber amplifier, wideband Hybrid amplifier, noise characteristic, amplifier spontaneous emission, noise amplifier, noise figure, Cumulative and effective noise figure, Noise impairments, amplifier applications.

Unit IV

Optical Transmitters and Receivers : Basic concepts, Light emitting diodes, Semiconductor laser, characteristics, Transmitter design, Optical Receivers; Basic concepts, P-n and pin photo detector. Avalanche photo detector MSM photo detector, Receiver design, Receiver noise, Receiver sensitivity, Sensitivity degradation, performance.

Electro-optic effect, electro optic retardation. Phase and amplitude modulators, transverse electro optic modulators, Acousto-optic effect, Raman-Nath and Bragg regime, acousto-optic modulators, magneto optic effects.

Unit V

Optical Multiplexing Techniques

Wavelength division multiplexing (WDM): Multiplexing Technique, Topologies and architectures, Wavelength shifting and reverse, Switching WDM demultiplexer, optical Add/drop multiplexer. Dense wavelength division multiplexing (DWDM): System consideration, Multiplexer and demultiplexers, fiber amplifier for DWDM, SONET/SDH Transmission, Modulation formats, NRZ and RZ signaling, DPSK system modeling and impairments.

REFERENCES

1 Optical Fibre Communication - G Keiser, McGraw Hill(4th Ed), 2006
2 OpticalFibre Communications - JM Senior(Prentice Hall India 1994)
3 Fibre Optic Communication - CAgarwa1(Wheeler, 1993)
4 OpticalFibre Communication Systems- J Gowar(Prentice Hall, 1995).
5. Fibre Optic Communication -J Palais (Prentice Hall International 1988).
6 Optical networks: A practical perspective Kumar N Sivarajan and Rajeev Ramaswami, MarcourtAsia, 2010

Course Code: OE-15
Course Title: SEMINAR
Credits: 1

Course Objectives: Expertise in understanding research topics in photonics and improving skills such as imparting knowledge and presentation.The seminar should be on a topic of current research. Students have to submit a detailed report and they have to make a presentation of 45 minutes-duration before the seminar committee.

Course outcomes :

1. Presentation Skills

1. In terms of content, students will be able to show competence in identifying relevant information, defining and explaining topics under discussion.
2. They will demonstrate depth of understanding, use primary and secondary sources; they will demonstrate complexity, insight, cogency, independent thought, relevance, and persuasiveness.
3. They will be able to make use of visual, audio and audio-visual material to support their presentation, and will be able to speak cogently with or without notes. Students will present either in groups or as individuals.

2. **Discussion Skills**

Students will be able to judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject, ask appropriate questions, use evidence to support claims, respond to a range of questions, take part in meaningful discussion to reach a shared understanding, speak with or without notes, show depth of understanding, demonstrate breadth of reading, use primary and secondary sources, show independence and flexibility of thought, help discussions to move forward, show intellectual leadership and effective time management.

3. Listening Skills

1. Students will demonstrate that they have paid close attention to what others say and can respond constructively.
2. Through listening attentively, they will be able to build on discussion fruitfully, supporting and connecting with other discussants.

4. **Argumentative Skills and Critical Thinking**

1. Students will develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information.
2. Students will be able to demonstrate use of appropriate methodologies, test the strength

of their thesis statement, show insight into a topic, appropriate signposting, and clarity of purpose.

3. They will also demonstrate problem-solving skills and apply theoretical knowledge.

5. Questioning

Through asking appropriate questions, students will demonstrate their understanding of discussions and spark further discussion.

Course Code: OE -16

Course Title: Comprehensive Viva voce

Credits: GRADE

Comprehensive Viva-Voce

A comprehensive viva -voce will be held immediately after the end of Semester. The Comprehensive Viva- Voce is intended to assess the student's understanding of various subjects he has studied during the M.Tech. course of study. The Viva-Voce would be conducted by a Board of Examiners consisting of the Head, Course Coordinator and all concerned Faculty Members of the both Electronics and Physics department. The Comprehensive Viva- Voce is evaluated on the basis of Grade. A candidate has to secure a minimum Grade to be declared successful. If he fails to obtain the minimum Grade, he has to reappear for the viva-voce during the next examination. The Grades are as follows.

Course Objetive: The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering acquired over 4 years of study in the undergraduate program .

Course outcomes: Viva will be conducted at the end of 1st,2nd and 4th semester which will be covering the complete syllabus. This will test the student's learning and understanding during the course of their M.Tech programme. In doing so, the main objective of this course is to prepare the students to face interview both in the academic and the industrial sector.

RANGE	QUALITATIVE_ASSESSMENT/GRADE	
91% - 100%	O	Outstanding
81% - 90%	A	Very Good
71% - 80%	B	Good
61% - 70%	C	Fair
50% - 60%	D	Pass

Below 50%	F	Failure

OE-17- Photonics Lab- I

AIM: Laboratory experience.

OBJECTIVE: To empower the students with hands-on experience and to provide practical knowledge about Optoelectronic sources, detectors, devices, optical fibers and Laser.

Course Outcomes: Students will have achieved the ability to:

1. Understand the behaviour of electronic and photonics components and perform analysis and design of bias circuits for diodes, transistors etc.
2. Set up testing strategies and select proper instruments to evaluate performance characteristics of photonic circuit.
3. Choosing testing and experimental procedures on different types of photonic circuit and analyse their operation different operating conditions.
4. To apply the most commonly used simulation tools in photonics applications.
5. To use laboratory test equipment useful in photonics applications.
6. To design and develop full opto-electronic systems by using the photonics-related components and technologies studied along the master.
7. To design and develop the required test and measurements procedures to evaluate the working operation of an optoelectronic system.
8. To apply the knowledge within the photonic engineering field in a real-life environment both at component and at system level.
9. To work effectively in a multidisciplinary group in the photonic field with the ability to react to technical and operative difficulties in a technological project.

Experiments are to be performed in the Advance Photonics Laboratory of S. O.S. in Electronics & Photonics

L 1 Fiber Optics Lab:

1. Study of setting up a Optic Analog Link.
2. Study of setting up a fiber Optic Digital Link.
3. Study of Losses in Optical Fiber.
4. Measurement of Numerical aperture of a optical fiber.
5. Study of Manchester Coding & Decoding of optical Signal.
6. Study of Time Division Demultiplexing through fiber optic link – B.
7. Measurement of Bit Error Rate of an optical signal through fiber optic link – B.
8. Study of Eye Pattern of fiber through fiber optic ling – B.
9. Forming PC to PC Communication Link-using Optical Fiber & RS – 232 Interface.

L 2 – Laser Lab:

1. Study of Diode Laser characteristic.
2. Construction of laser beam expander.

3. Measurement of screw parameter.
4. Measurement of electro-optic coefficient.
5. Magneto-optic effect (Faraday Rotation)
6. High voltage sensor based on electro-optic effect.
7. Molecular Weight Measurement.
8. Holography.

The students are required to perform 5 programs using MATLAB platform

Course Code: OE-18
Course Title: Quantum Optics
Credits: 4

OE 18 Quantum Optics

Course Objectives :

1. To provide knowledge on the evolution of Quantum optics and its impact in technological applications.
2. To introduce the basic concepts and theory of Quantum Optics.

Course Outcomes

After taking this course, the student will be able to :

1. Discuss the basic theory of nonlinear optics including sum and difference frequency generation (understand level)
2. Analyze the origin of optical bistability and its implications (analyze level)
3. Examine different mathematical transforms used in optical signal processing and compute the transforms of given functions (Analyze level)
4. Construct spatial filtering geometries based on the Fourier transform property of lens (Apply level)
5. Analyze the role of various light modulators in signal processing (Analyze level)
6. Describe the basic concepts of optical computing and optical neural networks and their practical implementation (Understand level)

Unit-I

Introduction: What is quantum optics, A brief history of quantum optics

Classical optics Maxwell's equations and electromagnetic waves ,Electromagnetic fields ,Maxwell's equations ,Electromagnetic waves , Polarization , Diffraction and interference

Unit-II

Formalism of quantum mechanics , The Schr¨ odinger equation,Properties of wave functions m, Measurements and expectation values, the uncertainty principle, The Stern–Gerlach experiment ,The band theory of solids

Unit III

Radiative transitions in atoms, Einstein coefficients, Radiative transition rates , Selection rules

Photon statistics : Introduction, Photon-counting statistics, Coherent light, Classification of light by photon statistics.

Coherent states and squeezed light , Light waves as classical harmonic oscillators , Light as a quantum harmonic oscillator , Coherent states , Squeezed states , Detection of squeezed light .

Unit IV

Quantum information processing, Quantum cryptography, Classical cryptography , Basic principles of quantum cryptography Quantum key distribution according to the BB84 protocol , System errors and identity verification , Error correction , Identity verification , Practical demonstrations of quantum cryptography ,Quantum cryptography in optical fibres .

Unit V

Quantum computing

Introduction , Quantum bits (qubits) ,The concept of qubit, Quantum logic gates and circuits , Preliminary concepts Single-qubit gates , Two-qubit gates , Practical implementations of qubit operations optical realization of some quantum gates.

Reference Books:

1. Quantum Optics by M. Fox, Oxford Master series in Atomic, Optical and Laser physics
2. Introductory Quantum Optics by C.C. Gerry and P.L. Knight, Cambridge University Press
3. Quantum Optics by M.O. Scully and M.S. Zubairy, Cambridge University Press
4. Quantum Theory of Light by R. Loudon, Oxford science publication

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR (C.G.)

SYLLABUS
M. Tech in Optoelectronics and Laser Technology

SEMESTER – 2
JANUARY – JUNE, 2021

Course Code: OE-21
Course Title: PHYSICS OF ADVANCED MATERIALS
Credits: 4

Course objectives

1. Use the fundamental science and engineering principles relevant to materials that include the relationships between nano/microstructure, characterization, properties, processing, performance and design of materials.
2. Use their knowledge of the significance of research, the value of continued learning and environmental/social issues surrounding materials.
3. Use the technical and communication skills developed in the program as a foundation for careers in engineering, research and development, the pursuit of advanced education and other professional careers.

Course outcomes

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

OE-21- PHYSICS OF ADVANCED MATERIALS

UNIT I

Nano Particles and Nano Structured Materials:

Properties of Individual Nano-Particle: metal nanoparticles, geometric and electronic structure, magnetic clusters, Semiconductor nanoparticles, optical properties, rare gas and molecular clusters, methods of synthesis of nanoparticles. Carbon nanostructure, C60 carbon nanotube and application.

Bulk nano structured materials: Solid disordered nanostructures, methods of synthesis, properties, metal nano-cluster composite glasses, porous silicon; Nano structured crystals.

UNIT II

Quantum Nanostructures and Nano-Machines/Devices:

Quantum wells, wires and dots, preparation, size & dimensionality effects, excitons, single electron tunneling, applications of quantum nanostructure. Super conductivity. Self-assembly, process of self-assemby, semiconductor islands, monolayers. Catalysis, surface area of nanoparticles, porous, and colloidal materials.

Nanomachines and Devices: Microelectromechanical system (MEMSs), Nanoelectromechanical system (NEMSs), Photonic nano & micro circuits, nano and micro fluidics. Application of NEMS and MEMS in Rf, Microfluilds, Optics, BioScience, and Precious Manufacturing.

UNIT- III

Solid state lasers: Material requirement for solid state lasers, Activator ions and centers, Material design parameters for semiconductor laser diode, choosing alloy composition and thickness, making ohmic contracts, Other III-V heterojunction laser materials. Introduction to organic laser. Material selection for light emitting diodes.

Electrical, Optical and Thermal properties of III-V and II-VI semiconductors required for optoelectronics devices for visible and IR range.

Electroluminescent materials: Inorganic electroluminescence, AC powder EL, ACTFEL device, EL characteristics, EL excitation mechanism. Electroluminescence in Organic solids, Material useful for organic thin film EL devices, polymeric material for EL. LED Technologies for Light Emission and Displays. QLED.

UNIT IV

Characterization of Materials: Introduction to emission and absorption spectroscopy: Nature of electromagnetic radiation, electromagnetic spectrum, atomic, molecular, vibrational and X-ray energy levels Basics of UV-VIS spectroscopy: Radiation sources, wavelength selection, Cells and sampling devices, Detectors, Basic ideal of IR spectrometry: Correlation of Infrared spectra with Molecular Structure.

Fundamental of X-ray diffraction, Powder diffraction method, Quantitative determination of phases; Structure analysis. EDAX, Lithography (top down and bottom up), Contact preparation of thin films for device fabrication.

Epitaxial thin film techniques : Liquid phase epitaxy, vapour phase epitaxy, Metal Organic chemical vapour deposition, Atomic layer epitaxy.

UNIT V

Experimental Techniques: High resolution X ray diffraction, Double Crystal diffraction, Drift mobility and Hall mobility, Hall effect for Carrier density and Hall mobility, Photoluminescence (PL) and Excitation Photoluminescence (PLE) Optical pump probe experiments.

Basic idea of Microscopic Techniques: Optical microscope, Scanning Electron Microscope (SEM), Transmission Electron microscope (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), Thickness measurement – Gravimetric method, Basics of Ellipsometry: Optical parameter measurements (n and k).

TEXTS BOOKS

1. Nanotechnology by Charles P. Poole Jr. and Frank J. Owens (Willey Inter. Science pub 2003).
2. Nanostructures and Nanomaterials – Synthesis properties and Applications by Guozhong Cao (Empirical College Press World Scientific Pub. 2004).
3. Physics of Semiconductor Devices by S. M. Sze(Willey Int., 1981)
4. Instrumental methods of analysis, H. H. Willard, L. L. Merritt, J A Dean, F A Sellte, CBs Publishers New Delhi 1996.

REFERENCE BOOKS

1. Scanning Electron Microscopy : OOtley
2. Handbook of Electroluminescent Materials Ed. D. R. Vij Inst of Physics, Bristol and Philadelphia
3. Electronic and Optoelectronic properties of Semiconductor, Jaspreet Singh, Cambridge University Press
4. H. Baltes, O. Brand, Enabling Technology for MEMS and Nanodevices, Wiley, New York, 2004

Course Code: OE-21
Course Title: FIBER OPTICS , LASER INSTRUMENTATION AND SOLAR PHOTOVOLTAIC TECHNOLOGIES
Credits: 4

OE-22- FIBER OPTICS LASER INSTRUMENTATION AND SOLAR PHOTOVOLTAIC TECHNOLOGIES

Course Objectives :

1. To introduce students the fundamental theories and technological aspects of power generation using solar photovoltaic technology**.**
2. To learn theory, working and applications of solar cells.

Course Outcomes: At the end of the course the student should be able to

1. explain the theory of propagation of light in an optical fiber (Understand level)
2. analyze the formation of modes in a planar optical wave guide (Analyze level)
3. examine single mode and multimode optical fibers and classify optical fibers based on their refractive index profiles (Analyze level)
4. compare the loss mechanisms in optical fibers and to compute various losses (Analyze level) 5. distinguish between different techniques to provide optical connections in fibers (Analyze level)
5. summarize the functioning of optical fiber sensors that use amplitude, phase, frequency and polarization type modulation schemes (Evaluate level)
6. analyze the different nonlinear processes associated with light-matter interaction. (Analyze level)
7. Identify lasers with appropriate wavelength for various applications (Understand level)
8. to understand the role of solar energy in the context of regional and global energy system, its economic, social and environmental connotations, and the impact of technology on a local and global context.
9. to understand the physical principles of the photovoltaic (PV) solar cell and what are its sources of losses.
10. to understand and apply the basic concepts of solar radiation necessary for dimensioning (sizing) PV systems installations.
11. to know the electrical (current-voltage and power-voltage) characteristics of solar cell, panel or generator and how the environment parameters influence it

Unit I

OPTICAL FIBER AND THEIR PROPERTIES

Principle of light propagation through a fiber – Different types of fiber and their properties –

Fiber materials and their characteristics – Transmission characteristic of fibers – absorption losses – scattering losses – Dispersion – measurement of optical fibers – optical sources – Optical detectors. Dispersion shifted Fiber Technologies.

Unit II

FIBER OPTIC SENSORS IN MEASUREMENTS

Fiber optic instrumentation system – Fiber optic sensors, Different types of modulators, Applicationin instrumentation, Interferometric method of length Measurement, Measurement of pressure, temperature, current, voltage, liquid level and strain. Magnetic and electric field sensors based on the characteristics like intensity, phase, polarization, frequency and wavelength of light wave , Plasmonic nano-sensors.

Laser Plasma Interaction: Basic concepts and two-fluid description of plasmas, electromagnetic wave propagation in plasmas.

Unit III

LASERS IN MEASUREMENTS AND TESTING

Laser for measurement of distance, velocity, acceleration, current, voltage, and atmospheric effect, Laser application in Spatial Frequency filtering. surface topology & optical component testing, beam modulation telemetry, laser Doppler velocimetry, surface velocity measurement using speckle patterns, measurements of rate and rotation using laser gyroscope.

Holography: Basic principle, methods; Holographic interferometry and applications; Holography for non–destructive testing – Holographic components. The wavefront reconstruction process: Inline hologram, the off axis hologram, Fourier hologram, the lens less Fourier hologram, image hologram.

Unit IV

Lasers in Industry – Laser material processing: Laser matter interactions, mode of coupling energy from beam to the material. CW and pulsed heating and the resulting effect. Thermal processing of materials with lasers, Application in material processing, Laser Welding, Hole Drilling, Laser cutting, Laser Tracking, heat treatment, glazing, alloying, cladding, hardening of surfaces, semiconductor annealing and trimming.

BioMedical Application of Lasers: Medical applications of lasers; laser and tissue interaction – Laser instrument of surgery. Laser light scattering, application in biomedicine. Light transport in tissue.

Photochemical, photothermal, photomechanical effects and their therapeutic applications. Optical imaging and diagnosis. Biomedical Instruments.

Unit V

Solar Photovoltaic Technologies

Generation of Photo voltage, Light Generated current,, I-V equation, Solar Cell Characteristics, parameters of solar cells, Relation of Voc and Eg

Design of solar cells: Upper limit of cell parameters, Losses in Solar Cell, Design for High Isc, Voc and FF Analytical Techniques: Solar Simulator-IV measurement, Quantum efficiency measurement, Minority carrier lifetime & diffusion length measurement.

TEXT BOOKs

1. Optical fiber communication-G Keiser ,McGraw Hill Education; Fifth edition (2017)
2. Introduction to fiber optics , Ajoy Ghatak and K. Thyagarajan, Cambridge Univ Press (2017)
3. Optical Fiber Communications: Principles and Practice, John M Senior, Pearson Education India, 3rd edition (2010)
4. Fundamentals Of Fibre Optics In Telecommunication And Sensor Systems, B P Pal, new age publishers (1992)
5. Solar Photovoltaics: Fundamentals, Technologies and Applications, C. S. Solanki, 2nd Edition Prentice Hall of India, 2011.
6. Understanding fiber optics, J Hecht, Laser Light Press, 5 edition (2016)
7. John F Ready, Industrial application of lasers. Academic press 1978
8. John Crisp, Introduction to Fibre Optics , an imprint of Elsevier Science 1996
9. Understanding Fiber Optics, 4th or 5th edition; Jeff Hech; Prentice Hall Publishers
10. Optical Fiber Communication Principles and Systems, A. Selvarajan, S. Kar and T. Srinivas TMH

REFERENCE BOOK

1. Fiber Optic Communication System, G. P. Agarwal, Willey Eastern
2. Laser Material processing by W.M. Steen
3. Industrial Laser and their applications, John and Harry, McGraw Hill
4. M.L. Wolbarshi, Ed. Laser Applications in Medicine & Biology, Vol.1, 2 & 3 (Plenum, New York, 1971,74,77)
5. Solar cells: Operating principles, technology and system applications, by Martin A. Green, Prentice- Hall Inc, Englewood Cliffs, NJ, USA

JANUARY – JUNE, 2021

Course Code: OE-23
Course Title: OPTICAL NETWORKS
Credits: 4

OE-23- OPTICAL NETWORKS
Course Objectives:
The main objectives of the course are to:

1. Familiarize students with the optical network evolution, from the point-to-point link to the intelligent transport
2. Introduce the main elements and components of the all-optical networking solution
3. Explore the capabilities and limitations of the optical network
4. Expose students to recent research articles on various optical networking issues

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

1. Identify the three generations of optical networking evolution
2. Name the all-important technological issues that affect how optical networks are implemented Comprehend the potentialities and limitations of optical networks
3. Underline how these networks fit in the more classical communication networks based on electronic time division
4. Compare the performance of optical networks via computer discrete-event simulation
5. Review current optical networking trends like optical packet, burst or label switching from research articles

Unit I
WDM Technology and Issue in WDM Optical networks: Introduction – Optical networks – WDM – WDM optical network evolution- Enabling Technology for WDM optical networks – WDM optical network architecture – Issue in Wavelength routed networks – Next generation optical Internet networks, The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

Unit II
Wavelength Routing Algorithms : Introduction – Classification of RWA algorithms – Fairness and Admission control – Distributed control protocols – Permutation routing and Wavelength requirements Wavelength Rerouting algorithms : Introduction – benefits of wavelength routing – Issue in Wavelength routing – Light path Migration – Rerouting schemes – Algorithm AG – Algorithm MWPG – Rerouting in WDM networks with Sparse Wavelength conversion – Rerouting in Multifiber networks – Rerouting in Multifiber Unidirectional ring Networks .

Unit III

Wavelength Convertible networks : Introduction - need for Wavelength converters – Wavelength convertible switch architecture – routing in convertible networks – Performance evaluation of convertible networks – Networks with Sparse Wavelength conversion – Converter placement problem – Converter allocation problem.

Unit IV

Virtual topology Design: Introduction – Virtual Topology design problem – Virtual topology sub problems – Virtual topology design Heuristics – Regular virtual topology design – predetermined virtual topology and lightpath routes – Design of multi fiber networks.

Virtual Topology Reconfiguration: Introduction – Need for virtual topology reconfiguration – Reconfiguration due to Traffic changes – reconfiguration for fault restoration.

Unit V

Network Survivability and provisioning: Failures and Recovery – Restoration schemes – Multiplexing techniques – Distributed control protocols. Optical Multicast routing – Next generation optical internet network.

JANUARY – JUNE, 2021

TEXT BOOKS

1. C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks : Concepts, Design and Algorithms ", Prentice Hall India 2002.
2. Rajiv Ramasami and Kumar N. Sivarajan, " Optical networks : A Practical Perspective", A Harcourt publishers international company 2000.

Course Code: OE-24
Course Title: ADVANCED OPTICAL COMMUNICATION
Credits: 4

Course Objectives:

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion, SM fibers.
- To learn the various optical sources, materials and fiber splicing
- To learn the fiber optical receivers and noise performance in photo detector.
- To learn link budget, WDM, solitons and SONET/SDH network.

Course Outcomes:

CO1: Demonstrate an understanding of optical fiber communication link, structure, propagation and transmission properties of an optical fiber.

CO2: Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers CO3: Describe the principles of optical sources and power launching-coupling methods.

CO4: Compare the characteristics of fiber optic receivers

CO5: Design a fiber optic link based on budgets

CO6: To assess the different techniques to improve the capacity of the system

OE-24-ADVANCED OPTICAL COMMUNICATION

Unit I

Introduction to optical components – optical amplifiers – types – issue in optical amplifiers – photonic switching – Cross connect – Wavelength conversion – Multiplexer – Demultiplexer, Filters– tunable filters, Photonic Crystal Fibers : Introduction, Guiding mechanism, modified total internal reflection and photonic bandgap guidance, properties and applications, introduction to OICs and its applications.

Unit II:

First Generation Optical Networks

SONET/SDH – multiplexing , element of a SONET/SDH infrastructure - SONET/SDH physical layer, Computer interconnects – ESCON, Fiber channel, HIPPI , Metropolitan area networks – FDDI, ATM, Layered Architecture - SONET/SDH layers – Second generation optical network layers.

Unit III

DWDM: Networks, Devices, and Technology :Fundamentals of DWDM Technology, Architecture and components, Working of DWDM, Topologies and Protection Schemes for DWDM, IP over DWDM Networks, Ethernet switching over DWDM, OTN (Optical Transport Networking), Capacity expansion and Flexibility in DWDM, Future of DWDM, Survivability in DWDM Networks.

Unit IV

OTDM Technology

Important issues of OTDM – optical solitons. Optical pulse compression – fiber grating compressor soliton effect compressor. Modulation instability, fundamental and higher-order solitons, soliton lasers, soliton-based communication systems, fiber loss, frequency chirp, soliton interaction, design aspects, higher-order nonlinear effects. Broadcast OTDM networks, bit interleaving and packet interleaving, optical AND gates, nonlinear optical loop mirrors, terahertz optical asymmetric demultiplexer, switch based networks. Applications of solitons.

Unit -V

FTH and PON Technology

Proposed architecture and issues of Fiber to the home (FTH) – Passive Optical Network (PON), Near space communication – open air optical communication. Inter satellite link hops (ISL). Introduction to all optical networks (AON), Military, Civil, consumer and industrial applications.

TEXT BOOKS :

1. Rajiv Ramaswami and Kumar N. Sivrajan, " Optical networks – A practical perspective", A Harcourt Publishers International Company 2000
2. R. G. Junsperger, " Integrated Optics – Theory and Technology, Springer Series in Optical Sciences", 3rd Edition 1991
3. Gerd Keiser, " Optical Fiber Communications" ,McGraw Hill International Edition 191
4. G. P. Aggarwal," Non Linear Optics", Academic Press.
5. Stamations V. Kartalopoulos, "Understanding SONET/ SDH and ATM Communication network for Next Millennium", PHI 2000.
6. C. Sivaram and mohan Gurusamy, " WDM Optical Networks : Concepts, Design and Algorithms" PHI India 2002.

REFERENCE BOOKS:

1. DWDM: Networks, Devices, and Technology 1st Edition, by "Stamatios, V. Kartalopoulos"
2. Broadband Networking ATM, Adh and SONET, " Mike Sexton, Andy Reid"
3. F. Poli, A. Cucinotta and S. Selleri : Photonic crystal fiber properties and application, Springer, 2007

OE-27- PHOTONICS LAB –II

The Photonics Laboratory is a mandatory course for students aiming to use the experimental facilities of the photonics group. It provides students a hands - on experience with sophisticated instruments under the mentorship of senior students. The experiments are designed carefully to motivate the students towards design, analysis and interpretation. This lab enables scholars to deal with difficulties encountered and precautions to be taken while performing experiments and hence serves as a preparatory course for their research.

M. Tech in Optoelectronics and Laser Technology

Course Outcomes

1. Acquire a theoretical knowledge base in photonics related areas of physics (Optics, Electrodynamics, Physics of Semiconductors, Quantum Mechanics)
2. Develop understanding of application of fundamental laws of physics in such engineering areas as telecommunications, optoelectronics, nano and microfabrication, growth techniques
3. Learn fundamentals of computerized modeling of diverse optical and photonics systems and gain working experience with standard computational tools used in industry.
4. Acquire essential laboratory skills in designing experiments, assembling standard optical tools for optical experimentation, carrying out measurements with customary optical instruments and analyzing acquired data
5. Become familiar with economics and management of photonics related engineering projects
6. Learn to communicate scientific and engineering ideas both orally and in written form
7. Acquire experience working in industrial or research lab settings as a part of a team

Experiments are to be performed in the Advance Photonics Laboratory of S.O.S. in Electronics & Photonics

EXPERIMENTS

1. To calculate the wavelength of Laser using Michelson interferometer.
2. To determine the size of tiny particles using Laser.
3. To determine the grating pitch of transmission grating.
4. To determine the wavelength of a Laser using meter scale ruling.
5. To find the refractive index of glass (transparent materials) by measuring Brewster angle.
6. To determine the bending losses that occurs in a multimode fiber when it is bent along various radii.
7. To determine the absorption coefficient of transparent materials (glass slide).
8. To study the variation of splice losses due to transverse offset, angular tilt and longitudinal separation.
9. To observe the refraction of light in liquid and to calculate its refractive index.
10. To study the wavelength dependence of attenuation in the given optical fiber.
11. To determine insertion loss of each channel of WDM mux, loss uniformity and optical cross talk in channels.
12. To setup optical Add/Drop multiplexer (OADM) using fiber Bragg grating .
13. To setup the WDM link with the given components and determine the total loss for each wavelength.
14. To find the refractive index of transparent Bar using diode Laser.
15. To observe the absorption of Laser light when various colors are introduced in its path.
16. Preparation of thin films with the help of Dip Coating Unit and resistance/ impedance measurement using Source measuring unit.
17. Preparation of thin films with the help of Spray pyrolysis method and resistance/ impedance measurement using Source measuring unit.

18. Preparation of thin films with the help of Spin Coating Unit and optical constant measurement using ellipsometer .

Note: Students have to perform at least 15 experiments

OE 28 Theory-V

The motivation for the course is to make the students understand the fundamentals and physics of photonic materials, devices and nano photonics, as well as nano-photonic devices. **The student may elect one from OE 28 [A] or OR 28 [B].**

Course Code: OE-28[A]
Course Title: PHOTONICS MATERIALS AND DEVICES
Credits: 4

This course covers the theory, design, fabrication and applications of photonic materials and devices. After a survey of optical materials design for semiconductors, dielectrics and polymers, the course examines ray optics, electromagnetic optics and guided wave optics; physics of light-matter interactions; and device design principles of LEDs, lasers, photodetectors, modulators, fiber and waveguide interconnects, optical filters, and photonic crystals. Device processing topics include crystal growth, substrate engineering, thin film deposition, etching and process integration for dielectric, silicon and compound semiconductor materials. The course also covers microphotonic integrated circuits and applications in telecom/datacom systems.

Course Objectives:

1. Photonics is the technology of this century and this course aims to develop an interest and awareness about Photonics in the students.
2. To learn the fundamentals of Lasers and its applications, optical fiber technology, holography and nanophotonics.
3. analyze transmission properties of optical guides
4. describe the mechanisms contributing to signal degradation in optical transmission links
5. describe the performance characteristics of active components, including fiber amplifiers, laser diode, light emitting diode, and photodetector
6. evaluate spectral characteristics of passive components, such as grating and coupler using coupled-mode theory
7. design optical guides and passive guided-wave components with prescribed transmission characteristics

Course Outcomes:

1. Acquire a theoretical knowledge base in photonics related areas of physics (Optics, Electrodynamics, Physics of Semiconductors, Quantum Mechanics)
2. Develop understanding of application of fundamental laws of physics in such engineering areas as telecommunications, optoelectronics, nano and microfabrication, growth techniques

3. Learn fundamentals of computerized modeling of diverse optical and photonics systems and gain working experience with standard computational tools used in industry.
4. Acquire essential laboratory skills in designing experiments, assembling standard optical tools for optical experimentation, carrying out measurements with customary optical instruments and analyzing acquired data
5. Become familiar with economics and management of photonics related engineering projects
6. Learn to communicate scientific and engineering ideas both orally and in written form
7. Acquire experience working in industrial or research lab settings as a part of a team.

OE 28[A] PHOTONICS MATERIALS AND DEVICES

Course Objectives:

1. Acquire a theoretical knowledge base in photonics related areas of physics
2. Learn the fundamental principles of photonics and light-matter interactions,
3. Develop the ability to formulate problems related to photonic structures/processes and analyze them, and
4. Understand processes that help to manipulate the fundamental properties of light.

Course Outcomes : Students should be able to do the following upon completion of this module:

1. Be able to analyze the properties of materials and associated technologies and make judicious choice of the appropriate material/technology for a given application
2. To have a grasp of the state-of-the-art materials and technologies relevant for current and emerging topics in optics and photonics.
3. Explain working principles of basic photonic devices,
4. Make simple calculations to quantify performances of various photonic devices,
5. Choose appropriate photonic devices for achieving certain system requirements,
6. Tell technological limits of several photonic devices such as solar cells, displays, LED bulbs, and describe potential solutions to those problems.

UNIT I

Materials for nonlinear optics, preparation and characterization, evaluations of second order and third order nonlinear coefficients, 3 wave and 4 wave mixing in uniaxial and biaxial crystals.

UNIT II

Frequency up and Frequency down conversions, Photorefractive materials, phase conjugation and its applications.

UNIT III

AO Phenomenon, Raman-Nath and Bragg modulators, deflectors, spectrum analyser devices based on EO and MO effects.

UNIT IV

EL and POS devices, fluoride glass based fibres and their applications, optical fibre based signal processing.

UNIT V

Optical Integrated Circuits, architecture fabrication and applications, CD read/write mechanism, memory storage, information storage and retrivel using holography.

REFERENCE BOOKS

l. Optoelectronic devices and systems, SC Gupta, Prentice Hall India (2005) (Text)
2. Handbook of Nonlinear optical crystals - Dmtriev (Springer Verlag), 2003
3. Optical Electronics - Thyagaraj an and Ghatak W (Cambridge University Press), 1997

Course Code: OE-28[B]
Course Title: NANOPHOTONICS
Credits: 4

[OE 28 B] NANOPHOTONICS

Course Objectives : This advanced topical course shall introduce the basic principles, applications and latest advances in the area of nanophotonics. Student shall have a clear view about this excited new area and ready to contribute to the advances of photonic technology for a broad area of applications, from telecommunication/data communications to solid state display, energy and sensing technologies. Students shall have an opportunity to get the latest update on this new field from the seminars offered by the experts in this area. The main objectives are :

1. To introduce the students to fields of confinement of matter and light matter interaction at the nanoscale and its applications.
2. To learn fundamentals of nanotechnology and its applications in Photonics.

Course Outcomes :

After completing this course students will be able to:

1. Learn about the background on Nanophotonics
2. Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment

3. Apply their learned knowledge to develop Nanomaterial's.

UNIT I

Foundations for Nanophotonics

Confinement of Photons and Electrons, Propagation Through a Classically Forbidden Zone: Tunneling, Localization Under a' Periodic Potential: Bandgap, Cooperative Effects for Photons and Electrons, Nanoscale Optical Interactions, Axial and Lateral Nanoscopic Localization, Nanoscale Confinement of Electronic Interactions, Quantum Confinement Effects, Nanoscopic Interaction Dynamics, Nanoscale Electronic Energy Transfer.
Near-Field Interaction and Microscopy : Near-Field Optics, Modeling of Near-Field Nanoscopic Interactions, Near-Field Microscopy, Aperture less Near-Field Spectroscopy and Microscopy, Nanoscale Enhancement of Optical Interactions, Time- and Space-Resolved Studies of Nanoscale Dynamics.

UNIT II

Quantum-Confined Materials : Quantum Wells, Quantum Wires, Quantum Dots
Quantum Rings, Manifestations of Quantum Confinement, Optical Properties, Quantum-Confined Stark Effect, Dielectric Confinement Effect, Single-Molecule Spectroscopy, Quantum-Confined Structures as Lasing Media, Metallic Nanoparticles and Nanorods, Metallic Nanoshells Applications of Metallic Nano structures.
Growth and Characterization of Nanomaterials : Growth Methods for Nano materials, Epitaxial Growth, Laser-Assisted Vapor Deposition (LAND) Nano chemistry, Characterization of Nano materials, X-Ray Characterization, Transmission Electron Microscopy (TEM) Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM).

UNIT III

Nanostructured Molecular Architectures :Non covalent Interactions, Nanostructured Polymeric Media, Molecular Machines, Dendrimers, Supramolecular Structures, Monolayer and Multilayer Molecular Assemblies.
Photonic Crystals : Basics Concepts, Theoretical Modelling of Photonic Crystals, Features of Photonic Crystals, Methods of Fabrication, Photonic Crystal Optical Circuitry Nonlinear Photonic Crystals, Photonic Crystal Fibers (PCF), Photonic Crystals and Optical Communications, Photonic Crystal Sensors.

UNIT IV

Nanocomposites ,Nanocomposites as Photonic Media, Nanocomposite Waveguides, Random Lasers: Laser Paints, Local Field Enhancement, Multiphasic Nanocomposites, Nanocomposites for Optoelectronics.
Industrial nanophotonics: Nanolithography, Nanosphere Lithography, Dip-Pen Nanolithography, Nanoimprint Lithography, Nanoparticle Coatings, Sunscreen Nanoparticles, Self-Cleaning Glass Fluorescent Quantum Dots, Nano barcodes.

UNIT-V

Bio N ano photonics and nanomedicine :Bioderived Materials, Bioinspired Materials Bio templates, Bacteria as Biosynthesizers, Near-Field Bio imaging, Nanoparticles for Optical Diagnostics and Targeted Therapy, Semiconductor Quantum Dots for Bio imaging Bio sensing, Nano clinics for Optical Diagnostics and Targeted Therapy, Nanoclinic Gene Delivery Nano clinics for Photodynamic Therapy.

REFERENCE BOOKS

Nanophotonics : P N Prasad, Wiley Interscience (2003) (Text)
Biophotonics: P N Prasad, Wiley Publications (2004)
L. Novotny and B. Hecht, Principles of Nano-optics, Second Edition, Cambridge University Press, 2012

Comprehensive Viva-Voce

A comprehensive viva -voce will be held immediately after the end of Semester I, II and IV. The Comprehensive Viva- Voce is intended to assess the student's understanding of various subjects he has studied during the M.Tech. course of study. The Viva-Voce would be conducted by a Board of Examiners consisting of the Head, Course Coordinator and all concerned Faculty Members of the both Electronics and Physics department. The Comprehensive Viva- Voce is evaluated on the basis of Grade. A candidate has to secure a minimum Grade to be declared successful. If he fails to obtain the minimum Grade, he has to reappear for the viva-voce during the next examination. The Grades are as follows.

RANGE	QUALITATIVE_ASSESSMENT/GRADE
91% - 100%	O Outstanding
81% - 90%	A Very Good
71% - 80%	B Good
61% - 70%	C Fair
50% - 60%	D Pass
Below 50%	F Failure

M. Tech in Optoelectronics and Laser Technology

SEMESTER III (July – December, 2021)

Course Code: OE
Course Title: Major Project Phase- I
Credits: 16

Major Project Phase - I

AIM: To enable students to develop deep knowledge, understanding, capabilities and attitudes in Photonics. It should improve their subject knowledge level, experimental and report making skills. It should also enhance aptitude for research and assist career growth.

OBJECTIVE: Each student has to submit a first level of report of the M.Tech project that they are undergoing at the end of the 3rd semester.

Student Outcomes

The Master of Technology in optoelectroics & laser Technology is comprised of rigorous coursework followed by a full year of research project in two phases.

In addition to communication, team work and research skills, each student will attain at least the following learning outcomes from this degree course:

- Demonstrate a depth of knowledge of Photonics
- Complete an independent research project, resulting in at least a thesis publication, and research outputs in terms of publications in high impact factor journals, conference proceedings, and patents.
- Demonstrate knowledge of contemporary issues in their chosen field of research.
- Demonstrate an ability to present and defend their research work to a panel of experts.

Project Work Scheme

Project evaluation shall be done at the end of III and IV semesters and the students will have to submit a dissertation on his / her project work as per the Regulation for M.Tech. The problem may be selected form an appropriate Industry or Institution. The candidate is expected to work under the guidance of a project guide for at least for a period as decided. In case the project work is taken up in an external Industry/Institution, the project shall have two guides: one in the participating organization (Industry/Institution) who is the external guide and the other shall be one of the faculty members form Department who is the internal guide. The dissertation should be submitted within tow calendar years form the starting date of the third semester, Six copies of the dissertation have to be submitted to the M.Tech. Course Coordinator. These copies shall be distributed to the External examiner, Internal Examiner, Project guide (Faculty), Department Library and University Library and the Candidate.

Evaluation of Project Work

The project evaluation committee shall be responsible for the project work evaluation The project evaluation committee as per M.Tech. Regulation. The project guide (faculty from department) shall be the internal examiner. The external examiner shall be a technical expert in the concerned subject form any organization other than that of the project guide and is selected form the panel of experts submitted by the Course Coordinator. The dissertation shall be evaluated by the external examiner.

Three bound copies along with a soft copy of the dissertation shall be submitted to the Head of the Department/Coordinator within the last date prescribed by the Department / School for the purpose. The project work shall be evaluated through presentations and viva voce. The grade/marks shall be given to the students according to the level and quality of work and presentation/documentation.

SEMESTER IV (January – June, 2022)

Major Project Phase- II

Course Code: OE

Course Title: Major Project Phase- II

Credits: 16

AIM: To enable the students to develop deep knowledge, understanding, capabilities and attitudes in Photonics. It should improve their subject knowledge level, experimental and report making skills. It should also enhance aptitude for research and assist career growth.

OBJECTIVE: At the end of 4th semester, each student has to submit a dissertation consisting of the work they have done and findings obtained during their project.

Coding for Question Papers

M. A./ M. Sc. Geog. – 0308

M. A. (First Sem.) GEOGRAPHY

S. No.	Code	
1.	**Geog 101**	Paper – I (Geomorphology) – I
2.	**Geog 102**	Paper – II (Climatology) – II
3	**Geog 103**	Paper – III (Geographical Thought) – III
4	**Geog 104**	Paper – IV (Geography of India)– IV
5	**Geog 105**	Paper – V (Practical-I : Advanced Cartography) – V

M. A. (Second Sem.) GEOGRAPHY

6	**Geog 201**	Paper VI (Economic and Natural Resource Management) - VI
7.	**Geog 202**	Paper VII (Oceanography) - VII
8.	**Geog 203**	Paper VIII (Regional Development and Planning) - VIII
9.	**Geog 204**	Paper IX (Social Geography) - IX
10.	**Geog 205**	Paper X (Practical-II : Map Projections, Interpretation and Surveying) – X

M. A. (Third Sem.) GEOGRAPHY

11.	**Geog 301**	Paper XI (Population Geography) - XI
12.	**Geog 302**	Paper XII (Settlement Geography) - XII
13.	**Geog 303A**	Paper XIII (A) (Remote Sensing Techniques) - XIII
14.	**Geog 303B**	Paper XIII (B) (Biogeography and Ecosystem - XIII
15.	**Geog 304**	Paper XIV (Research Methodology) - XIV
16.	**Geog 305**	Paper XV (Practical – III: Remote Sensing and Quantitative Techniques) – XV

M. A. (Fourth Sem.) GEOGRAPHY

17.	**Geog 401**	Paper XVI (Geography Of Health) - XVI
18.	**Geog 402**	Paper XVII (Agricultural Geography) - XVII
19.	**Geog 403A**	Paper XVIII (A) (Geographical Information System) - XVIII
20.	**Geog 403B**	Paper XVIII (B) (Environmental Geography) - XVIII
21.	**Geog 404**	Paper XIX Field Work (Physical and Socio-Economic) - XIX
22.	**Geog 405**	Paper XX (Practical-IV: Geographical Information system and Quantitative Techniques) - XX

M.A./M. Sc. GEOGRAPHY
SEMESTER I (2020-21)

M. A. /M. Sc. Geography Semester I shall consist the following papers:

S. No.	Paper	Title	M. M.		
			Written	Inte. Asse.	Total
1.	I	Geomorphology	80	20	100
2.	II	Climatology	80	20	100
3.	III	Geographical Thought	80	20	100
4.	IV	Geography of India	80	20	100
5.	V	Practical-I : Advanced Cartography	---	---	100

1. The M. A. /M. Sc. Semester I examination in Geography shall consist of 500 marks.

There shall be four theory papers each of 100 marks and one practical of 100 marks as follows:

Paper I	Geomorphology
Paper II	Climatology
Paper III	Geographical Thought
Paper IV	Geography of India
Paper V	Practical-l: Advanced Cartography

2. The theory papers shall be of three hours duration.

3. Candidates will be required to pass separately in theory and practical examinations.

4. (a) In the practical examination the following shall be the allotment of time and marks.

(i)	Practical record	20%
(ii)	Lab work (up to three hours)	70%
(iii)	Viva on i. ii.	10%

(b) The external and internal examiners shall jointly submit marks.

(c) All the candidates shall present at the time of the practical examination their practical record regularly signed by the teachers concerned.

PAPER –I (2020-21)

GEOMORPHOLOGY

Outcomes:

Geomorphology is essentially a field science, therefore students be taken to the field for effective understanding of geomorphology forms and processes. Department must have good geomorphic lab equipped with photographs of landforms of various climatic regions and toposheets of Survey of India.

On completion of the course, students are able to:

1. Understand the nature, scope and significance of geomorphology and fundamental concepts in subject.

2. To examining the Origin and Evolution of the earth primary relief features by different theories in subject.

3. Understand about Exogenous Processes considering weathering and mass wasting and nature and types of the slope.

4. Evaluate the fundamental Model of Davisian Cycle of Erosion to learn the function of fiver and its landforms development process.

5. Understand formation, process and development of Fluvial and Karst Landforms.

6. To recognize and understand the formation, process and development of Glacial and Aeolian Landforms in geomorphology.

PAPER - II (2020-21)

CLIMATOLOGY

Outcomes:

Weather and climatic chart be made available to the students to explain weather conditions. Audio-visual aids be used for effective technique.

On completion of the course, students are able to:

1. Understand the difference between weather & climate and aims, nature, scope of climatology.

2. Understand the origin, composition and structure of atmosphere

3. Getting facts about Heat Budget and factors effects Heat Budget.

4. Understand the concept of horizontal, vertical temperature and inversion of temperature.

5. Identify the Atmospheric pressure and winds humidity and concept of precipitation and its types.

6. Understand the Air masses and Fronts and the Weather Forecasting.

PAPER – III (2020-21)

GEOGRAPHICAL THOUGHT

Outcomes:

1. Students of geography may be encouraged to interact with their counterparts from other disciplines and discuss the nature of their subject.
2. The students may be encouraged to collect information on any theme amenable to geographical interpretation.
3. To study and understand the founding concepts of human geography in the nineteenth century academy, the authors examine the range of theoretical perspectives that have emerged within human geography over the last century from feminist and Marxist scholarship, through to post-colonial and non-representational theories.

PAPER – IV (2020-21)

GEOGRAPHY OF INDIA

Outcomes:

- On completion of the course, students are able to:
- 1. Understand the about the physiographic division of India and the geography of Chhattisgarh State.
- 2. Understand the India Drainage system of India Rivers.
- 3. Understand the climatic variation in India and climatic region of India and Chhattisgarh State.
- 4. Examine and understand the types of vegetation of India and Chhattisgarh.
- 5. Understand the variation in industrial development in India and Chhattisgarh State.
- 6. Examine and understand the developed and underdeveloped states in India.

PAPER – V (2020-21)

PRACTICAL I - ADVANCED CARTOGRAPHY

Outcomes:

The students need to be trained in the use of conventional vis-à-vis modern tools and techniques of cartographic analysis.

On completion of the course, students are able to:

1. Understand the types and scales of Data measurement.

2. Use data representation by various techniques of maps and Diagrams.

M.A./M. Sc. GEOGRAPHY (2020-21)

SEMESTER – II

M. A. /M. Sc. Geography Semester II shall consist the following papers:

S. No.	Paper	Title	M. M.		
			Written	Inte. Asse.	Total
1.	VI	Economic and Natural Resource Management	80	20	100
2.	VII	Oceanography	80	20	100
3.	VIII	Regional Development and Planning	80	20	100
4.	IX	Social Geography	80	20	100
5.	X	Practical-II : Map Projections, Map Interpretation and Surveying	---	---	100

1. The M. A./M. Sc. Semester II examination in Geography shall consist of 500 marks.

There shall be four theory papers each of 100 marks and one practical of 100 marks as follows:

Paper VI Economic and Natural Resource Management.

Paper VII Oceanography

Paper VIII Regional Development and Planning

Paper IX Social Geography

Paper X Practical-II : Map Projections, Interpretation and Surveying.

2. The theory papers shall be of three hours duration.

3. Candidates will be required to pass separately in theory and practical examinations.

4. (a) In the practical examination the following shall be the allotment of time and marks.

(i) Practical record 20%

(ii) Lab work (up to three hours) 40%

(iii) Field work (up to three hours) 30%

(iv) Viva on i, ii & iii above 10%

(b) The external and internal examiners shall jointly submit marks.

(c) Candidates shall be examined in survey individually. They will however be allowed to take the help of a labourer each at their own expense.

(d) All the candidates shall present at the time of the practical examination their

Practical record regularly signed by the teachers concerned.

PAPER- VI (2020-21)

ECONOMIC AND NATURAL RESOURCE MANAGEMENT

Outcomes:

The students should be acquainted with the different branches of economic geography with examples. They should be motivated to interact with the teacher to identify economic activities of the people residing in different parts of the world.

On completion of the course, students are able to:

1. Students Understand about the Nature and Scope, approaches of Economic Geography and recent trends of economic geography.

2. Understand about the basic Economic Processes- Production, Exchange, Consumption and its applications.

3. Understand the fundamental theories in economic geography.

4. Review, understand and apply the modes of economics development by various models.

5. Compare the economic environment and economic development in the world.

6. Understand the economies scale, transportation and communication and nature and role of international trade in economic development of India.

7. To Students Understand about the definition, types and Forms of energy and classified

material based and process based energy resources.

8. To study the locations of industry and their activities primary and secondary and its factors responsible for same.

9. To review on world distribution of some industries and selected countries and understand the global nature of industrialization and related problems,

10. Study the physical, economic, social and political factors influencing on national and international trade

11. Understand types, characteristics, merits and demerits of modes of transportation at state, national and international level.

12. Understand the various problems of transportation in urban areas.

PAPER – VII (2020-21)

OCEANOGRAPHY

Outcomes:

Detailed charts and maps showing oceanic relief, currents and circulation of water be used for teaching. Audio visual aids be provided for teaching.

On completion of the course, students are able to:

1. Understand the meaning, nature and scope, modern trends in Oceanography.

2. Understand the ocean floor and relief of the ocean bottom.

3. Understand the properties like temperature, density, salinity of ocean water.

4. Understand the characteristics and properties of factors affecting on formation of sea waves.

5. Understand the tides, tide generating forces, types of tides and tidal effects in coastal areas.

6. Get knowledge about distribution of lithogenous, biogenous, and hydrogenous sediments on ocean floor.

PAPER – VIII (2020-21)

REGIONAL DEVELOPMENT AND PLANNING

Outcomes:

1. The students should be made to do seasonal assignments based on diverse data to formulate region at the local, regional levels, and identify the regional differentiations.
2. They should be made conversant with the trends in development of the regional concepts, using ‘space’ in the multi disciplinary approach to regional development.

PAPER – IX (2020-21)

SOCIAL GEOGRAPHY

Outcomes:

The students need to be trained in the use of conventional vis-à-vis modern tools and techniques of cartographic analysis.

On completion of the course, students are able to:

1. Understand the map projections definitions, method, techniques and the types of prospective and non prospective, conventional and classification of Map Projections.
2. Understand the Principles and methods of different topographical surveying techniques.
3. Use the topographical data and understand of thematic maps.

M.A./M. Sc. GEOGRAPHY
SEMESTER III (2020-21)

M.A./M. Sc. Geography Semester III shall consist the following papers:

S. No.	Paper	Title	M. M.		
			Written	Inte. Asse.	Total
1.	XI	Population Geography	80	20	100
2.	X II	Settlement Geography	80	20	100
3.	XIII (A)	Remote Sensing Techniques	80	20	100
	OR	**OR**			
4.	XIII (B)	Biogeography and Ecosystem	80	20	100
5.	XIV	Research Methodology	80	20	100
	XV	Practical-III : Remote Sensing and Quantitative Techniques	---	---	100

1. The M.A. /M. Sc. Semester III examination in Geography shall consist of 500 marks.
   There shall be four theory papers each of 100 marks and one practical of 100 marks as' follows:
   Paper XI : Population Geography
   Paper XII : Settlement Geography
   Paper XIII (A) : Remote Sensing Techniques
   OR
   Paper XIII (B) : Biogeography and Ecosystem
   Paper XIV : Research Methodology
   Paper XV : Practical – III: Remote Sensing and Quantitative Techniques
2. The theory papers shall be of three hours duration.
3. Candidates will be required to pass separately in theory and practical examinations.
4. (a) In the practical examination the following shall be the allotment of time and marks.
   (i) Practical record : 20%
   (ii) Lab work (up to Four hours) : 70%
   (iii) Viva on i. & ii. Above : 10%
   (b) The external and internal examiners shall jointly submit marks.
   (c) All the candidates shall present at the time of the practical examination their practical record regularly signed by the teachers concerned.

SEMESTER – III (2020-21)

PAPER - XI

POPULATION GEOGRAPHY

Outcomes:

Classroom discussion may focus on population and development linkage. Students may also be encouraged to consider various quantitative attributes of population from census 2001, India. Discussion may be arranged on the implication of population policies announced from time to time.

On completion of the course, students are able to:

1. Understand the nature, scope and significance of population geography and fundamental concepts in subject.
2. To review the demographic pattern of national and international level.
3. To understand the composition in terms of age and sex, rural, urban residence, educational status and occupational structure of population.
4. To examine the Fertility and Mortality of population.
5. Understand the concept and methods, population regions of India, population policies of India.

SEMESTER III (2020-21)

PAPER - XII
SETTLEMENT GEOGRAPHY

Outcomes:

1. The students should be trained in the interpretation of settlement pattern from the topographical sheets.
2. They should be encourage to use census and allied data sources to understand hierarchy/ centrally/ functional organization of settlements in space.
3. The students should be taken for the field visits to identify the exact from of relationship between population growths. Changes in morphological structure and environmental degradation and the settlement and should be encourage to write field report based on their observation.
4. Understand the Nature and Scope of Settlement Geography and their evolution, significance and approaches for the study.
5. Understand the settlement types, pattern and nature and process of urban settlement And some basic concept related to settlement geography.

SEMESTER – III (2020-21)

PAPER – XIII (A)
REMOTE SENSING TECHNIQUES

Outcomes:

- Students may be taken to any nearby remote sensing organization to observe different equipments, techniques, and products.
- Students may be asked to look into weather satellite photographs being published in the daily news papers and to prepare some quick report of weather.
- Students may be asked to visit any nearby ground area with its imagery and to compare the ground reality and the corresponding reality in the imagery.

On completion of the course, students are able to:

1. Understand the modern techniques in geography under this course such as remote sensing and aerial photography.
2. Examining the history, basic theories of EMR, and other concepts.
3. Understand and get the knowledge about fundamental concept, types of aerial photography characteristics of aerial photographs and aerial camera.
4. Review on development of Indian remote sensing and functions of IRS.
5. To understand the types of remote sensing, and types of platforms in remote sensing.
6. To get an knowledge about satellite sensor and types of sensors, and their functions and Characteristics
7. Understand the data product, types of data product and its applications and uses in remote Sensing.

PAPER – XIII (B) (2020-21)

BIOGEOGRAPHY AND ECOSYSTEM

Outcomes:

1. The students should be taken on field visit to the local floral fauna zones; they should be acquainted with the local biogeography of the areas.
2. Seminars/lecture should be organized where speakers from the allied disciplines environmental science, ecology, biosciences etc. should be invited to discuss with the students various issues of biogeography with a multidisciplinary approach.
3. There must be more interaction between teacher and students on different aspects of ecology with the help of models, charts and pictures. Emphasis should be given on environmental problems faced by Indian recent years.

SEMESTER – III (2020-21)

PAPER - XIV
RESEARCH METHODOLOGY

Outcomes:

On completion of the course, students are able to:

1. Examining the introduction of research, motivation in research, types of research significance of research, research process and criteria of good research.
2. To understand the research problems, selecting research problems, literature review and to study the hypothesis, its types, sources, formation of hypothesis and utility of hypothesis in scientific research.
3. To understand the research design, need, features basic principal and developing of research plan, and sampling design and its basic types, steps, characteristics of sampling design.
4. Study about type"s data and methods of data collection and study the processing and analysis of data using different statistical methods.
5. Understand the interpretation and report writing, techniques, precaution of interpretation, layout of research report, types of reports and oral presentation mechanics of writing a research report.

SEMESTER – III (2020-21)

PAPER - XV

PRACTICAL –III

Outcomes:

On completion of the course, students are able to:

1. Understand the modern techniques in geography under this course such as remote sensing and aerial photography.
2. Examining the history, basic theories of EMR, and other concepts.
3. Understand and get the knowledge about fundamental concept, types of aerial photography characteristics of aerial photographs and aerial camera.
4. Review on development of Indian remote sensing and functions of IRS.
5. To understand the types of remote sensing, and types of platforms in remote sensing.
6. To get an knowledge about satellite sensor and types of sensors, and their functions and characteristics
7. Understand the data product, types of data product and its applications and uses in remote sensing.
8. Students are able to known the Product moment and Rank Correlation Coefficients of sample data.
9. Students are understood the types and characteristics of data for which hypothesis testing are required to analysis.

M.A./M. Sc. GEOGRAPHY
SEMESTER IV (2020-21)

M.A./M.Sc. Geography Semester IV shall consist the following papers:

S. No.	Paper	Title	M. M.		
			Written	Int. Ass.	Total
1.	XVI	Geography of Health	80	20	100
2.	X VII	Agricultural Geography	80	20	100
3.	XVIII (A)	Geographical Information System	80	20	100
	OR	**OR**			
4.	XVIII (B)	Environmental Geography	80	20	100
	XIX	Field Work (Physical and Socio-Economic)	---	---	100
5.	XX	Practical-IV: Geographical Information System and Quantitative Techniques	---	---	100

1. The M.A./M.Sc. Semester IV examination in Geography shall consist of 500 marks.

   There shall be three theory papers and one Field Work report each of 100 marks and one practical of 100 marks as follows.

S. No.	**Paper**		**Title**
1.	XVI	:	Geography Of Health
2.	XVII	:	Agricultural Geography
.3.	XVIII (A)	:	Geographical Information System
			OR
	XVIII (B)	:	Environmental Geography
4.	XIX	:	Field Work (Physical and Socio-Economic)
5.	XX	:	Practical-IV: Geographical Information system and Quantitative Techniques

2. The theory papers shall be of three hours duration.
3. Candidates will be required to pass separately in theory and practical examinations.
4. Candidates will be required to submit their Field Report in three copies in hard bound at least one hundred pages for Valuation.
5. (a) In the practical examination the following shall be the allotment of time and marks.

   (i) Practical record 20%

   (ii) Lab work (up to Four hours) 70%

   (iii) Viva on i. & ii. above 10%

   (b) The external and internal examiners shall jointly submit marks.

(c) All the candidates shall present at the time of the practical examination their practical record regularly signed by the teachers concerned.

PAPER XVI (2020-21)

GEOGRAPHY OF HEALTH

Outcomes:

There should be interactions between the teacher and students. The teacher should cite examples from neighboring localities. Day trips to health centers may be of interest to the students. Video shows may be arranged where facilities are available.

On completion of the course, students are able to:

1. Understand fundamental concepts, approaches, development and challenges of health care in India.
2. Learn the geographical factors affecting on human health.
3. Get the knowledge of genetic, communicable, non-communicable and occupational diseases.
4. Understand diffusion of diseases and causes major diseases.
5. Understand rural environment and health and health problems of tribes in India.
6. Get the knowledge about urban environment and health; pollution.

SEMESTER – IV (2020-21)
PAPER – XVII
AGRICULTURAL GEOGRAPHY

Outcomes:

On completion of the course, students are able to:

1. Understand about the introduction to agriculture, nature, scope, significance and Development of agriculture geography, study approaches applied in agriculture.

2. Understand the influence of physical, Economic and Technological factors on agriculture patterns.

3. To understand the agricultural system its meaning and concept, Von Thunen's theory of agricultural location, whittlesey‟s classification of agricultural system, types of agricultural, study the types of agricultural in respect of area, salient features and their problems.

4. Understand the agricultural regionalization and modes in agricultural geography and their classification of agricultural models and some theories.

5. Understand definition and characteristics of arid and semi-arid regions and study about droughts and famines, role of irrigation and dry farming.

SEMESTER – IV (2020-21)

PAPER – XVIII (A)
GEOGRAPHICAL INFORMATION SYSTEM

Outcomes:
On completion of the course, students are able to:

- Understand the all fundamental concept of GIS, potential of GIS, concept of space & time, objectives of GIS, elements of GIS, GIS tasks, history of GIS and GIS applications in different field.
- To examine and understand the spatial and non spatial data models and all its functions components and applications in geography.
- Extract the knowledge and information about geospatial analysis and database query and GIS data analysis the various concept and problems in analyzed in GIS environment.
- Understand the concept of map, projections, and coordinate systems and basic of the same for different purposes in geography.
- GIS applied in the various kinds of fields, agriculture, populations, watershed planning and land use planning.

SEMESTER – IV (2020-21)

PAPER – XVIII (B)
ENVIRONMENTAL GEOGRAPHY

Outcomes:

- There must be more interaction between teacher and students on different aspects of ecology with the help of models, charts and pictures. Emphasis should be given on environmental problems faced by Indian recent years.
- The student should be made to do seasonal assignments on different environmental problems, policy and find out some suitable remedies for relevant topics.
- Students are able to known the different environmental policy which has been taken by national and international level.

SEMESTER – IV (2020-21)

PAPER - XIX

FIELD WORK (PHYSICAL AND SOCIO- ECONOMIC) Physical

Outcomes:

1. The practical exercises should aim at identification of micro-geomorphic features on the ground and their relationship to land-use/ settlement pattern.
2. The exercise should familiarize the students with basic-economic characteristics of the chosen area/ settlements through lab experiments. Followed by field visit and conducting enquiry at the village/town/household level.
3. This is also training report writing for the students.

SEMESTER – IV (2020-21)

PAPER – XX

PRACTICAL-IV

Outcomes:

On completion of the course, students are able to:

1. Understand the all fundamental concept of hardware, peripherals of GIS environment,
2. To examine and understand the spatial and non spatial data models and all its functions components and applications in geography through computerized GIS.
3. Extract the knowledge and information about geospatial analysis and database query and GIS data analysis the various concept and problems in analyzed in GIS environment.
4. Understand the concept of map, projections, and coordinate systems and basic of the same for different purposes through GIS.
5. The different modern techniques like GPS, DEM, TIN, and Network analysis are used in GIS for better understand of Physical Geography as well as human geography.
5. GIS applied in the various kinds of fields, agriculture, populations, watershed planning and land use planning.

Learning Outcomes-Based Curriculum Framework for postgraduate education in Geology

1. Introduction

Geology is a discipline in the special category of science with a multi disciplinary approach. It is a fast-moving, diversifying, multidisciplinary field that ranges from understanding the Earths origin in the solar system, the evolution of hydrosphere and atmosphere as well as the earth's materials at the atomic level, through the geological processes that drive volcanoes and earthquakes, surface processes that shape landscapes and create the geological record, biological processes that build diversity and bring extinction, up to planetary-scale systems, such as plate tectonics, climate and the origins of life and ecosystems. The Earth Science takes you very close to the nature as this is basically a filed Science. The geology program integrates field trips with class room learning to give the candidate hands-on experience. These opportunities develop technical skills of the students using measuring instruments and laboratory equipment.

2. Learning outcomes-based approach to curricular planning:

2.1 Nature and extent of PG program in Geology:

The PG program in Geology builds on the basic Geosciences taught at the UG level. The curricula and syllabi are framed and implemented in such a way that the basic connection between theory and experiment and its importance in understanding Geology should be apparent to the student. This is very critical in developing a scientific temperament and urge to innovate, create and discover in Geology.

2.2 Aims of PG program in Geology

The aims and objective of PG educational programs in Geology are structured to

- to motivate and inspire the students to create deep interest in Geology, to develop broad and balanced knowledge and understanding of geological concepts, principles and theories of stratigraphy, geological mapping, exploration of natural resources and understand Earth evolution.
- Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learned in the class rooms.
- Develop the ability to apply the knowledge acquired in the class room and laboratories to specific problems in theoretical and applied Geology.
- Expose the student to the vast scope of Geosciences as a theoretical and experimental science with applications in solving most of the geogenic problems in nature spanning from disaster management, watershed management, water pollution, oil exploration and mining, etc.
- To emphasize the importance of Geology as one of the most important disciplines for sustaining the existing industries and establishing new ones to create job opportunities at all levels of employment.

3 Post Graduate Attributes in Geology

Some of the characteristic attributes of a Geology student are

3.1 Education and Training

a) Provide training of the highest academic quality in Geosciences in a challenging and supportive learning environment.
b) Develop a systematic understanding of both core areas and advanced topics in the study of the Earth, its materials and structure, its history over 4600 million years, and the processes that have control edits evolution as a planet by viewing Earth from new and challenging perspectives of time, space, process and pattern.
c) Develop the ability to evaluate primary evidence critically; and the conceptual understanding to present arguments and solutions based on primary data and theory.
d) Promote an appreciation of the limits to our present understanding of the Earth, its processes and the interactions between them.
e) Stimulate students to see Geology as a vital component of our culture, where science develops as in formed curiosity about the Earth and Society's environment, promoting human development and sustainability through the search for energy sources, raw materials, water supplies, sites for safe waste disposal, and the mitigation of natural hazards.
f) Provide for student interaction with high-level scientific expertise and advanced equipment in an environment committed to scientific advance.
g) Develop skills in gathering and interpreting the geological and geophysical data used to gain this understanding and thereby equip students with the foundations for their professional careers or additional study.
h) Provide an excellent preparation for a career in professional practice in industrial or environmental Earth Sciences, research in Geosciences, and specialist areas of other physical and natural sciences.

3.2 Communication Skills:

a) Skills to communicate in written, numerical, graphical and verbal forms, in ways that are appropriate to different audiences and indifferent situations, ranging from scientific and industry reports, to group and individual oral presentations, and from blogs and outreach articles, to news articles and essays.
b) Formulate a coherent written, electronic or oral presentation on the basis of material gathered dependently on a given topic.
c) Express clearly ideas and arguments, both orally and in writing and in electronic media.
d) Use group discussions and joint seminar presentations to research and present work collaboratively; and Develop oral presentation and participation skills during seminars and group-work, and in written form through online-learning tools, dissertations and essays.

3.3 Critical Thinking:

a) Acquire an understanding of the concept in geology and related disciplines and an ability to understand, integrate, and extend it so that all fundamental geological concepts are accessible.
b) Acquire, digest and critically evaluate scholarly arguments, the assumptions behind them, and their theoretical and empirical components.

3.4 Problem Solving:

a) Skills to recognize and articulate a problem and then apply appropriate conceptual frameworks and methods to solve it.
b) Emphasis is placed on larger, integrated problem-solving exercises, during which students are taught how to process complex data sets using a diverse range of skills and knowledge. This provides the foundation for student-led independent, but academically directed, project work.

3.5 Analytical Reasoning:

a) Competency in both field and laboratory skills, and in data analysis, interpretation and presentation that permit the successful pursuit of pure or applied problems in geology.

3.6 Research-Related Skills:

a) Develop a research design which has an appropriate problem related to earth sciences incorporating some scientific methods, ability to plan and write a research paper.
b) Ability to process and interpret large, complex, datasets, to hypothesis set and test, and to function as a numerate, literate scientist able to prove insight and guidance related to real-world problems and issues.
c) Ability to collect, analyze, synthesize and summarize to formulate and test hypotheses and to reach conclusions.

3.7 Self and Time Management:

a) Time management skills are developed through interaction with the assessment process in all years: students must learn how to meet deadlines for submission of continuous assessment material and how to set aside appropriate time to prepare for end of year examinations.
b) Time management is integral to the student's independent mapping project.

3.8 Team Work:

a) Ability to contribute effectively to team objectives and interact productively with others both in project-related settings and in meetings.
b) This is addressed through group exercises in Geology programme, including in-class presentations, group lab-sessions where students use research equipment, mock-industry presentations to panels of outside industry experts, and group fieldwork mini-projects.

3.9 Scientific Reasoning:

a) View the Earth from new and challenging perspectives of time, space, process & pattern.
b) Develop a systematic understanding of both core areas and advanced topics in the study of the Earth, its materials and structure, its history over 4600 million years, and the processes that have controlled its evolution as a planet.
c) Provide for student interaction with high-level scientific expertise and advanced equipment in an environment committed to scientific advance.
d) Develop the ability to evaluate primary evidence critically; and the conceptual understanding to present arguments and solutions based on primary data and theory.
e) Promote an appreciation of the limits to our present understanding of the Earth, its processes and the interactions between them.

3.10 Digital Literacy:

a) Ability of advanced Word skills and advanced GIS, statistics, databases spreadsheets, digital drawing through online workbooks and workshops
b) ability to use digital resources for presentations

3.11 Moral and Ethical Values:

a) The degree to which every student engages with these themes will vary but it is important that all think especially about ethical issues
b) Avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, and adopting objectives, unbiased and truthful actions in all aspects of work.

3.12 Leadership Readiness:

a) Provide training of the highest academic quality in Earth Sciences in a challenging and supportive learning environment
b) Be accessible to those qualified at intake in a broad and diverse range of sciences.
c) Provide an excellent preparation for a career in professional practice in industrial or environmental Earth Sciences, research in Earth Sciences

3.13 Life-long Learning:

a) ability to blend academic and practical skills
b) ability to transfer such skills to other domains of one's life and work

3.14 Global Competency:

a) After completing course in Geology, the student is expected to be fully knowledgeable about the subject and not only from the point of view of examination.
b) The candidate will be ready to accept challenges and stand in competition at a national and global level.

4. Qualification descriptors for a PG programs in Geology

4.1 Qualification descriptors for a M. Sc Geology

The qualification descriptors for the M.Sc. programme in Geology should have five learning attributes such as understanding, use, communication, expansion, and application of subject knowledge. The key qualification descriptor for M.Sc. Geology should have clarity of communication as well as critical thinking and ethical awareness. Each candidate in Geology should be able to:

- Demonstrate a coherent and systematic knowledge and understanding of the field of

Geology making intelligible Geoscientific research frontiers and theoretical developments in this field in the global context. This would also include the student's ability to collect, analyze, synthesize, summarize and inter-relate diverse processes and facts, to formulate and test hypotheses and reach conclusions.

- Demonstrate the ability to identify and differentiate rocks, minerals, fossils, other Earth materials and Earth structures in the field, as hand specimens and using laboratory techniques including microscopy and spectroscopic analysis. Skill to observe and record original field and laboratory data and then apply these to evaluate and resolve geological and geotechnical problems.

- Demonstrate the ability to assemble and analyze in complete and varied observational data and develop test able hypotheses, predictions or explanations from them. Skills to recognize associations between geological observations and then integrate them into their 3D and 4D (space-time) frame works.

- Demonstrate the ability to share the results of academic and disciplinary learning through different forms of communication such as essays, dissertations, reports, findings, notes, etc. on different platforms of communication such as the classroom, conferences, seminars, workshops, the media and the internet

- Ability to devise and carry out an independent field-based project, including the formulation and testing of hypotheses whilst in the process of carrying out the project. The integration of field-based, experimental and theoretical principles needed for the Earth Sciences.

- Demonstrate a systematic, extensive and coherent knowledge and understanding of the academic field of Geology as a whole and its applications, and links to related disciplinary areas/subjects of study; including a critical understanding of the established theories, principles and concepts, and of a number of advanced and emerging issues;

- Demonstrate procedural knowledge that creates different types of professionals related to Geology, including research and development, teaching and government and public service;

- Demonstrate comprehensive knowledge about materials, including current research, scholarly, and/or professional literature, relating to essential and advanced learning areas pertaining to various sub fields in Geology, and techniques and skills required for identifying problems and issues in their area of specialization.

- Demonstrate skills in identifying information needs, collection of relevant quantitative and/or qualitative geostatistical data drawing on a wide range of sources from the field and labs around the world, analyses and interpretation of data using methodologies as appropriate to the subject of Geology in the area of specialization of the candidate.

- Use knowledge, understanding and skills in Geology for critical assessment of a wide range of ideas and complex problems and issues relating to the various sub fields like mineralogy, petrology, hydrogeology, disasters, etc., etc.

- Communicate the results of studies undertaken in the academic field of Geology accurately in a range of different contexts using the established and emerging concepts, constructs and techniques;

- Address one's own learning needs relating to current and emerging areas of study in Geology, making use of research, development and professional materials as appropriate, including those related to new frontiers of knowledge in science.

The goal of the Geology postgraduate program is to equip students with the fundamental knowledge of the diverse fields of Geology (encompassing Geomorphology and Surface Processes, Hydrology & Low-Temperature Geochemistry, Sedimentology and Paleoecology, and Tectonics and Solid-Earth Processes). In addition, it is critical that students learn to think like a scientist and to apply the scientific method in their coursework and in their lives. The geology program integrates field trips with classroom learning to give the hands-on experience to succeed. These opportunities develop your technical skills using measuring instruments and laboratory equipment. The skills have been split into two groups:

skills needed by any science professional and skills specifically needed by geosciences professionals.

Critical Geosciences Skills

1. Make inferences about Earth systems from observations of the natural world
2. Readily solve problems, especially those requiring partial and temporal interpretation
3. Work with uncertainty, non-uniqueness, incompleteness, ambiguity, and indirect observations
4. Integrate information from different disciplines and apply systems thinking
5. Have strong field skills
6. Have strong computational skills for managing and analyzing multi-component datasets
7. Be able to collect, illustrate, and analyze spatial data

Critical Professional Scientist Skills

8. Think critically and problem-solve
9. Communicate effectively to scientists and non-scientists
10. Integrate information from different sources and continue to learn

The student with the Degree M.Sc. Geology should:

- Acquire a solid base of knowledge in the science of geology as a whole as well as earth materials, earth history, sedimentation and stratigraphy, deformational processes and structural features, and geomorphic processes and landforms.

- Know the geologic time scale and place important geologic events in a temporal framework
- Use compasses, survey instruments, and images in geological investigations
- Understand the pathways, fluxes, and influence of water and other fluids at Earth's surface and in the subsurface
- Interpret topographic maps and terrain models and create profiles
- Interpret geologic maps and construct cross sections from them
- Interpret geophysical measurements of subsurface properties
- Distinguish between various structural features and determine the types of stress responsible for their formation
- Describe and interpret types of surfacial deposits and landforms
- Apply principles of mathematics, chemistry, and physics to geologic problems
- Develop proficiency in conveying complex geologic concepts in clear, technically correct writing.
- Develop proficiency in oral communication of complex geologic concepts.
- Develop the aptitudes and dispositions necessary to help democratize society by obtaining and maintaining employment as a professional geologist.

5.2 Program Learning Outcomes in M. Sc. Geology

The student graduating with the Degree M. Sc. Geology should be able to

- Acquire

a) A fundamental understanding of Geology, its different learning areas and applications in basic Geology like Mineralogy, Petrology, Stratigraphy, Palaeontology, Economic geology, Hydrogeology, etc. and its linkages with related interdisciplinary areas/subjects

b) procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Geology, including professional seng aged in research and development, teaching and government/public service;

c) skills in areas related to one's specialization area within the disciplinary/subject area of Geology and current and emerging developments in the field of Geosciences.

- Demonstrate the ability to use skills in Geology and its related areas of technology for formulating and tackling geosciences-related problems and identifying and applying appropriate geological principle sand methodologies to solve a wide range of problems associated with geosciences.

- Recognize the importance of RS & GIS, mathematical modeling simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.

- Plan and execute Geology-related experiments or investigations, analyze and interpret data/information collect educing appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories in Geology.

- Demonstrate relevant generic skills and global competencies such as

a) problem-solving skills that are required to solve different types of geoscience-related problems with well-defined solutions, and tack leopen-ended problems that belong to the disciplinary area boundaries;
b) investigativeskills,includingskillsofindependentinvestigationofgeoscience-related issues and problems;
c) communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature;
d) analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Geology and ability to translate them with popular language when needed;
e) Personal skills such as the ability to work both independently and in Teams

- Demonstrate professional behavior such as

a) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism;
b) the ability to identify the potential ethical issues in work-related situations;
c) appreciate on of intellectual property, environmental and sustainability issues; and
d) promoting safe learning and working environment.

SEMESTER - I

COURSE: I - STRUCTURAL GEOLOGY

(i) Course learning outcome:

The course deals with geological structures resulting from the action of these forces on rocks. The student will gain knowledge of the geometry of the rock structures, understand the mechanism of the evolution of rock structures and its application in the field.

(ii) Broad contents of the course:

The course is designed for the students to understand the geometry and mechanics of the various geological structures that result through the deformative processes operative within the earth.

(iii) Skills to be learned:

The students learn the skills of identifying different structure and measurements using Bruntoncompass. This is fundamental to geological mapping. This course also helps to know how to use structures and help students appreciate the dynamic nature of the Earth lithosphere.

Learn how to read geologic maps and solve simple map problems using strike and preparations of cross sections.

(iv) The detail contents of this course and references and suggested books:

Rock deformation: Theory of stress & strain, their relationship; Factors controlling rock deformation Properties of elastic, plastic and brittle materials; Progressive deformation.

Strain analysis: types of strain; strain ellipse; strain ellipsoid; Geological application of strain theory. Rheology. Stress analysis: compressive and shear stress; biaxial and triaxial stress. Mohr's Circle and envelope.

Fold: Definition, Geometrical and Genetic Classification of Fold. Fleutys Classification, Ramsay Classification and Dip Isogon Classification. Mechanism of Fold formation and types of fold Superimposed fold; Outcrop pattern of superimposed structure comprising of two fold system. Joints, and its types; their analysis and relation with major structures, Types and mechanism of faulting. Principal stress orientation for the main fault types; Relationship between stress and strain ellipsoid. Analyses of brittle-ductile and ductile shear zones.

Petrofabric Analysis: Field and laboratory techniques. Preparation of petrofabric diagrams and their interpretation.Cleavage & Schistosity: definition and types. Mechanism of formation of Cleavage & Schistosity; its relationship with major deformation structures Lineation: definition and its types; their mode of development and relation to major structures. Plutons: Definition & description; its role in progressive deformation.

Tectonites: definition and its types Stereographic Projection: Principles and application Tectonics and structural characteristics of Plate Boundaries; associated structures in extensional, compressional and strike-slip terrains. Geodynamic evolution of the Himalayas

Books Recommended:

Ghosh, S.K. (1993): Structural Geology: Fundamental and Modern Development. Pergamon Press.
Hobbs, B.E., Means, W.D. and Williams, P.F. (1976): An outline of Structural Geology, John Wiley and Sons, New York.
Ramsay, J.G. (1967): Folding and fracturing of rocks, McGraw Hill.
Ramsay, J.G. and Huber, M.I. (1983): Techniques of Modern Structural Geology, Vol. I Strain Analysis, Academic Press.
Ramsay, J.G. and Huber, M.I. (1987): Techniques of Modern Structural Geology, Vol. II, Folds and Fractures, Academic Press.
Ramsay, J.G. and Huber, M.I. (2000): Techniques of Modern Structural Geology, Vol. III (Application of continuum mechanics), Academic Press.
Turner, F.J. and Weiss, L.E. (1963): Structural analysis of Metamorphic Tectonites, McGraw Hill.
Windley B. (1973): The Evolving continents, John Wiley and Sons, New York.

SEMESTER - I

COURSE: II – MINERALOGY

(i) Course learning outcome:

Studying the mineralogy helps in understanding and building the overall knowledge in Geology.

(ii) Broad contents of the course:

The course deals with the study of minerals in detail – their chemistry, optical and physical properties, paragenesis etc.

(iii) Skills to be learned:

The students will be able to identify common rock-forming minerals in hand specimens as well as in thin sections.

(iv) The detail contents of this course and references and suggested books:

Composition of minerals and Mineraloids. Physical Properties of Minerals depending on Crystal Growth, Crystal Structure, Chemical Composition and Interaction with light.Electrical Magnetic, Luminescence, Thermal and Radioactive Properties of Mineral. Structure of Silicates. Ionic Radius, Coordination Principles, Close Packing, Pauling's Rules. Unit Cell, Bonding Forces in crystals Ionic Bond, Covalent Bond, Van Der Waal's Bond, Metallic Bond.olid solution - Substitution, Interstitial and Omission solid solution. Ex-solution. Polymorphism, polytypism, pseudomorphism. Classification of Minerals. Systematic Mineralogy of Olivine Group b) Garnet Group c) Al2SiO5 Group d) Zircon,a) Topaz, b) Staurolite, c) Sphene. Sorosilicates – Epidote Cordierite b) Tourmaline c) Beryl, Pyroxene Group, Amphibole Group, Serpentine Group b) Mica Group c) Chlorite Group d) Clay Mineral Group – Kaolin and Talc, SiO2 Group, Zeolite Group, Feldspar Group, Feldspathoid Group, Carbonates and Phosphates Gem and Semi precious minerals.

Books Recommended:

Berry, L.G., Mason, B. and Dietrich, R.V. (1982): Mineralogy, CBS Publ. Dana, E.S. and Ford, W.E.(2002): A textbook of Mineralogy (Reprint).

Kerr, P.F. (1977): Optical Mineralogy, McGraw Hill.

Moorhouse, W.W. (1951): Optical Mineralogy, Harper and row Publ. Nesse, D.W. (1986): Optical Mineralogy, McGraw Hill.

Perkins, D. (1998): Mineralogy, Prentice Hall.

Winchell, E.N. (1951): Elements of Optical Mineralogy, Wiley Eastern.

SEMESTER - I

COURSE: III - GEOCHEMISTRY

(i) Course learning outcome:

The course provides a forum to introduce the concept of geochemistry and isotopes to the students and the use of radiogenic and stable isotopes in geosciences.

(ii) Broad contents of the course:

Geochemistry, radiogenic and stable isotopic studies are tools for understanding planetary differentiation, and tracing provenance and process in all spheres of the earth. This course examines the theory and application of geochemistry and isotope geochemistry to a broad range of geologic topics.

(iii) Skills to be learned:

At the end of the course the students will be appraised about the world of isotopesa md their use in dating or geochemical tracing

(iv)The detail contents of this course and references and suggested books

Cosmic Abundance of the Elements and Nucleosynthesis. Geochemical classification of elements. Formation of Solar System and Planets. Composition and Classification of Meteorites, Chondrules, Chondrites and Achondrites. Geology and Chemistry of Moon. Trace, Volatile, Semi volatile, Alkali and Alkaline earth elements its behaviour in Fractional Crystallization and Partial melting. REE and Y, HFSE elements, Transition & Noble elements-its importance and concentrations in various igneous rocks and its behaviour in various magmatic processes. Partition coefficient, Factors governing partition co-efficient. Compatible and incompatible elements, behaviour of these elements in Fractional Crystallization and partial melting.

Fundamental Laws of Thermodynamics. Free energy. Phase equilibrium and Gibb's Phase Rule. Thermodynamics of magmatic Crystallization. Geochemistry of island arcs. Geochemistry of Crust. Composition of Mantle, mineralogy of lower mantle. Phase transition in the Mantle, mineral-phase transition in lower mantle. Stable isotope geochemistry. Oxygen isotope studies. Isotope fractionation, application Oxygen isotope in geothermometry, use of oxygen isotope together with radiogenic isotope in correlation diagrams ,study of crustal contamination, Carbon isotope. Carbon isotope studies in association with Oxygen isotope for Carbonate rocks, Carbon isotope thermometry. Radiogenic isotopes. Decay scheme, Laws of decay, half life period. Decay scheme of K-Ar, Sm-Nd, U-Pb and Rb-Sr. Radiogenic isotopes in petrogenesis Isotopic reservoirs, Depleted mantle (DM), HIMU Mantle, Enriched Mantle, PREMA, Bulk Silicate Earth (BSE), Continental crustal source. Isotopes in geochronology, Concept of geological ages and isochron calculations in Rb-Sr, Sm-Nd systems. Model ages. Concordia and Discordia. Aquatic Chemistry- Acid Base reactions, Dissolution and Precipitation of CaCO3. Solubility of Mg, SiO2 and Al(OH)3Geochemical properties of clays - Kaolinite, Pyrophyllite and Chlorite Groups. Ion exchange properties of clays Redox in Natural Waters. Eutrophication. Factors controlling Weathering. Soil profile. Chemical andbiogeochemical cycling in the soil. Composition of Rivers. Composition of Seawater- Temperature variation.Density structure and deep circulation, Distribution of CO2 in Ocean. Carbonate dissolution and precipitation. Sources and sinks of Dissolved matter in seawater.

Books Recommended:

Drever, J. I., 1988. *The Geochemistry of Natural Waters,* Prentice Hall, Englewood Cliffs, 437 p.
Garrels, R. M. and C. L. Christ. 1965. *Solutions, Minerals and Equilibria*. New York: Harper and Row.
Burns, R. G. 1970. *Mineralogical Applications of Crystal Field Theory*. Cambridge: Cambr Univ. Press.
Henderson, P. 1986. *Inorganic geochemistry*. Oxford: Pergamon Press. Brownlow, A. H. 1996. *Geochemistry*. New York: Prentice Hall.
Krauskopf, K. B. and D. K. Bird. 1995. *Introduction to Geochemistry*. New York: McGraw-Hill.
Bowen, R. 1988. *Isotopes in the Earth Sciences*, Barking (Essex): Elsevier Applied Science Publishers.
Condie, K. C. 1989. *Plate Tectonics and Crustal Evolution*. Oxford: Pergamon. Rollinson Hugh R. *Using Geochemical Data: Evaluation, Presentation, Interpretation* Faure, G., 1986. *Principles of Isotope Geology,* 2nd ed., Wiley & Sons, New York, 589p. Hoefs Jochen: *Stable Isotope Geochemistry*
Dickin Alan P.*: Radiogenic Isotope Geology*
White, W. M. *Geochemistry*

SEMESTER – I

COURSE: IV - CRYSTALLOGRAPHY & CRYSTAL OPTICS

Course learning outcome:

The course will enable the students not only to differentiate minerals based on their optical properties, but also to understand how they originate and associate with each other in a rock.

Broad contents of the course:

The course covers the basics of geoscientific studies in mineralogy. The knowledge of optics is applied in understanding the genesis and identification of minerals.

Skills to be learned

This course will help the students to identify minerals in thin sections- an art and science essential for fundamental research in Geology.

The detail contents of this course and references and suggested books

Crystal growth. Development of ideas of internal structure of crystals. Space lattices and point systems. X-ray analysis of crystal structure, SEM, TEM. Morphology of crystals. Fundamental Laws of Crystal Zones and Zonal Symbols. Symmetry elements, operations. Classification of Crystals in 32 Classes. Symmetry and forms of crystals of isometric, tetragonal and hexagonal systems. Symmetry and forms of crystals of orthorhombic, monoclinic and triclinic systems. Goniometry of Crystals. Crystal Projections – Spherical, Gnomonic and Stereographic. Crystal Aggregates, Twinning, Irregularities & Imperfections in Crystals. Principles of transmission and reflection of light from crystals. Classification of minerals according to interaction of light, Interference colour. Refraction and Refractometry. Methods of determination of R.I. Birefringence in Crystals. Significance and use of plates, wedge and Bereck Compensator. Pleochroism in Crystals. Classification of Crystals into isotropic, Uniaxial and Biaxial minerals. Isotropic, uniaxial and biaxial indicatrix. Optical characters of Isotropic and uniaxial minerals. Optical characters of biaxial minerals. Optical Orientation – Extinction angle, Universal stage. Construction & Use. Dispersion in mineral optic axial angle. Optical anomalies. Systematic determination of optical properties of minerals.

Books Recommended:

Phillips, F.C (1971): Introduction to Crystallography,Longman Group Publ. Dana, E.S. and Ford, W.E. (2002): A textbook of Mineralogy (Reprint).

SEMESTER – II

COURSE: I – IGNEOUS PETROLOGY

(i) Course learning outcome:

On completion of the course the students will have gained an understanding of the processes involved in the formation of igneous rocks, their textures, structures, classifications and their importance.

(ii) Broad contents of the course:

Petrology is the science of rocks. The course will help the students to exhibit an improved understanding of fundamental petrologic processes and common rock types.

(iii) Skills to be learned:

Students learn to identify, describe and classify rocks using and specimens. The students will also acquire skills to determine and interpret geochemistry of rocks

(iv) The detail contents of this course and references and suggested books:

Factors affecting magma and its evolution. Composition of primary magma; mantle mineralogy. Partial melting of mantle – different models. Trace element behavior during partial melting. Magmatic differentiation processes. Behavior of major and trace elements during fractional crystallization. Concurrent assimilation and fractional crystallization. Magma mixing. Various criterion for classification of Igneous rocks. Petrographic Province. Different variation diagrams and their applications. Crystallization of basaltic magmas. Generation of magma with reference to plate tectonics. Study the petrogenetic significance of following silicate systems: Albite-Anorthite, Forsterite – Silica, Diopside-Albite-Anorthite, Diopside-forsterite-silica, Nepheline-kalsilite-silica, Dioside-Forsterite-Nepheline-Silica. Petrogenetic study of Basalt, Ophiolite, Peridotite, Ultramafite, Granite, Anorthosite, Komatite, Kimberlite and Lamproite, Carbonatite, Lamprophyre. Mid-ocean ridge volcanism and oceanic intra-plate volcanism. Magmatism associated with subduction related igneous activity- continental and island arcs. Magmatism in Large Igneous Plutons and continental alkaline magmatism.

Books recommended:

Bose, M.K. (1997): Igneous Petrology, World Press, Kolkata.

Best, Myron G. (2002): Igneous and Metamorphic Petrology, Blackwell Science. Cox, K.G., Bell, J.D.and Pankhurst, R.J. (1993):The Interpretation of Igneous Rocks, Champman and Hall, London.

Faure, G. (2001): Origin of Igneous Rocks, Springer. Hall, A. (1997): Igneous Petrology, Longman.

LeMaitre R.W. (2002): Igneous Rocks: A Classification and Glossary of Terms, Cambr University Press.

McBirney (1994): Igneous Petrology, CBS Publ., Delhi.

Phillpotts, A.R. (1994): Principles of Igneous and Metamorphic Petrology, Prentice Hall of India.

Sood, M.K. (1982): Modern Igneous Petrology, Wiley-Interscience Publ., New York. Srivastava, Rajesh K. and Chandra, R., (1995): Magmatism in Relation to Diverse Tectonic Settings, A.A. Balkema, Rotterdam.

Wilson, M. (1993): Igneous Petrogenesis, Chapman and Hall, London.

Winter, J.D. (2001): An Introduction to Igneous and Metamorphic Petrology, Prentice Hall, New Jersey.

SEMESTER – II
COURSE: II - METAMORPHIC PETROLOGY

Course learning outcome:

On completion of the course the students will have gained an understanding of the processes involved in the formation of metamorphic rocks, their textures, structures, classifications and their importance.

Broad contents of the course:

Petrology is the science of rocks. The course will help the students to exhibit an improved understanding of fundamental petrologic processes and common rock types.

Skills to be learned:

Students learn to identify, describe and classify rocks using and specimens. The students will also acquire skills to determine and interpret geochemistry of rocks

The detail contents of this course and references and suggested books:

Definition of metamorphism, significance of metamorphic rocks. Agents and kinds of metamorphism. Phase rule and its application in metamorphism. Structure and texture of metamorphic rocks and their significance. Classification of metamorphic rocks.Fabric of metamorphic rocks. Evolution of the concept of depth zones. Systematic study of Barrovian and Abukuma zones of metamorphism. Grade of metamorphism, Isograde & Isoreactiongrade and construction of petrogenetic grids. Concept of facies and facies series.Study of ACF, AKF and AFM diagrams. Polymetamorphism and paired metamorphic belts. Metamorphic differentiation. Retrograde Metamorphism and crystalloblastic series. General Characters of thermal and regional metamorphism of limestone, shale and basic igneous rocks.

Metamorphism in relation to magma and orogeny. Metasomatism-Principles and types of metasomatism. Granitization. Anataxis, Palingenesis. Origin of Migmatites in the light of experimental studies. Kinetics of metamorphic mineral reaction. Pressure – temperature – time paths. Ultra-high temperature and ultra-high pressure and ocean floor metamorphism.

Layering in metamorphic rocks. Petrogenetic significance of following rocks with special reference to Indian occurrences: charnockite, amphibolite, Khondalite, Gondite, Eclogite, and Blue schist.

Books Recommended:

Blatt, H. and Tracy, R.J. (1996): Petrology (Igneous, Sedimentary, Metamorphic), W.H. Freeman and Co., NewYork.
Bucher, K. and Martin, F. (2002): Petrogenesis of Metamorphic Rocks (7th Rev. Ed.), Springer–Verlag,.
Kerr, P.F. (1959): Optical Mineralogy, McGraw Hill Book Company Inc., New York. Philpotts, A.R. (1994): Principles of Igneous and Metamorphic Petrology, Prentice Hall. Powell, R. (1978): Equilibrium thermodynamics in Petrology: An Introduction, Harper and Row Publ., London.
Rastogy, R.P. and Mishra, R.R. (1993): An Introduction to Chemical Thermodynamics, Vikash

Publishing House.
Spear, F. S. (1993): Mineralogical Phase Equilibria and pressure – temperature – time Paths, Mineralogical Society of America.
Spry, A. (1976): Metamorphic Textures, Pergamon Press.
Winter, J.D. (2001): An introduction to Igneous and Metamorphic Petrology, Prentice Hall.
Wood, B.J. and Fraser, D.G. (1976): Elementary Thermodynamics for Geologists, Oxford University Press, London.
Yardley, B.W.D., Mackenzie, W.S. and Guilford, C. (1995): Atlas of Metamorphic Rocks and their textures, Longman Scientific and Technical, England.
Yardlley, B.W.D. (1989): An introduction to Metamorphic Petrology, Longman Scientific and Technical, New York.

SEMESTER- II
COURSE: III - SEDIMENTOLOGY AND CRUSTAL EVOLUTION

Course learning outcome:

On completion of the course the students will get a detailed picture of the sedimentation process and processes related to crustal evolution.

Broad contents of the course:

Various sedimentological processes as well as crustal evolution processes are dealt in detail

Skills to be learned:

Students will learn various sedimentological processes as well as crustal evolution processes

The detail contents of this course and references and suggested books

Earth surface system – liberation and flux of sediments. Processes of transport and generation of sedimentary structures. Flow regimes and related bed forms Stromatolites and their significance. Textural analysis of sediments, Graphical representation, statistical treatment and geological significance. Classification of sandstone and carbonate rocks. Dolomite and dolomitization. Volcaniclastics. Sedimentary environments and facies.

Continental: alluvial-fluvial facies, Lacustrine, Desert – Aeolian and glacial sedimentary environments. Shallow coastal clastics and shallow water carbonates. Evaporites. Deep-sea basins. Paleocurrents and basin analysis.
Clastic Petrofacies. Plaeoclimates and paleoenvironment analysis. Diagenesis of sandstone and carbonate rocks – changes in mineralogy, fabric, and chemistry.
Petrogenesis of arkoses, greywacke and quartz arenites. Evolution of lithosphere, hydrosphere, atmosphere and biosphere. Application of Trace, REE and stable isotopes geochemistry to sedimentalogical problems. Surface features of earth – island arcs, mid-oceanic ridges, Young mountain belts and their distribution. Evolution of continental and oceanic crust. Lithological, geochemical, stratigraphic characteristics of granite-greenstone belts Evolution of Proterozoic sedimentary basins of India. Anatomy of Orogenic belts and formation of mountain roots Life in Pre Cambrians, Pre Cambrian, Cambrian boundary with special reference to India

Books Recommended:

Blatt, H., Middleton, G.V. and Murray, R.C. (1980): Origin of Sedimentary Rocks, Prentice-Hall Inc.
Collins, J.D., and Thompson, D.B. (1982): Sedimentary Structures, George Allen and Unwin, London.
Lindholm, R.C. (1987) A Practical Approach to Sedimentology, Allen and Unwin, London.
Miall, A.D. (2000): Principles of Basin Analysis, Springer-Verlag.
Pettijohn;, F.J. (1975): Sedimentary Rocks (3rd Ed.), Harper and Row Publ., New Delhi. Reading, H.G. (1997): Sedimentary Environments and facies, Blackwell Scientific Publication.
Reineck, H.E. and Singh, I.B. (1973): Depositional Sedimentary Environments, Springer-Verlag.
Selley, R. C. (2000) Applied Sedimentology, Academic Press.
Tucker, M.E. (1981): Sedimentary Petrology: An Introduction, Wiley and Sons, New York.
Tucker, M.E. (1990): Carbonate Sedimentolgy, Blackwell Scientific Publication.
Allen P. A. and J.R.L. Allen (2005): Basin Analysis: Principles and Application, Blackwell Publ.
Perry, C.T. and Taylor, K.G. (2006): Envoronmental Sedimentology, Blackwell Publ., U.K.
Bird, J.M. (1980): Plate Tectonics, American Geophysical Union, Washington D.C. Briggs, J.C. (1987): Biogeography and Plate Tectonics, Elsevier.
Lieberman, B. L.(2000): Paleobiogeography: using fossils to study Global Change, Plate Tectonics and Evolution, Plenum Publ., New York.
Jacquelyne Kious, J. and Tilling, R.I. (2007): This Dynamic Earth: The story of Plate Tectonics, USGS Information Services.
Gass I.G. (1982): Understanding the Earth. Artemis Press (Pvt) Ltd.U.K. Windley B. (1973): The Evolving continents, John Wiley and Sons, New York.

SEMESTER – II

COURSE: IV - STRATIGRAPHIC PRINCIPLES AND INDIAN GEOLOGY

Course learning outcome:

The study of stratigraphy encompasses the aspects of the age of the earth, chronological arrangement of rocks and appearance and evolution of life through the geologic time. The knowledge of the concepts in stratigraphy, correlation, and paleontology would enable the students to understand the changes that occurred in the history of the earth and relate them to their field observations and also, in understanding the framework of the stratigraphy of India. The student will gain knowledge about the stratigraphy and geology of India with emphasis on the Stratigraphy of India with respect to Paleozoic, Mesozoic and Cenozoic Era which will help in understanding the different episodes on the earth during the geologic past.

Broad contents of the course: Stratigraphy, the branch of Geology work to unearth the secrets of age from rocks of the earth's crust. Stratigraphers study the composition and arrangement of layered or stratified rocks.. With these objectives in mind it becomes pertinent to understand the basic concepts of Stratigraphy

Skills to be learned:

The students will be exposed to the principles of stratigraphy including order of superposition. They will also be able to identify primary sedimentary structure and their depositional environments.

The detail contents of this course and references and suggested books:

Principles of stratigraphic scales and its divisions, dual classification. Stratigraphic units – lihtostratigraphic, biostratigraphic and chronostratigraphic. Rules of stratigraphic nomenclature. Stratigraphic correlation.Concept of sequence stratigraphy. Chief divisions of Indian sub continent and their physiographic characters. Archaean Era. Distribution and classification in Peninsula (Mysore, Bihar, M. P. and Rajasthan) and extrapeninsular regions. Their correlation and economic importance. Dharwar Supergroup (Classification, Distribution, Economic importance) Cuddaph Supergroup, Vindhyan Supergroup ,Chhattisgarh Group, Indravati Group and Khairagarh Group, Palaeozic formations of extra peninsular regions, Gondwana Supergroup. Gondwana formations. Jurassic system of rocks, Deccan Traps, Problems of Permo-triaassic and Cretaceous – Palaeocene boundaries. Distribution, succession, correlation and life of Siwalik formations. Distribution, lithology, correlation & life of the Cenozoics of Assam & Western India and Pleistocence (Quaternary) deposits, Karewa Beds, Indogangetic Alluvium. Quaternary climate, glacial and interglacial cycle, Eustatic changes

Books Recommended:

Boggs, S. (2001): Principles of Sedimentology and Stratigraphy, Prentice Hall. Danbar, C.O. and Rodgers, J. (1957): Principles of Stratigraphy, John Viley and Sons.

Doyle, P. and Bennett. M.R. (1996): Unlocking the Stratigraphic Record, John Viley and Sons.

Krishnan,M.S. (1982): Geology of India and Burma, C.B.S. Publ. and Distributors, Delhi. Naqvi, S.M. and Rogers, J.J.W. (1987): Precambrian Geology of India, Oxford University Press.

Pascoe, E.H. (1968): A Manual of the Geology of India and Burma (Vols.I-IV), Govt. of India Press, Delhi.

Pomerol, C. (1982): The Cenozoic Era? Tertiary and Quaternary, Ellis Harwood Ltd., Halsted Press.

Schoch, Robert, M. (1989): Stratigraphy: Principles and Methods, Van Nostrand Reinhold, New York.

Krumbein and Sloss (1963): Stratigraphy and sedimentation II Ed.Freeman & Co.

SEMESTER- III

Course –I - PALAEONTOLOGY

Course learning outcome:

The study of Palaeontology encompasses the aspects of the age of the earth, chronological arrangement of rocks and appearance and evolution of life through the geologic time. The knowledge of palaeontology would enable the students to understand the changes that occurred in the history of the earth and relate them to their field observations.

Broad contents of the course:

Palaeontologists study the fossils which have been preserved in the earth's crust by natural processes and are used to fingerprint a large chunk of the age of the earth in terms of time. Palaeontology encompasses study of micro-fossils, plant fossils, vertebrate and invertebrate fossils and their evolution. These aspects are fundamental not only to geology and stratigraphy but to inter-disciplinary fields of paleobotany, paleozoology and evolutionary biology.

Skills to belearned:

The students will acquire skills of discovering and describing fossils and their taxonomic classification. They will also be introduced to interpreting pale climate and pale environment conditions.

The detail contents of this course and references and suggested books:

Definition of fossil and modes of fossilization their application in age, determination, paleoclimatology, palaeogeography and evolution. Modes and theories of organic evolution, concept of bathymetric distribution of animals, migration and extinction of species.Study of morphology, classification, evolutionary trends and geologic and geographic distribution of Brachiopod, Pelecypoda, Gastropoda, Cephalopoda, Trilobites, Echinoids. Graptolites and Rugose Corals.Study of evolutionary history of Horse, Elephant and Man.General study of Siwalik mammalian fauna.Plant life through geologic ages.Study of fossil flora of Gondwana Group and Tertiary Formations of India. Detailed study of micropaleontology. Application of microfossils in stratigraphic correlation, age determination and palaeoenvironmental interpretations. Study of morphology of foraminifers. Classification, evolution and geological distribution of foraminifers.

Books Recommended:

Boardman, R.S., Cheethan, A.M. and Rowell, A.J. (1988): Fossil Invertebrates, Blackwell.
Clarksons, E.N.K. (1998): Invertebrate Paleontology and Evolution, Allen and Unwin, London.
Dobzhansky, Ayala, Stebbins and Valentine (1977): Evolution, Freeman.

Horowitz, A.S. and Potter, E.D. (1971): Introductory Petrography of Fossils, Springer Verlag.
Mayr, E. (1971): Population, Species and Evolution, Harvard.

Prothero, D.R. (2004): Bringing Fossil to Life – An Introduction to Paleontology (2nd Ed.), McGraw Hill.
Raup, D.M. and Stanley, S.M. (1985): Principles of Paleontology ,CBS Publ.. Smith, A.B.(1994): Systematics and Fossil Record – Documenting Evolutionary Patterns, Blackwell.

Strean, C.W. and Carroll, R.L. (1989): Paleontology – the record of life, John Wiley. Bignot, G., Grahm and Trottman (1985): Elements of Micropaleontoogy, London. Romer, A.S. (1966): Vertebrate Paleontology (3rd Edn.) Chicago University Press

SEMESTER - III

COURSE: II - ORE AND FUEL GEOLOGY.

Course learning outcome:

A student will understand and learn about the concepts of origin of ores as well as petrology resources

Broad contents of the course:

To provide the student detailed study of the various processes for ore genesis. Further, origin and migration of oil and gas are also dealt

Skills to be learned:

The students will be appraised about the various processes for ore genesis and also about the origin, migration and accumulation of oil and natural gas

The detail contents of this course and references and suggested books:

Modern concepts of ore genesis. Spatial and temporal distribution of ore deposits- Global perspective. Concept of ore bearing fluids, their origin and migration. Fluid inclusion in ores – limitations and applications. Texture, papargensis and zoning in ores. Wall rock alteration. Structural, physico-chemical and stratigraphic controls of ore localization. Orthomagmatic ores of mafic-ultramafic association _ Diamonds in Kimberlites, REE in Carbonatite, Ti -V Ores, Chromite and PGE, Ni Ores.Cyprus type Cu-Zn Ores. Ores of Silicic igneous rocks- Kiruna type Fe-P. Pegmatoids, Greisen and Skarn deposits. Porphyry associations – Kuroko type Zn-Pb-Cu, Malanjkhand Type Cu-Mo deposits. Ores of Sedimentary affiliations- Chemical and Clastic sediments. Stratiform and Stratabound ore deposits. (Fe, Mn, non ferrous). Placers and paleoplacers.Ores of Metamorphic affiliations. Metamorphism of ores and metamorphogenic ores.Ores related to weathered surfaces – Bauxite, Ni and Au laterite. Mineralogy, genesis, distribution in India and uses of Cu, Pb, Zn. Mineralogy, genesis, distribution in India and uses of iron, aluminium, manganese, gold, chromium and silver ore deposits. National Mineral Policy and mineral concession rules. Definition and origin of Kerogene and coal. Rank, Grade and type of coal. Microscopic constituents of coal. Chemical characterization of coal Proximate and Ultimate analysis. Coal bed methane. Distribution of Coal in India. Origin, nature and migration of oil and gas. Characteristics of reservoir rocks. Oil bearing basins of India. Geology of productive oil fields of India. Mode of Occurrence and association of atomic minerals in nature. Productive geological horizons.

Books Recommended:

Branes, H.L. (1979): Geochemistry of Hydrothermal Ore Deposits, John Willey. Cuilbert, J.M. and Park,Jr. C.F.(1986): The Geology of Ore Deposits, Freidman. Evans, A.M. (1993): Ore Geology and Industrial Minerals, Blackwell.

James R. Craig and David J.Vaughan (1994): Ore Microscopy and Petrography. Klemm, D.D. and Schnieder, H.J. (1977): Time and Strata Bound Ore Deposits, Springer-Verlag.

Mookherjee, A. (2000): Ore Genesis-A Holistic Approach, Allied Publisher. Ramdhor, P. (1969): The Ore Minerals and their Intergowths, Pergamon Press. Stanton, R.L. (1972): Ore Petrology, McGraw Hill.

Wolf, K.H. (1976-1981): Hand Book of Stratabound and Stratiform Ore Deposits, Elsevier Publ.

Chandra,D.Singh, R.M.Singh,M.P.(2000):Textbook of Coal (Indian context), Tara Book Agency, Varanasi.

Singh, M.P. (1998): Coal and organic Petrology, Hindustan Publishing Corporation, New Delhi.

Texbook of Coal petrology, Gebruder Borntraeger,Stuttgart.

Van Krevelen, D. W. (1993): Coal, Typology-Physics-Chemistry-Constitution), Elsevier Science, Netherlands.

North, F.K. (1985): Petroleum Geology, Allen Unwin.

Selley, R.C. (1998): Elements of Petroleum Geology, Academic Press. Mineral Concession Rules 1960 (2005), IBM, Nagpur.

Sinha, R.K. and Sharma, N.L. (1976): Mineral economics, Oxford and IBH Publ.

SEMESTER- III
COURSE: III - GEMORPHOLOGY AND REMOTE SENSING

Course learning outcome:

The course is meant to address the fundamental techniques used for geomorphology and remote sensing. At the end of this course, the student will be appraised with all the theoretical knowledge, information and skills to use Remotely Sensed data for geological applications.

Broad contents of the course:

This course intends to introduce students to the fundamental principles and techniques of remote sensing, basic properties of electromagnetic radiation and its inter action with matter, It will also include topics like instruments and platforms used for remote sensing, and the ways those systems can be used to determine geological structure and rock types.

Skills to be learned:

After completion of this course, the student will be well versed with the world of Remote Sensing and the applications and Interpretation of data related to geosciences.

The detail contents of this course and references and suggested books

Geomorphic concepts and geomorphic cycle. Geomorphic processes – Weathering, soil formation, Mass-Wasting. Valley development, cycle of erosion, rejuvenation. Drainage patterns and their significance. Fluvial landforms and Glacial landforms. Karst topography. Arid and Eolian landforms, Coastal and volcanic landforms. Terrain evaluation and concept of morphometric analysis. Geomorphological mapping based on genesis of landforms. Geomorphic regions of India. Principles of terrain analysis. Concept and physical basis of remote sensing. Platforms: Terrestrial, Aerial and Space platforms. Advantages and limitations. Electromagnetic spectrum and principles of remote sensing. Interaction of EMR with atmosphere and earth surface features. Remote sensing sensors, data acquisition, visual interpretation and digital processing techniques. Interpretation of topographic and tectonic features Aerial photography, photographs and their geometry. Photogrammetry. Satellite remote sensing. Global and Indian space missions. Satellite exploration Programs and their characteristics. Application of remote sensing in geology. Application in Geomorphology. Application in groundwater evaluation, terrain evaluation and strategic purposes.

Books recommended:

Drury, S.A. (2001): Image Interpretation in Geology, Allen and Unwin. Gupta, R.P. (1991): Remote Sensing Geology, Springer-Verlag.

Halis, J.R. (1983): Applied Geomorphology.

Holmes,A.(1992): Holmes Principles of Physical Geology, Edited by P. McL. D. Duff. Chapman and Hall.

Lillesand, T.M. and Kiefer, R.W. (1987): Remote Sensing and Image Interpretation, John Wiley.

Sharma, H.S. (1990): Indian Geomorphology, Concept Publishing Co., New Delhi. Siegal, B.S. and Gillespie, A.R. (1980): Remote Sensing in Geology, John Wiley. Thornbury, W.D. (1980): Principles of Geomorphology, Wiley Easton Ltd., New York.

SEMESTER - III

COURSE: IV - MINERAL EXPLORATION

By the end of this course the student will have learnt about techniques of mineral exploration and exploitation, estimation of ore reserves, environmental impact of mining, and the importance conservation of mineral resources.

Broad contents of the course:

Mining being a key source of revenue generation for the Central as well as State governments, and an important job provider for Geologists, this course is designed to equip the undergraduate student with basic knowledge of key concepts of mining processes right from exploration to exploitation, together with an acquaintance of government regulations that control the mining and mineral conservation processes.

Skills to be learned:

Upon completion of this course, the student will acquire all knowledge and skills required for himself/herself becoming a mining geologist.

The detail contents of this course and references and suggested books:

Prospecting & Exploration: Definition and characteristic features. Stages of prospecting, regional and detailed exploration; objectives and practices of these stages. Guides to ore search: global, regional and local guides. Detailed study of Regional, Physiographic, Stratigraphic, Lithological, Mineralogical and Structural guides.

Drilling: Type of drills, Diamond drilling, Drilling records and logs, Duty of geologists during drilling. Sampling: General principles, various methods and procedures. Salting. Precautions during Sampling. Calculating grade and tonnage of ore: Average grade, volume, specific gravity, tonnage factor, UNFC classification. Gravity Method of prospecting: Principle and Instrumentation. Gravity field surveys. Gravity corrections: Free-air correction, Bouguer correction, Latitude correction, Terrain correction. Magnetic method of prospecting: Magnetic properties. Magnetic anomaly. Magnetometer. Field survey. Preparation of magnetic anomaly maps. Aeromagnetic surveys. Seismic prospecting: Fundamentals of seismic wave propagation. Methods of seismic prospecting: Refraction and reflection seismic methods. Seismic Stratigraphy, Detection of hydrocarbons. Electrical methods of prospecting: Basic principles of resistivity method. Electrical properties of rocks, Flow of current through ground surface, Apparent resistivity, Electrode arrangements, Resistivity survey. Application and interpretation of resistivity data. Electromagnetic methods of prospecting: Electromagnetic spectrum and induction, EM frequency and depth of penetration, EM response of conductors, Classification of EM methods and their description: Telluric current method, Magnetotelluric method, CSMT/CSAMT, Tilt angle method, Turam method, VLF method, Transient EM methods, Ground Penetrating Radar. Radiometric prospecting and Borehole Logging. Radiometric survey, Application and interpretation of data. Borehole logging: Different geophysical logs, Equipment; measurements and interpretation. Geochemical mobility and association of elements. Forms of primary and surficial dispersion patterns. Secondary dispersion processes and anomalies. Factors affecting dispersion patterns. Geochemical surveys: Litho-geochemical and Pedo-geochemical surveys. Geochemical surveys: Hydro-geochemical, Atmo-geochemical and Bio- geochemical surveys. Case studies of regional exploration for deposits of plutonic associations; vein and replacement types; magmatic sulphides and chromite; pegmatitic depsoits of Sn and rare metals;Case studies of regional exploration for deposits of hydrothermal deposits of Au- Ag, base metals, W-Mo, U; skarn deposits; sedimentary and supergene deposits. Instrumental analytical techniques. Statistical analysis and interpretation of geochemical prospecting data.

Books Recommended:

Dobrin, M.B. and Savit, C.H. Introduction to Geophysical Prospecting, McGraw Hill, New York, 1988
Sheriff, R.E. and Geldart, L.P. Exploration Seismology, Cambridge University Press, Cambridge, 1995.
Telford, W.M., Geldart L.P., and Sheriff, R.E. Applied Geophysics, Cambridge University Press, Cambridge, 1990.
DS Parasanis. Principle of Applied Geophysics (Chapman and Hall, London)
PB Sharma. Environmental and Engineering Geophysics (Cambridge University Press) TS Ramakrishna. Geophysical Practice in mineral exploration and mapping (Geological Society of India, Memoir 62), 2006.
Peters, W.C. 1987. Exploration and mining geology. 2nd edition. John Wiley & Sons, New York.
Rose, A.W., Hawkes, H.E. & Webb, J.S. 1979. Geochemistry in mineral exploration. Academic Press, London.
Levinson, A.A. 1974. Introduction to exploration geochemistry. Applied Publication Co., Calgary Marjoribanks, R.W. 1997. Geological Methods in Mineral Exploration and Mining, Chapman & Hall, London.
Kuzvart, M. and Bohmer, M. 1986. Prospecting and Exploration of Mineral Deposits, Elsevier, Amsterdam, 1986.
Edwards, R.P and Atkinson, K. 1986. Ore Deposit Geology and its Influence on Mineral Exploration, Chapman & Hall, New York.
Moon, C.J., Whateley, M.K.G. and Evans, A.M. 2006. Introduction to mineral exploration, 2nd edition. Blackwell Publishing Ltd. Oxford.
Arogyaswami, R.P.N. (1996): Courses in Mining Geology, Oxford and IBH Publ. Bagchi,T.C.,Sengupta, D.K.,Rao, S.V.L.N. (1979):Elements of Prospecting and Exploration, Kalyani Publ.
Banerjee , P.K. and Ghosh, S. (1997): Elements of Prospecting for Non-fuel Mineral deposits, Allied Publ.
Chaussier, Jean – Bernard and Morer, J. (1987): Mineral Prospecting Manual. North Oxford Academic. Dhanraju, R. (2005): Radioactive Minerals, Geol. Soc. India, Bangalore. Rajendran, S. (2007): Mineral Exploration: Recent Strategies.
Sinha, R.K. and Sharma, N.L. (1976): Mineral economics, Oxford and IBH Publl.

SEMESTER - IV

COURSE: I – MINING GEOLOGY, ENGINEERING GEOLOGY AND MINERAL DRESSING

Course learning outcome:

The student will gain detail knowledge about the concepts, methods and hands on determination of soil and rock properties which will strength their knowledge of mining geology, Engineering Geology and mineral dressing.

Broad contents of the course:

This course deals with the mining, Geotechnical lab measurements used in Engineering Geology and mineral dressing

Skills to be learned:

The course provides vital skills in geotechnical lab work

The detail contents of this course and references and suggested books:

Definition of mining terms: pitting, trenching, adits, tunnels, and shafts. Role of geologist in mining industry. Geological structures of ore deposits and choice of mining methods. Mine Subsidence and mine support. Rock bursts, Mine Ventilation. Mine Drainage. Geological and geomorphic control on mining methods. Alluvial mining. Open pit mining. Methods of opencast mining; its advantages and limitations. Underground mining methods – drifting; cross cutting; winzing; stoping; room and pillaring; top –slicing; sub- level caving and block caving. Coal mining methods: Long wall, Board and Pillar method. Engineering properties of rocks and soil. Physical characters of building stones. Aggregate. Geological considerations for evaluation of Dam and reservoir sites. Dam foundation problems. Dam failure. Geotechnical evaluation of tunnel alignment and transportation routes. Methods of tunneling. Role of geologist in engineering projects. General principles and scope of Mineral Dressing. Primary and secondary breaking, crushing and grinding, liberation by sizes, reduction. Principles and methods of screening. Principles and methods of classification, classification as a means of concentration. Concentration methods, hand sorting, washing, jigging, tabling heavy fluid. Magnetic and electrostatic methods of separation of minerals. Floatation methods- Principles and techniques with examples. Application of ore microscopy in mineral dressing.

Books Recommended:

Dobrin, M. B.; Savit, C. H. (1988): Introduction to Geophysical Prospecting, McGraw- Hill.
Keary, P., Brooks, M. and Hill, I. (2002): An introduction to geophysical exploration, (3rd Ed.), Blackwell.

Krynine, D.H. and Judd, W.R. (1998): Principles of Engineering Geology, CBS Publ.. Rider, M. H. (1986): Whittles Publishing, Caithness. The Geological Interpretation of Well Logs, (Rev. Ed).
Schultz, J.R. and Cleaves, A.B. (1951): Geology in Engineering, John Willey and Sons, New York.
Singh, P. (1994): Engineering and General Geology, S.K. Kataria and Sons, Delhi. Bell F G Engineering Geology, Second Edition by, 2007. Butterworth-Heinemann, Oxford 5. Sathya Narayanaswami. Engineering Geology. Dhanpat Rai and Co. 1710, Nai Sarak, Delhi- 110006.. 2000

SEMESTER - IV
COURSE: II – ENVRIONMENTAL GEOLOGY

Course learning outcome:

Know the basic fundamentals of earth science as applied to the interaction between human activity and the natural environment. Understand the occurrence and availability of both surface and subsurface water resources and the role of the hydrologic cycle and pollution.

Broad contents of the course:

This course deals with environmental problems related to geology

Skills to be learned:

Students will be able to test and evaluate water quality for drinking and agricultural use. They will also have knowledge about various natural disasters.

The detail contents of this course and references and suggested books:

Basic concepts of Environmental Geology, Environment, Ecology, Ecosystems and habitat. Renewable and non-renewable natural resources. Role of geology in natural resources management and environmental planning. Landforms as ecosystem units.

Characteristics of various environmental regimes – fluvial, coastal, marine, Aeolian, desert, and glacial. Understanding their causes, types, Mitigation and Management. Geomorphic controls on biodiversity and its conservation. Conservation of soil and water resources. Geological hazards: Lands slides, Volcanic activity, Earthquake and Tsunami. Understanding their causes, types, Mitigation and Management. Draught and desertification, Measures of mitigation. Sea level changes. Measures of mitigation. Geological hazards -River flooding, erosion and sedimentation, coastal erosion, cyclones and tsunamis. Human modifications of nature on surface and subsurface by engineering. Human modifications of nature on surface and subsurface by mining activities. Human settlement and contamination of atmosphere, soil, surface water and groundwater by waste disposal and agro-industries. National Environmental Policy for air and water pollution. National Environmental Laws. Climate Change and global warming: Causes and Impact (Ozone layer depletion and ozone hole). Environment impact assessment report and preparation of environment Management plans.

Books Recommended:

Bryant, E. (1985): Natural Hazards, Cambridge Univ. Press. Keller, E.A.(1978): Environmental Geology, Bell and Howell, USA.

Nagabhushaniah, H.S. (2001): Goundwater in Hydrosphere, CBS Publ.

Perry, C.T. and Taylor, K.G. (2006): Environmental Sedimentology, Blackwell Publ. Singh, S. (2001): Geomorphology, Pustakalaya Bhawan, Allahabad.

Todd, D.K. (1995): Groundwater Hydrology, John Wiley and Sons.

Valdiya, K.S.(1987): Environmental Geology – Indian Context, Tata McGraw Hill. Montgomery, C.W. Environmental Geology, Won. C. Brown, Publishers, Iowa, 1989. Dorothy Merritts, Andrew de Wet, Kirsten Menking, Environmental Geology W. H. Freeman & Co. and Sumanas, Inc. USA, 1997

SEMESTER - IV
COURSE: III – HYDROGEOLOGY

Course learning outcome:

On completion of the course, the student will have gained an understanding of hydrogeological concepts, exploration, exploitation and recharge of groundwater and methods of monitoring groundwater quality and sources of pollution

Broad contents of the course:

To impart knowledge about groundwater, its movement, methods of its exploration, the criteria of its quality, methods of its conservation, recharge of groundwater monitoring of groundwater quantity and quality.

Skills to be learned:

Students will be able to acquire skills of systematic hydrogeological survey sand water quality monitoring

The detail contents of this course and references and suggested books

Scope of hydrogeology and its relation with hydrology, meteorology and their uses in the Hydrogeological investigation. Hydrologic cycle. Role of groundwater in the hydrologic cycle. Hydrograph, data collection and analysis. Water table and piezometric surface. Water table fluctuation. Water table contour maps, interpretation and uses.Water bearing formation. Isotropic, anisotropic aquifers. Porosity, permeability. Ground water movement: Darcy's law and its applications. Specific yield and specific retention. Storativity and transmissivity Steady and unsteady flow, leaky aquifers. Groundwater flow near aquifer boundaries. Bounded aquifers. Image wells. Water wells and their types. Well Development and completion. Pumping test and Yield of wells. Geological and Hydrogeological methods of groundwater exploration. Geophysical methods – Electrical resistivity method for groundwater exploration. Application of remote sensing in groundwater exploration. Basin wise development of groundwater with special reference to Chhattisgarh region.Groundwater provinces of India. Sources of dissolved constituents in groundwater. Groundwater quality standards-drinking, domestic, agriculture and industry. Groundwater pollution. Groundwater management. Safe yield, overdraft and spacing of wells. Conservation of Groundwater; conjunctive use of water. Artificial recharge.

Books Recommended:

C.F. Tolman (1937): Groundwater, McGraw Hill , New York and London.

D.K. Todd (1995): Groundwater Hydrology, John Wiley and Sons.

F.G. Driscoll (1988): Groundwater and Wells, UOP, Johnson Div.St.Paul. Min. USA.

H.M. Raghunath (1990): Groundwater, Wiley Eastern Ltd.

H.S. Nagabhushaniah (2001): Groundwater in Hydrosphere (Groundwater hydrology), CBS Publ.

K. R. Karanth (1989): Hydrogeology, Tata McGraw Hill Publ.

S.N. Davies and R.J.N. De Wiest (1966): Hydrogeology, John Wiley and Sons, New York

CORE ELECTIVE COURSES

ME- I ADVANCED HYDROGEOLOGY

Course learning outcome:

On completion of the course, the student will have gained an understanding of hydrogeological concepts, exploration, exploitation and recharge of groundwater and methods of monitoring groundwater quality and sources of pollution

Broad contents of the course:

To impart knowledge about groundwater, its movement, methods of its exploration, the criteria of its quality, methods of its conservation, recharge of groundwater monitoring of groundwater quantity and quality.

Skills to be learned:

Students will be able to acquire skills of systematic hydrogeological survey sand water quality monitoring

The detail contents of this course and references and suggested books

Hydrologic cycle, ground water in hydrologic cycle Hydrograph and hydrographic analysis Water balance studies,Springs (including thermal): Origin and movement of water. Geologic structures favouring groundwater movement. Groundwater reservoir properties. Forces and laws of groundwater movement. Well hydraulics: confined, unconfined, unsteady and radial flow. Water level fluctuation and its causative factors. Water well technology: Well types, drilling methods, construction, designing, development and maintenance of wells. Groundwater in arid and semiarid regions. Groundwater in coastal and alluvial regions. Groundwater in hard rocks and limestone terrain. Environmental impact on groundwater extraction. Ground water recharge: artificial and natural. Factors controlling recharge. Conjunctive and consumptive use of groundwater. Chemical characterization of groundwater in relation to domestic and industrial uses. Chemical characterization of groundwater for irrigation purposes. Water pollution: remedial measures and treatment Problems of arsenic and fluoride in water. Geological and hydrogeological methods of groundwater exploration. Geophysical surface resistivity and seismic methods in groundwater exploration. Geophysical water well logging. Application of remote sensing and radiogenic isotopes in hydrogeological studies. Basin-wise groundwater management.

ME-II PROJECT ORIENTED DISSERTATION

Course learning outcome:

To inculcate a culture of research and innovation at the undergraduate level so that the students are exposed to the nitty-gritty of the Scientific Research in their fields

Broad contents of the course:

This course is designed with great flexibility and involves the topico finterests of the students as well as his Research Supervisoror Institute where he intends to undertake the Dissertation work.

Skills to be learned:

The basic aim is to expose the students at anearly stage to field and laboratory technique sand sophisticated instrumentation.

The detail contents of this course and references and suggested books:

An opportunity to work on a six month-long research project in geosciences under the direct supervision of a faculty member in University/Institute or Government Organisation. Students will develop a research proposal, carry out data collection using field and/or laboratory studies, and complete a final report/presentation. Field studies, Laboratory studies / data processing, reference work and presentation of the thesis are four major components of the course. Students opting for this course should adhere to the following procedure.

1. Precise title and outline of work is to be submitted to the Head of the Department/Exam Coordinator.
2. The student shall spend at least one week in the field. The field work shall be carried out only during vacation or holidays, and in no case student will be permitted to be absent from regular teaching on account of dissertation. The student shall maintain field diaries and other record relevant to dissertation.
3. If (s) he is working on a laboratory project, the fieldwork component may or may not be essential.
4. Every month the students hall submit the progress report and laboratory work done, through the supervisor to Head of the Department/Exam Coordinator.
5. The student shall do dissertation at his own cost. The department will not spare funds for this purpose.
6. The students hall give a seminar before the submission of the dissertation.
7. The supervisor shall submit the practical sets based on topic of dissertation developed for the students to Head of the Department/Exam Coordinator prior to the commencement of practical examination.
8. Non-compliance of any of the above rules will disqualify students for grant of terms.
9. Four copies neatly typed on A4 paper, well bound together with maps and illustrations should be submitted.

Dissertation, on the basis of the work carried out by the student, will be submitted, through the supervisor concerned, to the Head of the Department//Exam Coordinator before the commencement of the practical examination, for being forwarded to the Board of Examiners. In case of student receiving help (training and / or participation in ongoing research activities) from other Institution/Organization for their dissertation work, the associated scientist from that Institute/ Organization will function as co-supervisor.

Learning Outcomes: S.o.S. in History

Program Outcomes (M.A. in History)

History helps us develop a better understanding of the world. You can't build a framework on which to base your life without understanding how things work in the world. History paints us a detailed picture of how society, technology, and government worked way back in past so that we can better understand how it works now.

Course Outcomes:

Historiography is important for a wide range of reasons. First, it helps us understand why historical events have been interpreted so differently over time. In other words, historiography helps us examine not only history itself, but also the broader overlying characteristics that shape the recording of history itself.

The 20th Century World was dominated by a chain of events that heralded significant changes in world history as to redefine the era: Spanish flu pandemic, World War I and World War II, nuclear weapons, nuclear power and space exploration, nationalism and decolonization, the Cold War and post-Cold War conflicts.

The History of Medieval India is an imortant period in the history of India because of the developments in the field of art and languages, culture and religion. Also the period has witnessed the impact of other religions on the Indian culture. Beginning of Medieval period is marked by the rise of the Rajput clan.

The History Of Modern India is also known as colonial period as during this period the British exploited our country to great extent .This period changed our traditional society to modern one. The modern period is During the late 16th and the 17th Centuries, the European trading companies in India competed with each other ferociously. By the last quarter of the 18th Century the English had outdone all others and established themselves as the dominant power in India. The British administered India for a period of about two centuries and brought about revolutionary changes in the social, political and the economic life of the country.associated with growth and progress. Railways ,Post and Telegraph and new system of Education etc were introduced in this period.

Once the British set their foot solidly on Indian soil, they began the commercial exploitation of the natural resources of India. By the middle of the 19th Century arrogant exploitation of the people had tried the patience of the Indians to the limit. The British imperialism reached its zenith between the middle of the nineteenth century and the First World War. The exploitative policies of the British in India saw the birth of nationalist agitation against it. With increasing intrusion of aliens in their lives, a group of middle class Intelligencia formed the Indian National Congress (1885).

The History of Indian National Movement is as relevant and significant as the modern revolutions which had the motto of altering the existing political and social structure and to establish a new politico-socio-economic system based on equality, social justice, rule of law and democratic outlook. With the birth of Indian National Congress and organized movement started and as a reaction against it communalism also grew .The anti British struggle became truly a mass movement with the arrival of Mahatma Gandhi. It was followed by numerous movements against the British rule such as Revolutionary movement and the INA etc. With the passage of time and stubbornness of the Indians the British had come to realize that the day was not far off when they will have to quit India. Successive campaigns had the effect of driving the British out of India in 1947, but with independence came the independence of the country into Pakistan.

History of Constitution and Governance is important because each generation needs to know not only the rights and privileges granted by the Constitution, but also the obligations of its citizens. The most important purpose of a Constitution is it draws a limit on the power of the Government by outlining a framework within which the Government must function. For example – irrespective of who is the President of India, the powers and functions of the Office of the President remain the same.

Regional History is an important instrument by which it will always be possible for us to measure the progress made by mankind. Regional History of Chhattisgarh is becoming more and more popular, for it has inherit potential of taping varied kinds of sources for studying the various aspects of history.

Learning Outcomes based Curriculum Framework

(LOCF)

For

Bachelor of Library and Information Science Programme

Library & Information Science subject is a professional course. Basis of admission to these course students with a bachelor's degree in any discipline can take. There are many employment opportunities for students with a one-year undergraduate degree, such as Library Assistant in any University or College library, Assistant Librarian in the public library, Library Assistant in any Ministry or Secretariat, Central school, Novodaya school, any School libraries, Technical Assistant in Research Centers, and Assistant Librarian in Doordarshan's Akashwani, etc. Therefore, the library has an important role to provide satisfaction to all the readers of this category of the library. That means all the necessary functions of the library in this course, such as Library Organization, Management, Cataloguing, Classification, Bibliography, Reference services, Documentation work, and Documentation service. Information service, Organizing knowledge around the world, including Information Retrieval, Statistical method, knowledge of information sources, knowledge of appropriate software for operation and administration of the library.

Library and Information Science is a discipline that systematically studies the acquisition, processing, management, maintenance, and dissemination of information and information sources. It also studies the purpose, nature, utility and effectiveness of services provided by Libraries and Information Centers.

It is clear that any library which is discussed above, in order to get all the functions done properly. In order to provide satisfaction by providing service to the users over the present time, this one-year professional course has its own specialties.

Structure of B. Lib. I. Sc. Programme

Paper	Subject	Internal Marks	Examination		Total Marks
			Marks	Duration	
1	Library Organization and Management	20	80	3 Hrs.	100
2	Library Cataloguing and Bibliography	20	80	3 Hrs.	100
3	Reference sources and Services	20	80	3 Hrs.	100
4	Documentation and Information Services	20	80	3 Hrs.	100
5	Computer Application in Libraries	20	80	3 Hrs.	100
6	Library Classification(Theory)	20	80	3 Hrs.	100
7	Library Classification(Practice)	20	80	3 Hrs.	100
8	Library cataloguing (Practice)	20	80	3 Hrs.	100
	Total Marks	160	640		800

Learning Outcomes and Syllabus Contents of Each Course

Paper-1 Library Organization and Management

Learning Outcomes:
After studying this paper, students shall be able to:

1. Understand what is Library?
2. Understand the concept of management.
3. Understand the highlight role of various library promoters at the national and international level.
4. Know the role of libraries in the development of various aspects of society.
5. Understand the routine work- acquisition, processing, management, maintenance, and dissemination of information and information sources.
6. Understand librarianship as a profession.
7. Assess the role of national and international library associations and organizations.
8. Know library Association, library rules-regulations and Laws.
9. Maintain the library statistics and prepare annual report.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 35%

UNIT-I

- Library Organization : Meaning , importance, principles and types
- Library Committee : Definition , types and functions
- Different Library systems- their salient feature and functions
- National Libraries of India, UK and USA
- Role of libraries as Academic and social institution

UNIT -II

- Ranganathan's five laws of library science and their applications
- Library legislation in India
- Library movement in India, UK and USA. NKC
- Library association / Professional organizations: their objectives and functions: UNESCO, IFLA, ALA, IASLIC,ILA

UNIT – III

- Management : Definition, Components, features and principles of management
- Administration versus Organization
- Library rules and regulations.
- Scientific management
- Personnel management

UNIT –IV

- Physical Environment : Basic consideration in planning of library building, furniture, fittings and equipments
- Routine procedures: Acquisition, circulation , serials control, stock verification Vs stock rectification
- Public relation and extension activities.

UNIT -V

- Financial Management
- Budgeting : its concepts , types and methods
- Collection Development : Different types of selection tools and their importance
- Maintenance of library record and statistics
- Annual report
- Resource sharing

Paper-2 Library Cataloguing and Bibliography

Learning Outcomes:
After studying this paper, students shall be able to:

1. Understand the concept of library catalogue.
2. Know about the main and added entries of library catalogue.
3. Know about various inner and outer forms of library catalogue.
4. Understand various approaches of deriving subject headings.
5. Understand the concept of co-operative and centralized cataloguing.
6. Know about the normative principles of cataloguing.
7. Understand the concept and importance of bibliography.
8. Know about National and International bibliography.
9. Understand the Information Retrieval.
10. Know about Trade bibliography and bibliographic control.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 35%

UNIT-I

- Library Catalogue: Objectives , purpose and functions
- Different between bibliography, catalogue and documentation list
- Canons and normative principles of cataloguing
- Physical and inner forms of library catalogue
- Selective and simplified cataloguing
- Descriptive cataloguing including

UNIT-II

- Entries-their types and functions
- Filling of entries
- Cooperative and centralized cataloguing
- Cataloguing in source and cataloguing in publication
- Comparative study of CCC and AACR-2
- Organization and management of cataloguing department

UNIT-III

- Subject cataloguing – meaning , purpose and objectives
- Subject Headings –Need and basic principles
- Derivation of subject headings-LCSH, Sears list of subject headings
- Chain procedures
- Study of ISBN and ISNN

UNIT-IV

- Bibliography – definitions , aims, need ,functions and types
- Subject bibliography
- National bibliography-need, scope and coverage
- Study of INB and BNB
- Trade bibliography
- Universal bibliography

UNIT-V

- Bibliography control
- Bibliography and documentation activities in U.S.A. and U.K.
- Bibliographical organizations in India and their services.

Paper-3 Reference sources and Services

Learning Outcomes:
After studying this paper, students shall be able to:

1. Understand what is Reference Service?
2. Know about Theories and philosophy of reference service.
3. Understand the concept of user education.
4. Know about kinds and nature of reference service in different types of libraries.
5. Understand the concept of classification of reference sources and their evaluation.
6. Understand the reference questions and their information sources with bibliographical description.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 35%

UNIT-I

- Reference service-concept , definition and importance
- Theories and philosophy of reference service
- Kinds and nature of reference service in different types of libraries
- Short range and long range services
- Orientation of a freshman
- User education

UNIT-II

- Enquiry techniques and methods of answering reference questions
- Classification of reference sources and their evaluation
- Organization and management of reference department
- Non-Documentary Sources of Information, Digital Sources

UNIT-III

- Dictionary –scope , purpose ,types, uses and alternative names
- Glossary, Thesaurus, Lexicon, Concordance etc.
- Checklist for evaluation of dictionaries
  Study of-
  (i) Random House Dictionary of English Language
  (ii) Webster's Third New International Dictionary of English Language
  (iii) Oxford English Dictionary
  (iv) Roget's International Thesaurus
- Encyclopedias-Scope, purpose, types and importance, criteria for evaluation
  Study of-
  (i) New Encyclopedias Britannica
  (ii) Encyclopedia American
  (iii) Encyclopedia of Library and Information Science
  (iv) International Encyclopedia of Social Science and Technology
  (v) McGraw –Hill Encyclopedia of Science and Technology
  (vi) Van Nostrand's Scientific Encyclopedia

UNIT-IV

- Years Books and Almanacs – scope , definition and purpose
  Study of-
  (i) Europa Yearbook
  (ii) Stateman's Yearbook
  (iii) India: a Reference Annual
  (iv) World Almanac and Book of Facts
- Directories –Definition, scope and types
  Study of-
  (i) World of Learning
  (ii) Study Abroad
  (iii) Times of India Directory and Yearbook including Who's Who

(iv) Universities Handbook, India

- Current reference sources-
  (i) Asian recorder: a weekly digest of Asian events with index

  (ii) Facts on file: weekly world news digests

  (iii) Keesing's contemporary archives

UNIT-V

- Geographical Sources –scope and categories – Gazetteers , guide books , maps ,atlases and globes
  Study of-

  (i) Colombia lipncott gazetteer of the world

  (ii) Gazetteer of India

  (iii) Fodor's India

- Biographical sources –scope , categories , characteristics
  Study of-

  (i) Dictionary of American biography

  (ii) Dictionary of National biography

  (iii) Dictionary of scientific biography

  (iv) India who's who

- Reference questions and their information sources with bibliographical description

Paper-4 Documentation and Information Services

Learning Outcomes:
After studying this paper, students shall be able to:

1. Understand the documentation.
2. Know about documentation work and services and their scope
3. Understand the documentation lists.
4. Know about information science and information services.
5. Understand the Abstracts, qualities of good abstracts and evaluation abstracting services.
6. Know about Pre-coordinate indexing and Post-coordinate indexing.
7. Know about Citation Indexing.
8. Understand documentation centers and systems and their activities.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 35%

UNIT-I

- Documentation : meaning and definition , its aim, scope and development
- Documentation work and their scope
- Documentation services and their scope
- Documentation lists-their kinds and preparation
- Reprographic and translation service

UNIT-II

- Information science –its definition , aims and scope
- Changing concept of information science
- Information users-their needs and information seeking behavior
- Nature of information needs
- Information services : CAS,SDI

UNIT-III

- Abstracting- definition , aims and scope
- Types of abstracts
- Canons of abstracting
- Characteristics and qualities of good abstracts
- Methods and stages of abstracting
- Study of Chemical abstracts , Biological Abstracts, Physical Abstracts, Mathematical reviews, Psychological Abstracts, Sociological Abstracts, Library and information science abstracts, Indian science abstracts, Indian library science abstracts

UNIT-IV

- Indexing-definition and functions
- Pre-coordinate indexing, chain indexing, PRECIS,POPSI
- Post coordinate indexing-Term entry system , peek-a-boo-system, edgenotched
- Punch card system
- Citation indexing
- Key word indexing

UNIT-V

- Documentation centers and systems-FID,VINITI,
- NISCAIR, DESIDOC,NASSDOC,UNISIST AND NISSAT

Paper-5 Computer Application in Libraries

Learning Outcomes:
After studying this paper, students shall be able to:

1. Know about Computer basics.
2. Know about create, edit and manage files using Word processing and Power Point Presentation software.
3. Understand the Hardware and Software.
4. Carry out library housekeeping operations using library management software.
5. Find bibliographic information from Web OPAC.
6. Understand the using library management software.
7. Know about library and Information networking.
8. Examine the concept of library networks and highlight their types and importance.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 35%

UNIT-I: Computer Basics

- Computer: Definition, Development and Computer Generation.
- Types of computers and their use
- Basic components of a computer, Computer Peripherals
- Electronic data processing

UNIT-II: Hardware and Software Components

- Computer Hardware: Components and Functions
- Computer Software : Types and Uses
- Operating System, functions and their commands: Window and UNIX/LINUX
- Flow Chart

UNIT-III: Software Packages

- Word Processing Packages
- Desktop Publishing
- Library Application Software: CDS/ISIS
- Different types of Library Software

UNIT-IV: Library Automation

- Library House Keeping Operations
- Computerized Information Services
- Selection of Library Software Packages
- Use of INTERNET for various library activities, e-journals, e-books

UNIT-V: Networking

- Definition, Need, Client Server Architecture
- Types of Network: LAN, WAN, MAN
- Network Topologies: Bus, Star, Ring etc.
- Library Information Network: DELNET, INFLIBNET, CALLIBNET, UGC-Infonet

Paper-6 Library Classification (Theory)

Learning Outcomes:
After studying this paper, students shall be able to:

1. Know about library classification, aims and their features.
2. Understand the characteristics, merits and demerits of different species of library classification schemes.
3. Know about salient features of major classification schemes.
4. Elucidate various facets of notation and call number.
5. Understand the basic subject and their kinds.
6. Understand the Postulates and Principles of Classification.
7. Discuss the Steps in practical classification.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 35%

UNIT-I

- Library classification: Its definition aims & function 3.
- Species of classification schemes- Enumerative & Faceted : their features, merits & demerits
- Basic subject & their kinds
- Comparative study of colon classification & Decimal classification

UNIT-II

- Knowledge classification & its canons
- Hospitality in array & chain
- Facet analysis
- Five fundamental categories & their postulates
- Principles for facet sequence

UNIT-III

- Types of isolates: common, special
- Devices used in Classification (chronological, geographical, subject, alphabetical Enumeration, superimposition & phase devices)
- System & specials

UNIT-IV

- Notation: definition, need & functions
- Types, structure & qualities of notation
- Mnemonics: 1its types & canons
- Indicator digits

UNIT-V

- Book classification: purpose & meaning
- Canons for book classification
- System of book number
- Knowledge classification vs book classification
- Rules for classifying books
- Steps in practical classification

Paper-7 Library Classification (Practice)

Learning Outcomes:
After studying this paper, students shall be able to:

1. Construct class numbers for documents with simple, compound and complex subject.
2. Synthesize class numbers by using the standard subdivisions/common isolates/auxiliary tables.
3. Compile book numbers and be able to use index of the classification scheme.
4. Discuss the Steps in practical classification.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 35%

Classification of documents by using latest available edition of DDC and colon classification (6 th ed. Reprint).

Paper-8 Library Cataloguing (Practice)

Learning Outcomes:
After studying this paper, students shall be able to:

1. Use the catalogue codes and standards.
2. Understand the concept of library catalogue.
3. Know about the main and added entries of library catalogue.
4. Know about various inner and outer forms of library catalogue.
5. Understand various approaches of deriving subject headings.
6. Prepare catalogue entries for various types of information sources.
7. Derive subject headings using various methods and tools.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 35%

Cataloguing of documents and continuing resources according to AACR-II(R)

Learning Outcomes based Curriculum Framework

(LOCF)

For

Master of Library and Information Science Programme

Library & Information Science subject is a professional course. The basis for admission to the course is a second class undergraduate in the subject of Library and Information Science. The course is two semesters along with one year. A post-graduate student have a lot of employment opportunities in the country and abroad as students with a minimum score of 55% or more qualifies for the Ph. D., UGC Net, Set, and PSC written test. Students with a minimum of 55% or more in the relevant subject become eligible for the UGC NET exam. Thereafter, students can get apply for any University, Public Library, Special Library, Documentation Centers, Information Centers, Ministry, Defense, Research Centers, Secretariat, National Library, All India Radio, Doordarshan Center, Central School Library, Navodaya School Library, DPS School Library, DAV School Library, etc. That means all the necessary functions of the library in this course, such as Library Organization, Management, Cataloguing, Classification, Bibliography, Reference services, Documentation work, and Documentation service. Information service, Organizing knowledge around the world, including Information Retrieval, Statistical method, knowledge of information sources, knowledge of appropriate software for operation and administration of the library.

Library and Information Science is a discipline that systematically studies the acquisition, processing, management, maintenance, and dissemination of information and information sources. It also studies the purpose, nature, utility and effectiveness of services provided by Libraries and Information Centers.

It is clear that any library which is discussed above, to get all the functions done properly. This course is specially designed to perform all the works in Library. To provide satisfaction by providing service to the users over the present time this professional course has its specialties.

Structure of M. Lib. I. Sc. Programme

FIRST SEMESTER **Total Credits - 20**

Paper	Subject	Internal Marks	External Marks	Credits
I	FOUNDATION OF INFORMATION SCIENCE	20	80	4
II	KNOWLEDGE ORGANISATION & INFORMATION PROCESSING	20	80	4
III	RESEARCH METHODS & STATISTICAL TECHNIQUES	20	80	4
IV	MANAGEMENT OF LIBRARY & INFORMATION CENTRES/INSTITUTION	20	80	4
V	INFORMATION PROCESSING AND RETRIEVAL (PRACTICE-I)	20	80	4
Total		100	400	20

SECOND SEMESTER **Total Credits - 20**

Paper	Subject	Internal Marks	External Marks	Credits
VI	INFORMATION RETRIVAL	20	80	4
VII	INFORMATION SOURCES, PRODUCTS AND SERVICES	20	80	4
VIII	INFORMATION TECHNOLOGY : BASICS & APPLICATIONS	20	80	4
IX-A	MANAGEMENT INFORMATION SYSTEMS.	20	80	4
X	INFORMATION PROCESSING & RETRIVAL (PRACTICE – II)	20	80	4
Total		100	400	20
Total Marks of Semester I & II		**200**	**800**	**40**

FIRST SEMESTER

Learning Outcomes and Syllabus Contents of Each Course

Paper-I FOUNDATION OF INFORMATION SCIENCE

Learning Outcomes:
After studying this paper, students shall be able to:

1. Comprehend the concept of information and the discipline of Library and Information Science.
2. Understand the concept of use of Information and communication channels.
3. Understand the Information user & their needs.
4. Know about the International and national programs and policies
5. Understand the Information products: Nature, concept, types, design and development and marketing.
6. Understand the Economics of Information.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 36%

UNIT-1: Information Science-

- Definition, Scope, Objectives, Genesis and development.
- Information Science as a discipline and its relationship with other subject fields.
- Information industry- Generators, Providers and intermediaries.

UNIT-2: Information and communication-

- Information: Characteristics, Nature and use of information.
- Conceptual difference between data,
- Information and Knowledge.
- Communication of Information.
- Information generation and diffusion.
- Communication channels and barriers.

UNIT-3: Information and the state-

- Policies relating to information including science and technology and education.
- International and national programs and policies (NAPLIC)
- IT and library.

- UAP, UBC
- Laws relating to information with special reference to India. Including press and registration act. Delivery of books (public Libraries) Act, Copyright Act.

UNIT-4: Information user & their needs-

- Categories of information users.
- Information needs: definition and models.
- Information seeking behavior.
- Methods and techniques of user studies.
- Evaluation of user studies.

Unit-5: Information products-

- Information products: Nature, concept, types, design and development and marketing.
- Economics of information.
- Information management.
- Knowledge management.

Paper-II KNOWLEDGE ORGANISATION & INFORMATION PROCESSING

Learning Outcomes:
After studying this paper, students shall be able to:

1. Know about different types of subjects and their modes of formation of subject.
2. Understand the standard schemes of library classification and its features and application.
3. Know about canons and normative principles.
4. Understand choice of schemes of classification.
5. Elucidate various facets of notation and call number.
6. Understand the design and development of a Scheme of library classification.
7. Understand the Postulates and Principles of for facet sequence
8. Know about recent trends and development of classification.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 36%

UNIT-1: Universe of Knowledge-

- Structure and attributes.
- Modes of formation of subjects,

- Different types of subjects and their modes of formation
- Universe of Knowledge as mapped in different schemes of classification.

UNIT-2: Methods of knowledge organization-

- Canons and normative principles of sayers and Ranganathan of classification.
- Species of Library Classification schemes.
- Standard schemes of library classification; Introduction, features and application-CC, DDC, & UDC.

UNIT-3:

- Universal and special schemes of classification.
- Abstract classification.
- Choice of schemes of classification.
- Study of categories postulated by different classificationists for grouping ideas.
- Postulates & Principles for facet sequence,
- Telescoping of facets.

UNIT-4: Notation-

- Notation: Types, Structure & qualities, canons of notation.
- Mnemonics- Types and canons
- Indicator digits.
- Zone analysis and sector notation.
- Canons for book classification.
- Systems of book number.

UNIT-5: Recent Trends & Developments-

- Design and development of a Scheme of library classification.
- Role of DRTC, CRG and FID.
- Contribution of International Conferences towards classification research.
- BSO: Salient features.

Paper-III RESEARCH METHODS & STATISTICAL TECHNIQUES

Learning Outcomes:
After studying this paper, students shall be able to:

1. Know about research: concept of research and process of research.

2. Understand the research design and Identification and formulation of problem of research.
3. Understand the hypotheses, testing of hypotheses.
4. Know about research methods, tool and technique.
5. Understand Data analysis and Interpretation, tabulation and generalization.
6. Understand the design and development of content analysis.
7. Understand the Citation-theory and analysis.
8. Understand Designing research proposal.
9. Understand the citing bibliographical references.
10. Know about current trends in library and information science research.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 36%

UNIT-1: Research-

- Research: Concept, Meaning, need and process of research.
- Types of Research- Fundamental and Applied.
- Research Design- Types of research design, Identification and formulation of problem, Hypotheses.

UNIT-2: Research methods-

- Research Methods- Scientific, Historical, Descriptive, Survey and case study methods, Experimental method and Delphi Method.
- Research techniques & Tools- Questionnaire, Schedule interview, Observation and sampling techniques.

UNIT-3: Data analysis and Interpretation-

- Descriptive Statistics- Measures of central tendencies- Mean, Median, Mode.
- Tabulation and generalization.
- Standard Deviation and Correlation.
- Testing of hypotheses.

UNIT-4: Bibliometrics, Informatrics & Scientometrics-

- Bibliometrics, Informatrics & Scientometrics: Concept definition and their scope
- Bibliometrics laws- Bradford, Zipf, Lotka.
- Content analysis,
- Sociometry.
- Citation studies- Citation-nature and definition, Citation-theory and analysis.
- Offset weight age formula of Sengupta.

UNIT-5: Research reporting- Designing research proposal-

- Structure, Style, Contents & Guidelines for Research reporting.
- Standards for citing bibliographical references (Like Chicago manual, MLA & Indian standards)

- Current trends in library and information science research.

Paper-IV MANAGEMENT OF LIBRARY & INFORMATION CENTRES/INSTITUTION

Learning Outcomes:
After studying this paper, students shall be able to:

1. Understand the concept of management.
2. Understand the function and Principles of Scientific Management.
3. Know the Organization structure, Job analysis and description; Job evaluation.
4. Understand motivation theory.
5. Understand budgeting technique & methods
6. Know the role of libraries in the development of various aspects of society.
7. Understand the routine work- acquisition, processing, management, maintenance, and dissemination of information and information sources.
8. Understand Financial Management, Budgeting technique & methods.
9. Assess the role of national and international library associations and organizations.
10. Know about the Total Quality Management and SWOT analysis.
11. Understand the Strategic management: objectives. Policies process & models.
12. Know about Collection development and managing change.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 36%

UNIT-1 Management

- Management styles and approaches.
- Management schools of thought.
- Functions and Principles of Scientific Management.
- Human Resource Management- Organization structure, Job analysis and description; Job evaluation, Motivation.

UNIT-2 Financial Management-

- Resource mobilization.
- Budgeting technique & methods: PPBS. Zero based budgeting etc. Budgetary control.
- Cost effectiveness and cost benefit analysis.
- Total Quality Management (TQM)- Definition, Concept & elements of TQM and quality audit.

UNIT-3 System Analysis and Design-

- System- definition, Concept and characteristics.
- Library as a system.

- Project management,
- PERT/CPM.
- Decision tables.
- DFD (Data Flow Diagram).
- Work study: Flow chart, Gantt chart, Block diagrams.

UNIT-4 Planning-

- Concept, Definition, Need, Purpose, Types, Policien and Procedures.
- MBO,MBE
- Strategic management- Definition objectives. Policies process & models of strategic management.
- SWOT analysis.

UNIT-5 Managing Change

- Concept of change: changes in procedures, method.
- Use of new tools and techniques;
- Techniques of managing change.
- Collection development and management- Policies and procedures.
- Time and motion study.

Paper-V INFORMATION PROCESSING AND RETRIEVAL (PRACTICE-I)

Learning Outcomes:
After studying this paper, students shall be able to:

1. Construct class numbers for documents with simple, compound and complex subject.
2. Synthesize class numbers by using the standard subdivisions/common isolates/auxiliary tables.
3. Compile book numbers and be able to use index of the classification scheme.
4. Discuss the Steps in practical classification.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 36%

Classification of titles/documents by Colon Classification (6^{th} Rev. Ed.) and UDC (Medium Edition).

SECOND SEMESTER

Paper-VI INFORMATION RETRIEVAL

Learning Outcomes:
After studying this paper, students shall be able to:

1. Understand the concept of library catalogue.
2. Know about the subject analysis and representation.
3. Know about subject headings using sears list of subject heading etc.
4. Understand the Indexing language and vocabulary control.
5. Know about the coordinate indexing system.
6. Understand the Standards for Bibliographical Description like AACR-2, ISBD, MARC (Format), CCF.
7. Know about Information Retrieval Systems.
8. Understand the principles & methods of searching.
9. Know about IR through OPAC and Internet.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 36%

UNIT-I: Subject analysis and representation-

- Problems of subject analysis and representation.
- Contributions of cutter, Ranganathan, Farradane and Coates.
- Principles of subject cataloguing- Assigning subject-Headings using library of Congress subject headings and sears list of subject heading etc.

UNIT-II: Indexing language and vocabulary control-

- Indexing languages- Types and characteristics.
- Vocabulary control- Tools of vocabulary control.
- Thesaurus- Structure and construction of an IR Thesaurus. Thesaurofacet.
- Trends in automatic indexing.
- Recall and Precision devices in indexing languages.

UNIT-III: Indexing systems-

- Pre coordinate and post coordinate indexing system.
- Outline study of the following indexing systems.
- KWIC, KOWC.
- Chain Indexing, PRECIS, POPSI.
- Uniterm indexing, Citation indexing.
- Standards for Bibliographical Description: AACR-2, ISBD, MARC(Format), CCF.

UNIT –IV: Information Retrieval Systems-

- Definition, Types, Components and operational stages of IRS.
- Information Retrieval- Data Base, Information base and SQL, IR Models.
- Search Process- Principles & methods of searching.

- Search Techniques- Boolean searches On-line searching techniques and retrieval.

UNIT-V: Information retrieval systems evaluation.

- Projects and parameters.
- Important test results- Cranfield, Medlars, Smart.
- Information retrieval through optical media and CD-ROM data base.
- IR through OPAC and Internet.

Paper-VII INFORMATION SOURCES, PRODUCTS AND SERVICES

Learning Outcomes:
After studying this paper, students shall be able to:

1. Understand the documentary sources of information.
2. Understand, identify and explore the different types of information sources like print, non-print including electronic nature.
3. Know about bibliographic and referral services.
4. Understand the information products- Nature, Concept, Types, Design and marketing Abstracting
5. Know the users education: technique and methods.
6. Understand resource sharing.
7. Understand library networking.
8. Know about the international information system and network.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 36%

UNIT-I: Information sources-

- Documentary sources of information.
- Print, Non-print including Electronic Nature.
- Characteristics, Utility and evaluation of different types of information sources.
- Non Documentary Information sources; Human and institutional – Nature, Types, Characteristics and utility.
- Internet as a source of information.

UNIT-II: **Information services-**

- Information services- Concepts, Definition need and trends.
- Techniques and evaluation of alerting services (CAS & SDI).
- Bibliographic, Referral.
- Document delivery and translation services.

UNIT-III: Information Products-

- Information products- Nature, Concept, Types, Design and marketing. Abstracting.
- Types and guidelines in preparing abstracts.

- Study and evaluation of important abstract periodicals information analysis, Repackaging and consolidation.

UNIT- IV: User Educations-

- Goals and objectives, Levels, Technique and methods.
- Reference interview and search techniques.
- Resource sharing and library networking.
- Study of Indonet, Inflibnet, Calibnet, Nicnet, Delnet, Adinet, Malibnet.

UNIT-V:

- International information system and network.
- AGRIS, BIOSIS, CAS, DEVSIS, ICSU, INIS, INSPEC, MEDLARS.

Paper-VIII INFORMATION TECHNOLOGY: BASICS & APPLICATIONS

Learning Outcomes:
After studying this paper, students shall be able to:

1. Understand the structure of computer and functions of its various units.
2. Know about create, edit and manage files using Word processing and Power Point Presentation software.
3. Understand the hardware and software.
4. Understand Internet-Basic features and tools.
5. Carry out library housekeeping operations using library management software.
6. Find bibliographic information from Web OPAC.
7. Understand the using library management software.
8. Know about library and information networking.
9. Know about data base management system.
10. Understand the digital libraries.
11. Examine the concept of library networks and highlight their types and importance.
12. Understand automation of in- house operations- Acquisitions, Cataloguing, Circulation, OPAC, Bar-coding.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 36%

UNIT-I Information Technology-

- Definition, need, scope and objectives.
- Historical background of computers.
- Generation of computers.
- Architecture CPU, Input/output devices.
- Hardware and software.
- Operating system-Ms-windows, UNIX, MS-DOS.

UNIT-II Networking-

- Types of networks-LAN, WAN, MAN.
- Local Area Networks; LAN Topologies, Network Hardware- Network interface card, hubs/switches.
- Getaways/Bridges, routes, modem.
- Network Protocols- TCP/IP, Net-BUI, IPX.

UNIT-III Internet-Basic features and tools-

- Connectivity- Dialup, Leased lines, Microwave, ISDN.
- Digital Subscriber Lines (DSL).
- E-mail-Protocols- Telnet, FTP, DTTP. Web browsers, Web servers, Search Engines, Keta Search,
- Web design- SGML, HTML, DHTML and XML.

UNIT-IV Data Base Management System-

- Models- Hierarchical, Network, Relational and object oriented.
- Software- CDS/ISIS, SOUL.
- Structure Query Language. Artificial Intelligence.
- Digital libraries- definition, characteristics & attributes,
- Storage media formats- DVD.

UNIT-V Library Automation-

- Planning and implementation of library automation.
- Automation of in- house operations- Acquisitions, Cataloguing, Circulation, OPAC Bar-coding.

Paper- IX (A) MANAGEMENT INFORMATION SYSTEMS.

(Any one of the following)

Learning Outcomes:
After studying this paper, students shall be able to:

1. Understand the management information system.
2. Know about MIS features, approaches.
3. Understand the MIS Systems analysis; Systems design.
4. Understand the management reporting system.
5. Understand the Decision Support Systems (DSS);
6. Understand the Office Automation Systems (OAS);
7. Understand the Knowledge Based Systems.
8. Understand the Internet and intranet -Basic features and tools.
9. Understand the using library management software.

10. Know about library and information networking.
11. Know about data base management system.
12. Understand the data communication.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 36%

- IX-A Management Information Systems.
- IX-B Business Information Systems.
- IX-C Biotechnology Information Systems.
- IX-D Health science Information Systems.
- IX-E Agricultural Information Systems.
- IX-F Social Science Information Systems.

(Note- In the initial stage only one information system, i.e. "IX-A; Management information Systems" is being implemented.)

Paper – IX ELECTIVES; Information Systems (Any one of the following)

UNTI-I

- Definition, concepts, elements and objectives of M.I.S.
- Information and management effectiveness.
- Information needs and management levels,
- Features of MIS system approach to MIS.
- Properties of MIS.

UNIT-II

- Structure of MIS.
- MIS and decision making.
- Planning for MIS-Systems analysis; Systems design.
- Techniques of system analysis; Techniques for MIS planning.

UNIT-III: Information Support System-

- Management reporting systems (MRS);
- Decision Support Systems (DSS);
- Office Automation Systems (OAS);
- Knowledge Based Systems.

UNIT IV: Functional Informational Systems-

- Financial Information Systems; Marketing IS; & Human resource IS.
- Implementation, Evaluation & Maintenance of MIS.

UNIT V

- Role of Computer in MIS.
- Data Base Management.
- Data Base Software-Software needs selection and development.
- Data communication and networking.
- Using Information superhighways- Internet and Intranet.

PAPER- IX-B Academic Library and Information System

Unit – 1 Academic Library

- History and Development of Libraries with special reference to India
- Role of Academic Library in Education
- Academic Library as a support System for Education

Unit – 2 Development of Academic Library

- Role of UGC in Promoting Academic Libraries, University College and other Institutions
- Role of library authorities of the Institutions in Promoting Library Resources
- Development of Library Services
- Financial Management of Academic Libraries

Unit – 3 Collection Developments

- Collection Development Policy, Weeding policy
- Problems in Collection Organization in an Academic Library
- Collection Development Programmes, Allocation of Funds to Collection Procurement,
- Curriculum and Collection Development
- Library Committees and their Role in Collection Development

Unit – 4 Staffing and Staff Development for Academic Library

- Norms and Patterns for Staffing in University, College and School Libraries
- Continuing Education Programmes for Academic Library Development
- Personal Management in Academic Library

Unit – 5 Resource Sharing Programmes

- Resource Sharing Services – its Objectives, Organization and Development
- INFLIBNET and its Implications to Library Resource Sharing
- Regional and City Network of Libraries and their Importance

PAPER- IX-C Archival, Museum and Archaeological Information System

Unit - 1 History and Development

- History and Development and types of Archival Centers
- Kind and identification of Archival material

Unit-2 Organisation and Management of Archival and Manuscripts

- Acquisition, Classification, Cataloguing and Indexing of Archival material
- Source material on Archival , Manuscripts
- Machine Readable and Microfilm of Archival records
- Database and Digitization of Archives
- Role of UNESCO and other agencies

Unit -3 Environment Control

- Building Design
- Planning and furniture and Fillings
- Use of Copy Right to information in relation to archives

Unit - 4 Preservation of Archives

- Objective and Purpose
- Cause of Deterioration
- Environmental Pollution : Physical , Chemical and Atmospheric
- Biological enemies of materials : Mould , Fungi , Insect and Rodents

Unit – 5 Rehabilitation of Documents

- Cleaning, removal of Stains
- Fuming and deacidification
- Repair and restoration techniques
- Lamination
- Standards for Storage Conditions

PAPER- IX-D Agricultural Information System

Unit - 1 Agriculture Education and Agriculture Libraries

- Growth and development of Agriculture education and research in India
- Role of Library in Agricultural education, research and Extension
- Development of Agriculture Library in India

Unit – 2 Information Source and Services in Agriculture

- Specialized Collection and Information Sources
- Information Service and products in Agricultural Science and Technology with
- Special reference to India
- Agriculture Information Centers - National and International

Unit-3 Organization and Management of Resources

- General Principle of Information Management
- Information Organization , Processing and Dissemination
- Developing need based and on Demand Specialized Services

Unit – 4 Information Needs

- Identifying special need of Agricultural faculty & research Staff
- User Studies of Local Agriculture Libraries

Unit - 5 Agriculture Information System and Networks

- Current Trends in agricultural System and Networks
- Resource Sharing and Networking in Agricultural Libraries in India
- International Agricultural Database
- Professional Associations.

PAPER- IX-E Legal Information System

Unit- 1 Law Librarianship

- Growth and Development of legal Institutional in India
- Nature Principle and Characteristics of legal Information and Law Libraries
- Type of Law Library

Unit – 2 Information Source Collections

- Special Information Sources : Bills , Acts , Books , Serials , Law Court notice ,
- Law case amendments
- Tribunal Report, Law Digests , Legal Judgment, Delegation Legislation
- Rules and orders , Legal information Sources and Lexicons

Unit - 3 Organizations and Management of Resources

- Information Processing : Classification, Cataloguing and Indexing
- Developing special skills and Techniques to handle legal information (personnel)
- Managing finance : Funds & Fund Generation

Unit – 4 Information need and services

- Special needs of lawyers and legal Professionals
- Study of Law Information Centers (Local)
- Special Services, Planning and design
- Preparation of rapports on Law Libraries (Local)
- Dissemination methods and techniques

Unit - 5 Legal Information System & Networks

- Legal information System :National and International
- Structure and their services
- Legal Database and Digital Libraries
- Resource and Networks of Legal Information

PAPER- IX-F Industrial Information System

Unit - 1 Growth and Development of Industries & Industrialization Libraries

- Industrial Growth in India
- Type of Industries: Government and Non-Government.
- Role of Libraries and Information Center in Industries
- Categories of Industrial Libraries

Unit – 2 Industrial Information Resource Collections

- Tread Literature
- Patents
- Standards
- Technical Reports Bulletins

Unit – 3 Organizations and Management of Industrial Information

- Special Classification Scheme and Indexing System
- Planning and Designing Specialized information services and Products
- System approach to Planning and Design and Implementation
- Managing personal Skills and Finance

Unit – 4 Information needs and Services of Industrial Libraries

- Special Classification Schemes and Indexing System
- Case Studies and field Experience of local Industries
- Preparation of Report of an Industrial Library Survey (Local)
- Marketing of Information
- Computerized Information Service

Unit – 5 Industrial Information System and Network

- Industrial Information Centers and Networks National and International
- (SENDOC)
- Structure and their services
- Industrial Databases
- Resource Sharing and Networking of Industrial Information Centers in India

PAPER – X INFORMATION PROCESSING & RETRIVAL (PRACTICE- II)
(AACR-2)

Learning Outcomes:
After studying this paper, students shall be able to:

1. Use the catalogue codes and standards.
2. Understand the concept of library catalogue.
3. Know about the main and added entries of library catalogue.
4. Know about various inner and outer forms of library catalogue.
5. Understand various approaches of deriving subject headings.
6. Prepare catalogue entries for various types of information sources.
7. Derive subject headings using various methods and tools.

Full Marks: 100 (Theory: 80, Internal Assessment: 20) Pass Marks 36%

Cataloguing of Publications by AACR-2

(42)

साहित्य एवं भाषा अध्ययनशाला
पं0 रविशंकर शुक्ल विश्वविद्यालय, रायपुर, 492010 (छ0ग0)

क्रमांक.731/सा.एवं भाषा/2022 दिनांक 22/03/2022

प्रति,

उपकुलसचिव (अकादमिक विभाग)
पं. रविशंकर शुक्ल वि. वि.,
रायपुर (छ.ग.)

विषय : पाठ्यक्रम के संबंध में ।

संदर्भ : क्रमांक 1360/अका./2022 रायपुर, दिनांक 22.03.2022।

महोदय,

विषयांतर्गत उपरोक्त संदर्भित पत्र के संबंध में विभाग में संचालित पाठ्यक्रमों से संबंधित Programme Outcome, Specific Outcome, Course Outcome तैयार करके आपकी ओर भेजी जा रही है।

संलग्न– Programme Outcome
Specific Outcome
Course Outcome

अध्यक्ष 24/03/2022
HEAD
SOS in Lit. & Languages
Pt. Ravishankar Shukla Univ.
Raipur (C.G.)

प्रतिलिपि –
क्रं 732/A/सा. एवं भाषा/2022 रायपुर, दिनांक 22/3/2022
1. डायरेक्टर, IQAC, Pt. R.S.U., Raipur ।

अध्यक्ष 24/3/2022
साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,
रायपुर (छत्तीसगढ़)

PT. RAVISHANKAR SHUKLA UNIVERSITY

School of Studies in Literature & Languages

Outcome Based Curriculum

M.A. Hindi: All Stream

(Semester- I to IV)

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अध्यक्ष
साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,
रायपुर (छत्तीसगढ़)

Program Learning Outcomes: Hindi

This course enables students

1. To recognize the importance of interpersonal skills
2. To describe how good communication with others can influence our working relationships
3. To demonstrate critical and innovative thinking.
4. To show an understanding of opportunities in the field of communication.
5. To use current technology related to the communication field.
6. To respond effectively to cultural communicative differences.
7. To communicate ethically.
8. To research and write focused, convincing analytical essays in clear, grammatical prose.

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रायपुर (छत्तीसगढ़)

Pt. Ravishankar Shukla University, Raipur
SoS Literature & Language
Scheme of Examination
M.AHindi Semester-I Examination

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	प्रथम	आदिकाल एवं पूर्व मध्यकाल	
2.	द्वितीय	प्राचीन एवं मध्यकालीन काव्य	
3.	तृतीय	छायावाद एवं पूर्ववर्ती काव्य	
4.	चतुर्थ	आधुनिक गद्य साहित्य (नाटक, एकांकी एवं रेखाचित्र (साहित्य)	

Pt. Ravishankar Shukla University, Raipur
Center for Basic Sciences
Scheme of Examination
Hindi Semester-II Examination

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	पंचम	उत्तरमध्यकाल एवं आधुनिक काल	
2.	षष्ठ	मध्यकालीन काव्य	
3.	सप्तम	प्रयोगवादी एवं प्रगतिवादी काव्य	
4.	अष्टम	आधुनिक गद्य साहित्य (उपन्यास, निबन्ध एवं कहानी	
Total			

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अध्यक्ष
साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,
रायपुर (छत्तीसगढ़)

Pt. Ravishankar Shukla University, Raipur

Center for Basic Sciences

Scheme of Examination

M.A. Semester-III

BiologyStream

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	प्रथम	साहित्य के सिद्धांत तथा आलोचना शास्त्र	
2.	द्वितीय	भाषाविज्ञान	
3.	तृतीय	कामकाज हिन्दी एवं पत्रकारिता	
4.	चतुर्थ	भारतीय साहित्य	
Total			

Pt. Ravishankar Shukla University, Raipur

Center for Basic Sciences

Scheme of Examination

M A Hindi Semester-IV Examination

BiologyStream

S.No.	Paper Code	Paper Title	Contact hrs/ per week Theory + Tu torials	Credits
Theory Paper				
1.	पंचम	हिंदी आलोचना तथा समीक्षा शास्त्र		
2.	षष्ठ	हिंदी भाषा		
3.	सप्तम	मीडिया लेखन एवं अनुवाद		
4.	अष्टम	जनपदीय भाषा और साहित्य (छत्तीसगढ़ी)		
Total				

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अध्यक्ष
साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,
रायपुर (छत्तीसगढ़)

2. SPECIFIC OUTCOME : M.A. Hindi (I SEMESTER)

Paper Code	Paper Name	M. A. Hindi I Semester
0103.01	आदिकाल एवं पूर्वमध्यकाल	1. आदिकाल एवं पूर्वमध्यकाल विषय के अध्ययन से हिंदी साहित्य के प्रारंभिक अवस्था एवं साहित्य इतिहास लेखन की परम्परा से अवगत होना। 2. आदिकालीन हिंदी साहित्य की विस्तृत जानकारी। 3. पूर्व मध्यकालीन (भक्तिकाल) विविध भक्ति धाराओं एवं भक्त कवियों के साथ तादात्म्य स्थापना। 4. कृष्ण एवं राम भक्ति परंपरा की सुदृढ़ता। 5. तात्कालिन सामाजिक, राजनीतिक, धार्मिक प्रवृत्तियों की जानकारी।
0103.02	प्राचीन एवं मध्यकालीन काव्य	1. प्राचीन एवं मध्यकालीन काव्य के अध्ययन से तात्कालीन परिस्थितियों सेअवगत होना। 2. कबीर की वाणियों के माध्यम से सामाजिक सुधार के विशेष प्रयास से प्रेरित होना, धार्मिक सद्भावना की जागृति। 3. ऐतिहासिक एवं लोक कथाओं के प्रति उत्सुकता। 4. भक्ति की चरम अवस्था का ज्ञान होना
0103.03	छायावाद एवं पूर्ववर्ती काव्य	1. छायावादी काव्य के अध्ययन से प्रकृति प्रेम की भावना। 2. प्रकृति के रहस्य को जानने की उत्सुकता। 3. राष्ट्रीय मूल्य को बढ़ावा । 4. नारी के प्रति सम्मान भाव में वृद्धि। 5. मानवीय संवेदना का विकास।
0103.04	आधुनिक गद्य साहित्य (नाटक, एकांकी एवं रेखाचित्र (साहित्य)	1. आधुनिक गद्य साहित्य के अंतर्गत नाटक, एकांकी एवं रेखाचित्र के उद्भव विकास एवं प्रवृतियों की जानकारी। 2. आधुनिक दृष्टिकोण। 3. सामाजिक यथार्थता बोध। 4. विविध जीवन–मूल्यों का उद्घाटन एवं कर्त्तव्यबोध।

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अध्यक्ष
साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,
रायपुर (छत्तीसगढ़)

2. SPECIFIC OUTCOME : M.A. Hindi (II SEMESTER)

Paper Code	Paper Name	M. A. Hindi II Semester
0103.05	उत्तर मध्यकाल से आधुनिक काल तक	1. उत्तरमध्यकालीन काव्यगत प्रवृत्तियों एवं परिस्थितियों का विस्तृत परिचय। 2. आधुनिक काल के साहित्य के अध्ययन से देश–प्रेम की भावना का विकास। 3. हिंदी के गद्य साहित्य की आरंभिक अवस्था की जानकारी। 4. समाज सुधार के भावना में दृढ़ता। 5. वर्ग–भेद भूलाकर सामाजिक समरसता के भाव का उदय।
0103.06	मध्यकालीन काव्य	1. मध्यकालीन काव यके अध्ययन से भक्ति भावना से तादात्म्य। 2. धार्मिक सहिष्णुता का विकास। 3. समाज में समन्वय की भावना।
0103.07	प्रयोगवादी एवं प्रगतिवादी काव्य	1. साहित्य के माध्यम से आधुनिक विचारधारा से परिचय। 2. काव्य लेखन कला कौशल में विकास । 3. निम्न वर्ग के प्रति संवेदना भाव। 4. नेट परीक्षा में उपयोगी।
0103.08	आधुनिक गद्य साहित्य (उपन्यास, निबंध एवं कहानी)	5. हिंदी गद्य साहित्य की विविध विधाओं उपन्यास, निबंध एवं कहानी की विकास यात्रा का ज्ञान। 6. समाज के विविध वर्गों की मानसिकता से परिचय। 7. देश की नींव कहे जाने वाले किसानों से प्रगाढ़ता। 8. विद्यार्थियों में साहित्य पढ़ने की रूचि जागृत होना। 9. विविध मानवीय गुणों से साक्षात्कार। 10. नेट परीक्षा में उपयोगी।

अध्यक्ष
साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,

2. SPECIFIC OUTCOME : M.A. Hindi (III SEMESTER)

Paper Code	Paper Name	M. A. Hindi III Semester
0103.09	साहित्य के सिद्धांत तथा आलोचना शास्त्र	1. भारतीय काव्यशास्त्र के अध्ययन से साहित्य सिद्धांतों से परिचित होना। 2. पाश्चात्य काव्य शास्त्रीय स्वरू॰ एवं अवधारणा से अवगत होना। 3. साहित्य लेखन की कला का ज्ञान होना। 4- नेट एवं प्रतियोगी परीक्षा के लिए उपयोगी ।
0103.10	भाषाविज्ञान	1. भाषा के विविध रूपों का ज्ञानर्जन। 2. भाषाविज्ञान में वर्णनात्मक और ऐतिहासिक एवं तुलनात्मक स्वरूप का ज्ञान। 3. भाषा के उच्चारण प्रक्रिया से अवगत होना। 4. व्याकरण के स्वरूप एवं प्रयोग से अवगत होना। 5. भाषा में शब्दों के प्रयोग का विस्तृत ज्ञान।
0103.11	कामकाजी हिंदी एवं पत्रकारिता	1. पारिभाषिक शब्दावली से परिचय। 2. प्रशासनिक काम–काज की भाषा से अवगत होना । 3. पत्रकारिता की भाषा से विविध स्वरूप उपयोगिता एवं महत्व से अवगत होना। 4. पत्रकारिता संबंधी 'प्रेस कानून' की जानकारी 5. हिंदी भाषा के क्षेत्र में कम्प्यूटर की उपयोगिता एवं महत्व से अवगत होना 6. कार्यालयीन पत्र–लेखन के मानक स्वरूप का ज्ञान। 7. नेट परीक्षा में उपयोगी।
0103.12	भारतीय साहित्य	8. भारतीय साहित्य के अध्ययन से विस्तृत साहित्यिक पृष्ठभूमि का ज्ञानार्जन । 9. भारतीय साहित्य के अध्ययन से विविध प्रांतों के रीति–रिवाज, परंपरा एवं संस्कृति, से प्रगाढ़ता। 10. विविध भाषाओं के विचारों एवं विमर्शों से सकारात्मक संबंध स्थापित होते हैं। 11. भारतीय साहित्य के अध्ययन से सामाजिक एवं सांस्कृतिक मूल्यों से परिचय होता है। 12. वर्त्तमान भारत के प्रतिबिम्ब से परिचित होना । 13. भारतीय साहित्य के अनुवाद से हिंदी साहित्य में समृद्धि होगी। 14. अनुवाद की प्रवृत्ति के कारण भारतीय साहित्य के अध्ययन के प्रति रूझान। 15. भारतीय साहित्य के तुलनात्मक अध्ययन से वैचारिक समरसता। 16. भारतीय साहित्य के अध्ययन से अनेकता में एकता की भावना जागृत होना। 17. नेट परीक्षा में उपयोगी।

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साहित्य एवं भाषा अध्ययन शाला

2. SPECIFIC OUTCOME : M.A. Hindi (IV SEMESTER)

Paper Code	Paper Name	M. A. Hindi IV Semester
0103.13	हिंदी आलोचना तथा समीक्षा शास्त्र	1. पाश्चात्य समीक्षा शास्त्र का विस्तृत परिचय। 2. भारतीय समीक्षा शास्त्र का विस्तृत परिचय। 3. पाश्चात्य एवं भारती समीक्षा शास्त्र में साहित्य के विकास की रूपरेखा का ज्ञान। 4. पाश्चात्य समीक्षा शास्त्र का विस्तृत परिचय।
0103.13	हिंदी भाषा	1. हिंदी भाषा के विकास का अध्ययन। 2. हिंदी भाषा के अर्थ एवं शब्द परिवर्तन का ज्ञान। 3. हिंदी साहित्य में क्षेत्रीय भाषा और बोलियों के प्रभाव का अध्ययन।
0103.15	मीडिया लेखन एवं अनुवाद	1. मीडिया लेखन के अध्ययन से विद्यार्थियों में मीडिया लेखन कौशल का विकास। 2. अनुवाद प्रविधि के अध्ययन से अनुवाद में भाषागत कुशलता में वृद्धि। 3. जनसंचार के विविध स्वरूप से परिचय। 4. जनसंचार के दृश्य–श्रव्य माध्यक में दक्षता रोजगार में सहायक। 5. नेट एवं प्रतियोगी परीक्षा में उपयोगी।
0103.16	जनपदीय भाषा और साहित्य	1. जनपदीय भाषा और साहित्य के अध्ययन से छत्तीसगढ़ी भाषा–संरचना का ज्ञान होना। 2. छत्तीसगढ़ी साहित्य की विकास यात्रा से परिचय। 3. छत्तीसगढ़ी साहित्यकार के प्रति आत्मीयता के भाव का उजागर होना। 4. छत्तीसगढ़ी साहित्य के विविध विधाओं के माध्यम से अपनी माटी से जुड़ाव की भावना। 5. छत्तीसगढ़ी रीति–रिवाज, परंपरा एवं संस्कृति से प्रगाढ़ता। 6. छत्तीसगढ़ की भौगोलिक सीमाओं एवं विशेषताओं से अवगत होना। 7. नेट परीक्षा में उपयोगी।

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साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,

Course Outcome : M. A. Hindi

1. To display competence in oral and written communication.
2. To apply communication theories.
3. To demonstrate positive group communication exchanges.
4. To generate a close reading of a text, recognize, understand, and explain textual elements—for example, word choice, imagery, form, and connotations.
5. To participate in discussions by listening to others perspectives, asking productive questions, and articulating original ideas.

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साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,
रायपुर (छत्तीसगढ़)

साहित्य एवं भाषा अध्ययनशाला
पं0 रविशंकर शुक्ल विश्वविद्यालय, रायपुर, 492010 (छ0ग0)

क्रमांक.731 / सा.एवं भाषा / 2022 दिनांक 22 / 03 / 2022

प्रति,

उपकुलसचिव (अकादमिक विभाग)
पं. रविशंकर शुक्ल वि. वि.,
रायपुर (छ.ग.)

विषय : पाठ्यक्रम के संबंध में ।

संदर्भ : क्रमांक 1360 / अका. / 2022 रायपुर, दिनांक 22.03.2022 ।

महोदय,

विषयांतर्गत उपरोक्त संदर्भित पत्र के संबंध में विभाग में संचालित पाठ्यक्रमों से संबंधित Programme Outcome, Specific Outcome, Course Outcome तैयार करके आपकी ओर भेजी जा रही है।

संलग्न– Programme Outcome
Specific Outcome
Course Outcome

अध्यक्ष 24/03/2022
HEAD
SOS in Lit. & Lang.
Pt. Ravishankar Shukla Univ.
Raipur (C.G.)

प्रतिलिपि –
क्रं 732/A/ सा. एवं भाषा/2022 रायपुर, दिनांक 22/3/2022
1. डायरेक्टर, IQAC, Pt. R.S.U., Raipur ।

अध्यक्ष 24/3/2022
साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,
रायपुर (छत्तीसगढ़)

PT. RAVISHANKAR SHUKLA UNIVERSITY

School of Studies in Literature & Languages

Outcome Based Curriculum

M.A. Chhattisgarhi : All Stream

(Semester- I to IV)

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साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,

Programme Outcome: M. A. Chhattisgarhi

1. **छत्तीसगढ़ी भाषा और साहित्य की राष्ट्रीय एवं अंतरराष्ट्रीय पहचान है।** पाठ्यक्रम का अध्ययन करने के उपरांत आपको निम्नलिखित करने में सक्षम होना चाहिए :
2. अपने मातृभाषा में पारस्परिक कौशल के महत्व को पहचानें
3. मातृभाषा में अच्छा संचार करने में कुशल हों
4. अपने मौलिक एवं नई दिशा के सोच को विकसित करना
5. मातृभाषा में संचार के सिद्धांतो को लागू करें
6. छत्तीसगढ़ी में सकारात्मक समूह माध्यम से संचार को अत्यधिक प्रदर्शित करें
7. कविता, पदबंधों, कहानी कहने, गीत के माध्यम से शुद्ध उच्चारण को जानना।
8. शोध और लेखन केंद्रित, विषयों का विश्लेषणात्मक अध्ययन करना।
9. शब्दों–संरचना, से शब्दार्थ का विकास करना।
10. साहित्य की पृष्ठभूमि को अनुसंधान के द्वारा व्यवस्थित करना
11. अनुभव एवं अनुसंधान के माध्यम से शोधकर्ताओं को नए क्षेत्र में आगे बढ़ना
12. छत्तीसगढ़ी की संमृद्ध परंपरा के आलोक में अनुसंधान को बढ़ाना
13. छात्रों में जीवन के सभी पक्षों और अपनी क्षमताओं का संतुलित विकास करना

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साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,

Pt. Ravishankar Shukla University, Raipur
SoS Literature & Language
Scheme of Examination
M.A. Chhattisarhi Semester-I Examination

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	प्रथम	छत्तीसगढ़ी के भौगोलिक अउ ऐतिहासिक पृष्ठभूमि	
2.	द्वितीय	छत्तीसगढ़ी के ध्वनि–संरचना	
3.	तृतीय	छत्तीसगढ़ी के व्याकरण	
4.	चतुर्थ	छत्तीसगढ़ी साहित्य के इतिहास	

Pt. Ravishankar Shukla University, Raipur
Center for Basic Sciences
Scheme of Examination
Hindi Semester-II Examination

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	पंचम	छत्तीसगढ़ी के लोक–कला अउ संस्कृति	
2.	षष्ठ	छत्तीसगढ़ी लोक साहित्य	
3.	सप्तम	छत्तीसगढ़ी–काव्य	
4.	अष्टम	छत्तीसगढ़ी अर्थ–मीमांसा	
Total			

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साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,

Pt. Ravishankar Shukla University, Raipur

Center for Basic Sciences

Scheme of Examination

M.A. Semester-III

BiologyStream

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	प्रथम	छत्तीसगढ़ी के शब्द–संरचना	
2.	द्वितीय	छत्तीसगढ़ी के भाषा–भूगोल	
3.	तृतीय	प्रयोजन मूलक छत्तीसगढ़ी	
4.	चतुर्थ	राजभाषा छत्तीसगढ़ी	
Total			

Pt. Ravishankar Shukla University, Raipur

Center for Basic Sciences

Scheme of Examination

M A Hindi Semester-IV Examination

BiologyStream

S.No.	Paper Code	Paper Title	Contact hrs/ per week Theory + Tu torials	Credits
Theory Paper				
1.	पंचम	छत्तीसगढ़ी के वाक्य–संरचना		
2.	षष्ठ	छत्तीसगढ़ी अउ अनुवाद		
3.	सप्तम	छत्तीसगढ़ी के तीज तिहार अउ परंपरा		
4.	अष्टम	प्रायोगिक प्रशिक्षण अउ आंतरिक–मूल्यांकन		
Total				

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साहित्य एवं भाषा अध्ययन शाला

पं. रविशंकर शुक्ल विश्वविद्यालय,

2. SPECIFIC OUTCOME : M.A. Chhattisgarhi (I SEMESTER)

Paper Code	Paper Name	Int. M. A. Chhattisgarhi I Semester
104.1	छत्तीसगढ़ी के भौगोलिक अउ ऐतिहासिक पृष्ठभूमि	1. छत्तीसगढ़ के भौगोलिक और ऐतिहासिक पृष्ठभूमि का अध्ययन। 2. छत्तीसगढ़ी का भाषा–परिवार एवं अन्य भाषा से तुलनात्मक अध्ययन। 3. छत्तीसगढ़ी भाषा का भारोपीय भाषा–परिवार के अन्य भाषा से संबंध। 4. छत्तीसगढ़ी पर अन्य भाषा का प्रभाव। 5. छत्तीसगढ़ी भाषा के बदलते स्वरूप का अध्ययन। 6. विभिन्न प्रतियोगी परीक्षा में उपयोगी।
104.2	छत्तीसगढ़ी की ध्वनि संरचना	1. छत्तीसगढ़ी भाषा के स्वर और व्यंजन का अध्ययन। 2. वर्णमाला एवं अक्षर संरचना का अध्ययन। 3. ध्वनि उच्चारण को समझना । 4. शुद्ध उच्चारण में सक्षम।
104.3	छत्तीसगढ़ी के व्याकरण	1. छत्तीसगढ़ी की भाषिक व्यवस्था को जानना । 2. भाषा के मानकीकरण का अध्ययन करना। 3. विभिन्न प्रतियोगी परीक्षा में उपयोगी।
104.4	छत्तीसगढ़ी साहित्य के इतिहास	1. आदिकाल एवं मध्यकाल के साहित्य से परिचय। 2. छत्तीसगढ़ी साहित्य के गद्य विधा –उपन्यास, निबंध, कहानी, नाटक का अध्ययन करना। 3. सामाजिक यथार्थता बोध। 4. विविध जीवन–मूल्यों का उद्घाटन एवं कर्त्तव्यबोध। 5. विभिन्न प्रतियोगी परीक्षा में उपयोगी

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साहित्य एवं भाषा अध्ययन शाला

2. SPECIFIC OUTCOME : M.A. Chhattisgarhi (II SEMESTER)

Paper Code	Paper Name	Int. M. A. Chhattisgarhi II Semester
104.5	छत्तीसगढ़ी के लोक साहित्य अउ संस्कृति	1. गाथायुग साहित्य की प्रवृत्तियों एवं परिस्थितियों का विस्तृत परिचय। 2. लोक साहित्य का उद्भव और विकास की जानकारी। 3. लोक कला एवं लोक नाट्य का ज्ञान। 4. लोक नृत्य के विभिन्न प्रकार का अध्ययन। 5. प्रतियोगी परीक्षा में उपयोगी ।
104.6	छत्तीसगढ़ी के लोक साहित्य	1. छत्तीसगढ़ी के विभिन्न क्षेत्र के लोक परंपरा की विस्तृत जानकारी देना। 2. छत्तीसगढ़ी लोक साहित्य का विकास। 3. छत्तीसगढ़ी लोक साहित्य में मुहावरो एवं लोकोक्तियों का ज्ञान कराना।
104.7	छत्तीसगढ़ी काव्य	1. छत्तीसगढ़ी साहित्य के माध्यम से आधुनिक विचारधारा से परिचय। 2. छत्तीसगढ़ी काव्य लेखन कला कौशल में विकास । 3. छत्तीसगढ़ी साहित्य में सामाजिक एवं सांस्कृतिक भाव के उदाहरणों को बताना । 4. साहित्य में लोक परंपरा की अर्थ वत्ता को बताना
104.8	छत्तीसगढ़ी अर्थ–मीमांसा	1. छत्तीसगढ़ी साहित्य में अर्थ की विकास यात्रा का ज्ञान। 2. छत्तीसगढ़ी शब्दावली का परिचय। 3. छत्तीसगढ़ी भाषा और साहित्य में अर्थ के परिवर्तन का ज्ञान कराना।

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साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,
रायपुर (छत्तीसगढ़)

2. SPECIFIC OUTCOME : M.A. Chhattisgarhi (III SEMESTER)

Paper Code	Paper Name	Int. M. A. Chhattisgarhi III Semester
104.9	छत्तीसगढ़ी के शब्द संरचना	1. छत्तीसगढ़ी शब्दों का ज्ञान । 2. छत्तीसगढ़ी व्याकरण की जानकारी। 3. छत्तीसगढ़ी शब्दार्थों से परिचय।
104.10	छत्तीसगढ़ी के भाषा–भूगोल	1. छत्तीसगढ़ी के भौगोलिक संरचना के आधार पर बोली परिवर्तन का ज्ञान 2. बोली के परिवर्तन के कारणों का ज्ञान।
104.11	छत्तीसगढ़ी प्रयोजन मूलक छत्तीसगढ़ी	1. छत्तीसगढ़ी के विविध रूप का ज्ञान। 2. छत्तीसगढ़ी के व्यावहारिक उपयोग के आधार पर ज्ञान
104.12	राजभाषा छत्तीसगढ़ी	1. कार्यालयीन भाषा के आधार पर छत्तीसगढ़ी का ज्ञान 2. छत्तीसगढ़ी भाषा परिवर्तन के आधार पर राजकीय परिपत्र तैयार करने का ज्ञान

Sheilk

अध्यक्ष
साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,

2. SPECIFIC OUTCOME : M.A. Chhattisgarhi (IV SEMESTER)

Paper Code	Paper Name	Int. M. A. Chhattisgarhi IVSemester
104.13	छत्तीसगढ़ी के वाक्य संरचना	1. छत्तीसगढ़ी वाक्य की अशुद्धियाँ और उसका शुद्ध रूप। 2. छत्तीसगढ़ी वाक्य संरचना बनाने में सक्षम होगें।
104.14	छत्तीसगढ़ी अउ अनुवाद	1. अनुवाद की प्रक्रिया से छात्रों को अवगत करना। 2. सफल अनुवादक बनाना । 3. छत्तीसगढ़ी से हिंदी और हिंदी से छत्तीसगढ़ी में अनुवाद। 4. हलबी, भतरी, गोंडी को छत्तीसगढ़ी में अनुवाद करना सीखना और अनुवाद करने की क्षमता का विकास करना।
104.15	छत्तीसगढ़ी के तीज–तिहार अउ परंपरा	1. छत्तीसगढ़ के लोक जीवन और संस्कृति से परिचय। 2. विभिन्न प्रतियोगी परीक्षाओं के लिए इस प्रश्न के संबंधित ज्ञान से छात्रों को अवगत कराना।
104.16	प्रायोगिक परीक्षण एवं आंतरिक मूल्यांकन	1. विभिन्न प्रतियोगी परीक्षाओं के लिए इस प्रश्न में छात्रों को अभ्यास कराना । 2. क्षेत्रीय भाषाओं एवं बोलियों सर्वेक्षण करने की प्रक्रिया की जानकारी देना। 3. क्षेत्रीय भाषाओं एवं बोलियों सर्वेक्षण कर उसके परीक्षण कर रिर्पोट तैयार कराना। 4. विलुप्तप्रायः बोलियों में सर्वेक्षण कराना।

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अध्यक्ष
साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,

Course Outcome : M. A. Chhattisgarhi

1. छत्तीसगढ़ी के विभिन्न क्षेत्र के लोक परंपरा की विस्तृत जानकारी देना।
2. छत्तीसगढ़ी लोक साहित्य का विकास।
3. छत्तीसगढ़ी साहित्य के माध्यम से आधुनिक विचारधारा से परिचय।
4. छत्तीसगढ़ी काव्य लेखन कला कौशल में विकास ।
5. छत्तीसगढ़ी शब्दों का ज्ञान ।
6. छत्तीसगढ़ी व्याकरण की जानकारी।
7. छत्तीसगढ़ी शब्दार्थों से परिचय।
8. क्षेत्रीय भाषाओं एवं बोलियों सर्वेक्षण कर उसके परीक्षण कर रिर्पोट तैयार कराना।
9. विलुप्तप्रायः बोलियों में सर्वेक्षण कराना।

अध्यक्ष
साहित्य एवं भाषा अध्ययन शाला
पं. रविशंकर शुक्ल विश्वविद्यालय,

Pt. Ravishankar Shukla University, Raipur

Scheme of Examination

M.A./M.Sc. (MATHEMATICS) (Semester-I)

2021 - 22 (Examination – Dec. 2021) onwards

There shall be five papers. Each paper shall have 100 marks. **Overall tally of marks will be 500.**

Paper	Code	Description	Theory	Sessional	Practical	Total Marks
I	101	Advanced Abstract Algebra (I)	80	20	-	100
II	102	Real Analysis (I)	80	20	--	100
III	103	Topology	80	20	--	100
IV	104	Advanced Complex Analysis (I)	80	20	--	100
V	105	Advanced Discrete Mathematics (I)	80	20	--	100

M.Sc./M.A. Course (First Semester)
PAPER -I

Advanced Abstract Algebra (I)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Demonstrate capacity for mathematical reasoning through analyzing, Proving and explaining concepts from advanced algebra.
2. Understand the concept of Normal and subnormal series, solvable group, state and prove Jordan-Holder theorem.
3. Understand the concepts of fields, extension of fields and splitting fields of polynomials.
4. Identify and analyze different types of algebraic structures such as Algebraically closed fields, Splitting fields, Finite field extensions to understand and use the fundamental results in Algebra. Design, analyze and implement the concepts of Gauss Lemma, Einstein's irreducibility criterion, separable extensions etc.
5. Create, select and apply appropriate algebraic structures such as Galois extensions, Automorphisms of groups and fixed fields, Fundamental theorem of Galois theory to understand and use the Fundamental theorem of Algebra, solvability of polynomials.

Contents:

Unit-I Groups - Normal and Subnormal series. Composition series. Jordan-Holder theorem. Solvable groups. Nilpotent groups.

Unit-II Field theory- Extension fields. Algebraic and transcendental extensions. Separable and inseparable extensions. Normal extensions.

Unit-III Perfect fields. Finite fields. Primitive elements. Algebraically closed fields.

Unit-IV Automorphisms of extensions. Galois extensions. Fundamental theorem of Galois theory.

Unit-V Solution of polynomial equations by radicals. Insolvability of the general equation of degree 5 by radicals.

Books Recommended:

1. P.B.Bhattacharya, S.K.Jain, S.R.Nagpaul: Basic Abstract Algebra, Cambridge University press
2. I.N.Herstein: Topics in Algebra, Wiley Eastern Ltd.
3. Quazi Zameeruddin and Surjeet Singh : Modern Algebra

References

1. M.Artin, Algeabra, Prentice -Hall of India, 1991.
2. P.M. Cohn, Algebra,Vols. I,II &III, John Wiley & Sons, 1982,1989,1991.
3. N.Jacobson, Basic Algebra, Vols. I , W.H. Freeman, 1980 (also published by Hindustan Publishing Company).
4. S.Lang, Algebra, 3rd edition, Addison-Wesley, 1993.
5. I.S. Luther and I.B.S. Passi, Algebra, Vol. I-Groups, Vol.II-Rings, Narosa Publishing House (Vol.l-1996,Vol. II-1999)
6. D.S.Malik, J.N.Mordeson, and M.K.Sen, Fundamentals of Abstract Algebra, Mc Graw-Hill, International Edition,1997.
7. Vivek Sahai and Vikas Bist: Algebra, Narosa Publishing House, 1999.
8. I. Stewart, Galois theory, 2nd edition, chapman and Hall, 1989.
9. J.P. Escofier, Galois theory, GTM Vol.204, Springer, 2001..
10. Fraleigh , A first course in Algebra Algebra, Narosa,1982.

M.Sc./M.A. Course (First Semester)
PAPER-II

Real Analysis (I)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the concept of sequences and series of functions and apply the test for their convergence.
2. Understand the concept of convergence and divergence of power series and apply Abel's and Tauber's theorems.
3. Understand the concept of functions of several variables and properties of sets of vectors in R^n.
4. Understand the concept of maxima and minima of real valued functions from R to R and from R^n to R.
5. Understand the concept of Integration theory that is closely related to the theory of Euclidean spaces and derivatives of functions of several variables.

Contents:

Unit-I Sequences and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and differentiation, Weierstrass approximation theorem.

Unit-II Power series, uniqueness theorem for power series, Abel's and Tauber's theorems. Rearrangements of terms of a series, Riemann's theorem.

Unit-III Functions of several variables, linear transformations, Derivatives in an open subset of R^n, Chain rule, Partial derivatives, interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem, Implicit function theorem.

Unit-IV Jacobians, extremum problems with constraints, Lagrange's multiplier method, Differentiation of integrals.

Unit-V Partitions of unity, Differential forms, Stoke's theorem.

Recommended Books:

1. Principle of Mathematical Analysis By Walter Rudin (3rd edition) McGraw-Hill, Kogakusha, 1976, International student edition.
2. Real Analysis By H.L.Roydon, Macmillan Pub.Co.Inc.4th Edition, New York .1962.

References

1. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi,1985.
2. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar,Inc. New York,1975.
3. A.J. White, Real Analysis; an introduction, Addison-Wesley Publishing Co.,Inc.,1968.
4. G.de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
5. E. Hewitt and K. Stromberg. Real and Abstract Analysis, Berlin, Springer, 1969.
6. P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 Reprint 2000).
7. I.P. Natanson, Theory of Functions of a Real Variable. Vol. l, Frederick Ungar Publishing Co., 1961.
8. Richard L. Wheeden and Antoni Zygmund, Measure and Integral: An Introduction to Real Analysis, Marcel Dekker Inc.1977.
9. J.H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962.
10. A. Friedman, Foundations of Modern Analysis, Holt, Rinehart and Winston, Inc., New York, 1970.
11. P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
12. T.G. Hawkins, Lebesgue's Theory, of Integration: Its Origins and Development, Chelsea, New York, 1979.
13. K.R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.
14. R.G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966.
15. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1969.
16. Inder K. Rana, An Introduction to Measure and Integration, Norosa Publishing House, Delhi, 1997.
17. Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing Co.Ltd. New Delhi, 1966.

M.Sc./M.A. Course (First Semester)
PAPER-III

Topology

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the concept of countable and uncountable sets and its properties.
2. Understand the concept of topological spaces and its examples, bases, sub-bases, subspaces and relative topology.
3. Understand the concept of countable, separable spaces and separation axioms with their characterizations and basic properties.
4. Understand the concept and properties of compactness, continuous functions.
5. Understand the concept and properties of countable compactness in metric spaces.

Contents:

Unit-I Countable and uncountable sets. Infinite sets and the Axiom of Choice. Cardinal numbers and its arithmetic. Schroeder-Bernstein theorem. Cantor's theorem and the continuum hypothesis. Zorn's lemma, well-ordering theorem.

Unit-II Definition and examples of topological spaces. Bases and sub-bases. Subspaces and relative topology. Alternate methods of defining a topology in terms of terms of Kuratowski Closure Operator and Neighbourhood Systems. Continuous functions and homeomorphism.

Unit-III First and Second Countable spaces. Lindelof's theorems. Separable spaces. Second countability and separability. Separation axioms; their Characterizations and basic properties. Urysohn's lemma, Tietze extension theorem.

Unit-IV Compactness. Continuous functions and compact sets. Basic properties of Compactness. Compactness and finite intersection property. Sequentially and countably compact sets. Local compactness and one point compactification. Stone-Cech compactification.

Unit-V Compactness in metric spaces. Equivalence of compactness, countable compactness and sequential compactness in metric space.

Connected spaces. Connectedness on the real line. Components. Locally connected spaces.

Recommended Books:

1. James R.Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd., New Delhi,2000.
2. K.D.Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.

References

1. J. Dugundji, Topology, Allyn and Bacon, 1966 (reprinted in India by Prentice Hall of India Pvt. Ltd.).
2. George F.Simmons, Introduction to Topology and modern Analysis, McGraw-Hill Book Company, 1963.
3. J.Hocking and G Young, Topology, Addison-Wiley Reading, 1961.
4. J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York,1995.
5. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
6. W.Thron, Topologically Structures, Holt, Rinehart and Winston, New York,1966.
7. N. Bourbaki, General Topology Part I (Transl.),Addison Wesley, Reading, 1966.
8. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
9. W. J. Pervin, Foundations of General Topology, Academic Press Inc. New York,1964.
10. E.H.Spanier, Algebraic Topology, McGraw-Hill, New York,1966.
11. S. Willard, General Topology, Addison-Wesley, Reading, 1970.
12. Crump W.Baker, Introduction to Topology, Wm C. Brown Publisher, 1991.
13. Sze-Tsen Hu, Elements of General Topology, Holden-Day,Inc.1965.
14. D. Bushaw, Elements of General Topology, John Wiley & Sons, New York, 1963.
15. M.J. Mansfield, Introduction to Topology, D.Van Nostrand Co. Inc.Princeton,N.J.,1963.
16. B. Mendelson, Introduction to Topology, Allyn & Bacon, Inc., Boston,1962.
17. C. Berge, Topological Spaces, Macmillan Company, New York,1963.
18. S.S. Coirns, Introductory Topology, Ronald Press, New York, 1961.
19. Z.P. Mamuzic, Introduction to General Topology, P. Noordhoff Ltd.,Groningen, 1963.
20. K. K. Jha, Advanced General Topology, Nav Bharat Prakashan, Delhi.

M.Sc./M.A. Course (First Semester)

PAPER-IV

Complex Analysis (I)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the fundamental concept of complex analysis. Evaluate Complex integrals with the help of theorems mention in the contents. Identity singularities.
2. Understand the concept of maximum modulus principle, and Inverse function theorem.
3. Understand the concept of residues and apply Cauchy's residue theorem to evaluate integrals.
4. Understand the concept of conformal mappings, bilinear transformations, their properties and classifications.
5. Understand the concept about the spaces of analytic functions.

Contents:

Unit-I Complex integration, Cauchy-Goursat. Theorem. Cauchy's integral formula. Higher order derivatives. Morera's Theorem. Cauchy's inequality and Liouville's theorem. The fundamental theorem of algebra. Taylor's theorem. Laurent's series. Isolated singularities. Meromorphic functions.

Unit-II Maximum modulus principle. Schwarz lemma. The argument principle. Rouche's theorem Inverse function theorem.

Unit-III Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to arg z, logz and z^a.

Unit-IV Bilinear transformations, their properties and classifications. Definitions and examples of Conformal mappings.

Unit-V Spaces of analytic functions. Hurwitz's theorem. Montel's theorem Riemann mapping theorem.

Recommended Books:

1. Complex Analysis By L.V.Ahlfors, McGraw - Hill, 1979.

2. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House,1980.

References

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford 1990.
2. Complex Function Theory By D.Sarason
3. Liang-shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
4. S. Lang, Complex Analysis, Addison Wesley, 1977.
5. D. Sarason, Complex Function Theory, Hindustan Book Agency, Delhi, 1994.
6. Mark J.Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University press, South Asian Edition, 1998.
7. E. Hille, Analytic Function Theory (2 Vols.) Gonn & Co., 1959.
8. W.H.J. Fuchs, Topics in the Theory of Functions of one Complex Variable, D.Van Nostrand Co., 1967.
9. C.Caratheodory, Theory of Functions (2 Vols.) Chelsea Publishing Company, 1964.
10. M.Heins, Complex Function Theory, Academic Press, 1968.
11. Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966.
12. S.Saks and A.Zygmund, Analytic Functions, Monografic Matematyczne, 1952.
13. E.C Titchmarsh, The Theory of Functions, Oxford University Press, London.
14. W.A. Veech, A Second Course in Complex Analysis, W.A. Benjamin, 1967.
15. S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.

M.Sc./M.A. Course (First Semester)
PAPER-V

Advanced Discrete Mathematics (I)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the concept of formal Logic, quantifiers, predicates and their uses in truth tables.
2. Understand the concept of homomorphism of semi groups and monoids.
3. Understand the concept of lattices as algebraic systems, Boolean algebras as lattices.
4. Apply Boolean Algebra to switching theory (using AND, OR & NOT gates).
5. Understand grammars and languages.

Contents:

Unit-I Formal Logic-Statements. Symbolic Representation and Tautologies. Quantifiers, Predicates and Validity. Propositional Logic. Semigroups & Monoids-Definitions and Examples of Semigroups and monoids (including those pertaining to concatenation operation).

Unit-II Homomorphism of semigroups and monoids. Congruence relation and Quotient Semigroups. Subsemigroup and submonoids. Direct Products. Basic Homomorphism Theorem.

Unit-III Lattices-Lattices as partially ordered sets. Their properties. Lattices as Algebraic Systems. Sublattices, Direct products, and Homomorphisms. Some Special Lattices e.g., Complete, Complemented and Distributive Lattices. Boolean Algebras-Boolean Algebras as Lattices. Various Boolean Identities. The Switching Algebra example. Subalgebras,

Unit-IV Direct Products and Homomorphisms. Join-Irreducible elements, Atoms and Minterms. Boolean Forms and Their Equivalence. Minterm Boolean Forms, Sum of Products Canonical Forms. Minimization of Boolean Functions. Applications of Boolean Algebra to Switching Theory (using AND,OR & NOT gates). The Karnaugh Map Method.

Unit-V Grammars and Languages-Phrase-Structure Grammars. Rewriting Rules. Derivations. Sentential Forms. Language generated by a Grammar. Regular, Context-Free, and Context Sensitive Grammars and Languages. Regular sets, Regular Expressions. Notions of Syntax Analysis, Polish Notations. Conversion of Infix Expressions to Polish Notations. The Reverse Polish Notation.

Recommended Books:

1. Elements of Discrete Mathematics By C.L.Liu
2. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.

References

1. J.L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
2. Seymour Lepschutz, Finite Mathematics (International) edition (1983), McGraw-Hill Book Company, New York.
3. S.Wiitala, Discrete Mathematics-A Unified Approach, McGraw-Hill Book Co.
4. J.E. Hopcroft and J.D Ullman, Introduction to Automata Theory, Languages & Computation, Narosa Publishing House.
5. C.L Liu, Elements of Discrete Mathematics, McGraw-Hill Book Co.
6. N. Deo. Graph Theory with Application to Engineering and Computer Sciences. Prentice Hall of India
7. K.L.P.Mishra and N.Chandrashekaran, Theory of Computer Science PHI(2002)

Pt. Ravishankar Shukla University, Raipur

Scheme of Examination

M.A./M.Sc. (MATHEMATICS) (Semester-II)

2021 - 22 (Examination – May-June 2022) onwards

There shall be five theory papers. Each paper shall have 100 marks. **Overall tally of marks will be 500.**

Paper	Code	Description	Theory	Sessional	Practical	Total Marks
I	201	Advanced Abstract Algebra (II)	80	20	-	100
II	202	Real Analysis (II)	80	20	--	100
III	203	General and Algebraic Topology	80	20	--	100
IV	204	Advanced Complex Analysis (II)	80	20	--	100
V	205	Advanced Discrete Mathematics (II)	80	20	--	100

M.Sc./M.A. Course (Second Semester)
PAPER-I
Advanced Abstract Algebra (II)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the concepts of modules, Noetherian and artinian modules. Prove Wedderburns theorem on finite division rings.
2. Discuss algebra of linear transformations and characteristics roots.
3. Find the metrics corresponding to linear transformation and different canonical forms like triangular and Jordan canonical form etc.
4. Prove and apply the Primary Decomposition Theorem, and the criterion for diagonalisability.
5. Find rational canonical form and generalized Jordan form over any field.

Contents:

Unit-I Modules - Cyclic modules. Simple modules. Semi-simple modules. Schuler's Lemma. Free modules. Noetherian and artinian modules and rings-Hilbert basis theorem. Wedderburn Artin theorem. Uniform modules, primary modules, and Noether-Lasker theorem.

Unit-II Linear Transformations - Algebra of linear transformation, characteristic roots, matrices and linear transformations.

Unit-III Canonical Forms - Similarity of linear transformations. Invariant subspaces. Reduction to triangular forms. Nilpotent transformations. Index of nilpotency. Invariants of a nilpotent transformation. The primary decomposition theorem. Jordan blocks and Jordan forms.

Unit-IV Smith normal form over a principal ideal domain and rank. Fundamental structure theorem for finitely generated modules over a Principal ideal domain and its applications to finitely generated abelian groups.

Unit-V Rational canonical from. Generalised Jordan form over any field.

Books Recommended:

1. P.B.Bhattacharya, S.K.Jain, S.R.Nagpaul : Basic Abstract Algebra, Cambridge University press
2. I.N.Herstein : Topics in Albegra, Wiley Eastern Ltd.
3. Quazi Zameeruddin and Surjeet Singh : Modern Algebra

References

1. M.Artin, Algeabra, Prentice -Hall of India, 1991.
2. P.M. Cohn, Algebra,Vols. I,II &III, John Wiley & Sons, 1982,1989,1991.
3. N.Jacobson, Basic Algebra, Vols. I & II,W.H. Freeman, 1980 (also published by Hindustan Publishing Company).
4. S.Lang, Algebra, 3rd edition, Addison-Wesley, 1993.
5. I.S. Luther and I.B.S. Passi, Algebra, Vol. I-Groups, Vol.II-Rings, Narosa Publishing House (Vol.l-1996,Vol. II-1999)
6. D.S.Malik, J.N.Mordeson, and M.K.Sen, Fundamentals of Abstract Algebra, Mc Graw-Hill, International Edition,1997.
7. K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi,2000.
8. S.K.Jain,A. Gunawardena and P.B Bhattacharya, Basic Linear Algebra with MATLAB, Key College Publishing (Springer-Verlag),2001.
9. S.Kumaresan, Linear Algebra, A Geometric Approach, Prentice-Hall of India, 2000.
10. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
11. I. Stewart, Galois theory, 2nd edition, chapman and Hall, 1989.
12. J.P. Escofier, Galois theory, GTM Vol.204, Springer, 2001.
13. T.Y. Lam, lectures on Modules and Rings, GTM Vol. 189, Springer-Verlag,1999.
14. D.S. Passman, A Course in Ring Theory, Wadsworth and Brooks/Cole Advanced Books and Softwares, Pacific groves. California, 1991.
15. Fraleigh , A first course in Algebra Algebra, Narosa,1982.

M.Sc./M.A. Course (Second Semester)
PAPER-II

Real Analysis (II)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the concept of Riemann-Stieltjes integral and apply it to evaluate definite integrals arising in different fields of science and engineering.
2. Understand development of measure and integration theory and Borel, Lebesgue measurability.
3. Compare integration theory of Lebesgue and Riemann with examples and counter examples.
4. Understand the concept and properties of functions of bounded variation.
5. Understand the concept of L^p-spaces and convergence in measure.

Contents:

Unit-I Definition and existence of Riemann-Stieltjes integral, Properties of the Integral, integration and differentiation, the fundamental theorem of Calculus, integration of vector-valued functions, Uniform convergence and Riemann-Stieltjes integration, Rectifiable curves.

Unit-II Lebesgue outer measure. Measurable sets. Regularity. Measurable functions. Borel and Lebesgue measurability. Non-measurable sets. Integration of Non-negative functions. The General integral. Integration of Series.

Unit-III Measures and outer measures, Extension of a measure. Uniqueness of Extension. Completion of a measure. Measure spaces. Integration with respect to a measure. Reimann and Lebesgue Integrals.

Unit-IV The Four derivatives. Lebesgue Differentiation Theorem. Differentiation and Integration. Functions of Bounded variation.

Unit-V The L^p-spaces. Convex functions. Jensen's inequality. Holder and Minkowski inequalities. Completeness of L^p, Convergence in Measure, Almost uniform convergence

Recommended Books:

1. Principle of Mathematical Analysis by W. Rudin
2. Real Analysis by H. L. Roydon

References

1. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi,1985.
2. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar,Inc. New York,1975.
3. A.J. White, Real Analysis; an introduction, Addison-Wesley Publishing Co.,Inc.,1968.
4. G.de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
5. E. Hewitt and K. Stromberg. Real and Abstract Analysis, Berlin, Springer, 1969.
6. P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 Reprint 2000).
7. I.P. Natanson, Theory of Functions of a Real Variable. Vol. l, Frederick Ungar Publishing Co., 1961.
9. Richard L. Wheeden and Antoni Zygmund, Measure and Integral: An Introduction to Real Analysis, Marcel Dekker Inc.1977.
10. J.H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962.
11. A. Friedman, Foundations of Modern Analysis, Holt, Rinehart and Winston, Inc., New York, 1970.
12. P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
13. T.G. Hawkins, Lebesgue's Theory, of Integration: Its Origins and Development, Chelsea, New York, 1979.
14. K.R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.
15. R.G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966.
16. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1969.
17. Inder K. Rana, An Introduction to Measure and Integration, Norosa Publishing House, Delhi, 1997.

M.Sc./M.A. Course (Second Semester)
PAPER-III

General and Algebraic Topology

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the concept of Tychonoff product topology and related concepts.
2. Understanding the connectedness, compactness and countability properties in product space.
3. Understand embedding, metrization and its related theorems.
4. Understand the concept of net, filter and its various topological properties and their inter-relations.
5. Understand fundamental group and covering spaces.

Contents:

Unit-I Tychonoff product topology in terms of standard sub-base and its characterizations. Projection maps. Separation axioms and product spaces.

Unit-II Product spaces. Connectedness and product spaces. Compactness and product spaces (Tychonoff's theorem). Countability and product spaces.

Unit-III Embedding and metrization. Embedding lemma and Tychonoff embedding. The Urysohn metrization theorem. Metrization theorems and Paracompactness-Local finiteness. The Nagata-Smirnov metrization theorem. Paracompactness. The Smirnov metrization theorem.

Unit-IV Nets and filter. Topology and convergence of nets. Hausdorffness and nets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to filters and vice-versa. Ultra-filters and Compactness.

Unit-V The fundamental group and covering spaces-Homotopy of paths. The fundamental group. Covering spaces. The fundamental group of the circle and the fundamental theorem of algebra

Recommended Books:

1. James R.Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd., New Delhi,2000.
2. K.D.Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.

References

1. J. Dugundji, Topology, Allyn and Bacon, 1966 (reprinted in India by Prentice Hall of India Pvt. Ltd.).
2. George F.Simmons, Introduction to Topology and modern Analysis, McGraw-Hill Book Company, 1963.
3. J.Hocking and G Young, Topology, Addison-Wiley Reading, 1961.
4. J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York,1995.
5. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
6. W.Thron, Topologically Structures, Holt, Rinehart and Winston, New York,1966.
7. N. Bourbaki, General Topology Part I (Transl.),Addison Wesley, Reading, 1966.
8. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
9. W. J. Pervin, Foundations of General Topology, Academic Press Inc. New York,1964.
10. E.H.Spanier, Algebraic Topology, McGraw-Hill, New York,1966.
11. S. Willard, General Topology, Addison-Wesley, Reading, 1970.
12. Crump W.Baker, Introduction to Topology, Wm C. Brown Publisher, 1991.
13. Sze-Tsen Hu, Elements of General Topology, Holden-Day,Inc.1965.
14. D. Bushaw, Elements of General Topology, John Wiley & Sons, New York, 1963.
15. M.J. Mansfield, Introduction to Topology, D.Van Nostrand Co. Inc.Princeton,N.J.,1963.
16. B. Mendelson, Introduction to Topology, Allyn & Bacon, Inc., Boston,1962.
17. C. Berge, Topological Spaces, Macmillan Company, New York,1963.
18. S.S. Coirns, Introductory Topology, Ronald Press, New York, 1961.
19. Z.P. Mamuzic, Introduction to General Topology, P. Noordhoff Ltd.,Groningen, 1963.
20. K.K.Jha, Advanced General Topology, Nav Bharat Prakashan, Delhi.

M.Sc./M.A. Course (Second Semester)

PAPER-IV

Advanced Complex Analysis (II)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the concept of Weierstrass' factorisation theorem, Riemann Zeta function, Gamma function and its properties..
2. Understand the concept of Analytic Continuation and its properties. Gain knowledge of power series of analytic function.
3. Understand the concept and properties of Harmonic functions on a disc.
4. Understand the concept of Canonical products, entire function and exponent of Convergence.
5. Understand the advanced concepts of Analytic functions and its properties.

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Contents:

Unit-I Weierstrass' factorisation theorem. Gamma function and its properties. Riemann Zeta function. Riemann's functional equation. Runge's theorem. Mittag-Leffler's theorem.

Unit-II Analytic Continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation Schwarz Reflection Principle. Monodromy theorem and its consequences.

Unit-III Harmonic functions on a disk. Harnack's inequality and theorem. Dirichlet Problem. Green's function.

Unit-IV Canonical products. Jensen's formula. Poisson-Jensen formula. Hadamard's three circles theorem. Order of an entire function. Exponent of Convergence. Borel's theorem. Hadamard's factorization theorem.

Unit-V The range of an analytic function. Bloch's theorem. The Little Picard theorem. Schottky's theorem. Montel Caratheodory and the Great picard theorem. Univalent functions. Bieberbach's conjecture (Statement only) and the "1/4-theorem.

Recommended Books:

1. L.V. Ahlfors, Complex Analysis, MCGraw - Hill, 1979.
3. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House,1980.

References

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford 1990.
2. Liang-shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
3. S. Lang, Complex Analysis, Addison Wesley, 1977.
4. Mark J.Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University press, South Asian Edition, 1998.
5. E. Hille, Analytic Function Theory (2 Vols.) Gonn & Co., 1959.
6. W.H.J. Fuchs, Topics in the Theory of Functions of one Complex Variable, D.Van Nostrand Co., 1967.
7. C.Caratheodory, Theory of Functions (2 Vols.) Chelsea Publishing Company, 1964.
8. M.Heins, Complex Function Theory, Academic Press, 1968.
9. Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966.
10. S.Saks and A.Zygmund, Analytic Functions, Monografic Matematyczne, 1952.
11. E.C Titchmarsh, The Theory of Functions, Oxford University Press, London.
12. W.A. Veech, A Second Course in Complex Analysis, W.A. Benjamin, 1967.
13. S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.
14. D. Sarason, Complex Function Theory, Hindustan Book Agency, Delhi, 1994.

M.Sc./M.A. Course (Second Semester)
PAPER-V

Advanced Discrete Mathematics (II)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the basic concept and properties in Graph Theory .
2. Understand Trees and its properties. Apply Kruskal's.
3. Apply Dijkstra's Algorithm and Warshall's Algorithm.
4. Understand the concept of Finite State Machines.
5. **U**nderstand Deterministic, Non-deterministic Finite Automata, Moore and mealy Machines.

Contents:

Unit-I Graph Theory-Definition of (Undirected) Graphs, Paths, Circuits, Cycles, & Subgraphs. Induced Subgraphs. Degree of a vertex. Connectivity. Planar Graphs and their properties. Trees. Euler's Formula for connected planar Graphs. Complete & Complete Bipartite Graphs. Kuratowski's Theorem (statement only) and its use.

Unit-II Spanning Trees, Cut-sets, Fundamental Cut -sets, and Cycle. Minimal Spanning Trees and Kruskal's Algorithm. Matrix Representations of Graphs. Euler's Theorem on the Existence of Eulerian Paths and Circuits. Directed

Unit-III Graphs. In degree and Out degree of a Vertex. Weighted undirected Graphs. Dijkstra's Algorithm.. strong Connectivity & Warshall's Algorithm. Directed Trees. Search Trees. Tree Traversals.

Unit-IV Introductory Computability Theory-Finite State Machines and their Transition Table Diagrams. Equivalence of finite State Machines. Reduced Machines. Homomorphism.

Unit-V Finite Automata. Acceptors. Non-deterministic Finite Automata and equivalence of its power to that of Deterministic Finite Automata. Moore and mealy Machines. Turing Machine and Partial Recursive Functions. The Pumping Lemma. Kleene's Theorem.

Recommended Books:

1. Elements of Discrete Mathematics By C.L.Liu
2. Graph Theory and its application By N.Deo
3. Theory of Computer Science By K.L.P.Mishra and N.Chandrashekaran

References

1. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
2. J.L. Gersting, Mathematical Structures for Computer Science, (3rd edition), Computer Science Press, New York.
3. Seymour Lepschutz, Finite Mathematics (International) edition 1983), McGraw-Hill Book Company, New York.
4. S.Wiitala, Discrete Mathematics-A Unified Approach, McGraw-Hill Book Co.
5. J.E. Hopcroft and J.D Ullman, Introduction to Automata Theory, Languages & Computation, Narosa Publishing House.
6. C.L Liu, Elements of Discrete Mathematics, McGraw-Hill Book Co.
7. N. Deo. Graph Theory with Application to Engineering and Computer Sciences. Prentice Hall of India.

Pt. Ravishankar Shukla University, Raipur

Scheme of Examination

M.A./M.Sc. (MATHEMATICS) (Semester-III)

2021- 22 (Examination – Dec. 2021) onwards

There shall be five theory papers. Two compulsory and three optional. Each paper shall have 100 marks. Out of these five papers, the paper which has theory and practical both, the theory part shall have 70 marks and practical part shall have 30 marks. **Overall tally of marks in theory and practical will be 500.**

Paper	Code		Description	Theory	Sessi-onal	Practical	Remark
Compulsory Papers							
I	301		Integration Theory and Functional Analysis (I)	80	20	--	--
II	302		Partial Differential Equations & Mechanics (I)	80	20	--	--
Optional Papers							
III	303	A	Fundamentals of Computer Science (Object Oriented Programming and Data Structure)	70	--	30	For regular students only
	304	B	Fuzzy Set Theory & Its Applications (I)	80	20	--	--
	305	C	Mathematical Biology (I)	80	20	--	--
IV	306	A	Operations Research (I)	80	20	--	--
	307	B	Wavelets (I)	80	20	--	--
V	308	A	Programming in C (with ANSI Features) (I)	70	--	30	For regular students only
	309	B	Graph Theory (I)	80	20	--	--

M.Sc./M.A. Course (Third Semester)
PAPER -I
Integration Theory and Functional Analysis (I)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the concept of Signed measure and its properties, Caratheodory's extension measure theory.
2. Understand modern theory of measure and integration.
3. Understand measure theory with respect to continuous functions, regularity of measures on locally compact spaces.
4. Understand finite dimensional normed linear and its basic properties.
5. Understand the concept of weak convergence and dual spaces.

Contents:

Integration Theory:

Unit-I Signed measure. Hahn decomposition theorem, mutually singular measures. Radon-Nikodym theorem. Labesgue decomposition. Riesz representation theorem. Extension theorem (Caratheodory).

Unit-II Lebesgue-Stieltjes integral, product measures, Fubini's theorem. Differentiation and Integration. Decomposition into absolutely continuous and singular parts.

Unit-III Baire sets. Baire measure, continuous functions with compact support. Regularity of measures on locally compact spaces. Integration of continuous functions with compact support, Riesz-Markoff theorem.

Functional Analysis :

Unit-IV Normed linear spaces. Banach spaces and examples. Quotient space of normed linear spaces and its completeness, equivalent norms. Riesz Lemma, basic properties of finite dimensional normed linear spaces and compactness.

Unit-V Weak convergence and bounded linear transformations, normed linear spaces of bounded linear transformations, dual spaces with examples.

Books Recommended :

1. P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
2. B.Choudhary and S.Nanda, Functional Analysis with Applications. Wiley Eastern Ltd. 1989.
3. H.L. Royden, Real Analysis, Macmillan Publishing Co. Inc., New York, 4'h Edition, 1993.

References

1. S.K. Berberian, Measure and integration, Chelsea Publishing Company, New York, 1965.
2. G. de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
3. P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited, New Delhi, 2000.
4. Richard L. Wheeden and Antoni Zygmund, Measure and Integral : An Introduction to Real Analysis, Marcel Dekker Inc. 1977.
5. J.H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962.
6. T.G. Hawkins, Lebesgue's Theory of Integration: Its Origins and Development, Chelsea, New York, 1979.
7. K.R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.
8. R.G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966.
9. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1967.
10. Inder K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, Delhi, 1997.
11. Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing.
12. Edwin Hewitt and Korl Stromberg, Real and Abstract Analysis, Springer-Verlag, New York.
13. Edwin Hewitt and Kenneth A. Ross, Abstract Harmonic Analysis, Vol. 1, Springer-Verlag, 1993.
14. G. Bachman and L. Narici, Functional Analysis, Academic Press, 1966.
15. N. Dunford and J.T. Schwartz, Linear Operators, Part I, Interscience, New York, 1958.
16. R.E. Edwards, Functional Analysis, Holt Rinehart and Winston, New York, 1965.
17. C. Goffman and G. Pedrick, First Course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.

18. P.K. Jain, O.P. Ahuja and Khalil Ahmad, Functional Analysis, New Age International (P) Ltd. & Wiley Eastern Ltd., New Delhi, 1997.
19. R.B. Holmes, Geometric Functional Analysis and its Applications, Springer-Verlag, 1975.
20. K.K. Jha, Functional Analysis, Students' Friends, 1986.
21. L.V. Kantorovich and G.P. Akilov, Functional Analysis, Pergamon Press, 1982.
22. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
23. B.K. Lahiri, Elements of Functional Analysis, The World Press Pvt. Ltd., Calcutta, 1994.
24. A.H.Siddiqui, Functional Analysis with Applications, Tata McGraw-Hill Publishing Company Ltd. New Delhi
25. B.V. Limaye, Functional Analysis, Wiley Eastern Ltd.
26. L.A. Lustenik and V.J. Sobolev, Elements of Functional Analysis, Hindustan Publishing Corporation, New Delhi, 1971.
27. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, New York, 1963.
28. A.E. Taylor, Introduction to Functional Analysis, John Wiley and Sons, New York, 1958.
29. K.Yosida, Functional Analysis, 3'" edition Springer-Verlag, New York, 1971.
30. J.B. Conway, A Course in Functional Analysis, Springer-Verlag, New York, 1990.
31. Walter Rudin, Functional Analysis, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1973.
32. A. Wilansky, Functional Analysis, Blaisdell Publishing Co., 1964.
33. J. Tinsley Oden & Leszek F. Dernkowicz, Applied Functional Analysis, CRC Press Inc., 1996.

M.Sc./M.A. Course (Third Semester)
PAPER -II
Partial Differential Equations and Mechanics (I)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand classification of partial differential equations in higher dimension.
2. Formulate and solve of PDEs like heat equation, initial value problem etc.
3. Understand basic concept related to discrete and continuous mechanical system.
4. Describe and understand the motion of a mechanical system using Poisson formalism.
5. Understand and evaluate attraction and potential in the problem related to rod, disc, spherical shells and sphere.

Contents:

Partial Differential Equations

Unit-I Examples of PDE. Classification. Transport Equation-Initial value Problem. Non-homogeneous Equation. Laplace's Equation-Fundamental Solution, Mean Value Formulas, Properties of Harmonic Functions, Green's Function, Energy Methods.

Unit-II Heat Equation-Fundamental Solution, Mean Value Formula, Properties of Solutions, Energy Methods. Wave Equation-Solution by Spherical Means, Non-homogeneous Equations, Energy Methods.

Analytical Dynamics:

Unit-III Generalized coordinates. Holonomic and Non-holonomic systems. Scleronomic and Rheonomic systems. Generalized potential. Lagrange's equations of first kind. Lagrange's equations of second kind. Uniqueness of solution. Energy equation for conservative fields. Hamilton's variables. Donkin's theorem. Hamilton canonical equations. Cyclic coordinates. Routh's equations.

Unit-IV Poisson's Bracket. Poisson's Identity. Jacobi-Poisson Theorem. Motivating problems of calculus of variations, Shortest distance. Minimum surface of revolution. Brachistochrone problem. Isoperimetric problem. Geodesic. Fundamental lemma of calculus of variations. Euler's equation for one dependent function and its generalization to (1) 'n' dependent functions, (ii) higher order derivatives. Conditional extremum under geometric constraints and under integral constraints.

Gravitation:

Unit-V Attraction and potential of rod, disc, spherical shells and sphere. Surface integral of normal attraction (application & Gauss' theorem). Laplace and Poisson equations. Work done by selfattracting systems. Distributions for a given potential. Equipotential surfaces. Surface and solid harmonics. Surface density in terms of surface harmonics.

Books Recommended :

1. L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Volume 19, AMS, 1998.
2. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975.
3. R.C.Mondal, Classical Mechanics, Prentice Hall of India
4. S.L. Loney, An Elementary Treatise on Statics, Kalyani Publishers, New Delhi, 1979.

References

1. Books on Partial differential equation by I.N. Sneddon, F. John, P. Prasad and R. Ravindran, Amarnath etc.

2. A.S. Ramsey, Dynamics Part II, The English Language Book Society and Cambridge University Press, 1972.
3. H. Goldstein, Classical Mechanics (2nd edition), Narosa Publishing House, New Delhi.
4. I.M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall.
5. Narayan Chandra Rana & Pramod Sharad Chandra Joag, Classical Mechanics, Tata McGraw Hill, 1991.
6. Louis N. Hand and Janet D. Finch, Analytical Mechanics, Cambridge University Press, 1998.
7. A.S. Ramsey, Newtonian Gravitation, The English Language Book Society and the Cambridge University Press.

M.Sc./M.A. Course (Third Semester)

PAPER-III (A)

Fundamentals of Computer Science-Theory and Practical

(Object Oriented Programming and Data Structure)

Max. Marks. 100

(Theory-70 +Practical-30)

Learning Outcomes: At the end of the course, the students will be able to :

6. Understand fundamentals of OOPs using C++ programming language.
7. Evaluate and apply the concepts of inheritance and virtual functions
8. Understand data structure, analysis of algorithms, list, stacks and queues.
9. Understand trees, binary trees, search tree implementations.
10. Apply various sorting techniques such as insertion sort, Shell sort, quick-short, heap sort and their analysis.

Contents:

Unit-I Object Oriented Programming-Classes and Scope, nested classes, pointer class members; Class initialization, assignment and destruction.

Unit-II Overloaded functions and operators; Templates including class templates; class inheritance and virtual functions.

Unit-III Data Structures-Analysis of algorithms, q, W, 0, o, w notations ; Sequential and linked representations, Lists, Stacks, and queues;

Unit-IV Trees: Binary tree- search tree implementation, B-tree (concept only);

Unit-V Sorting: Insertion sort, shell sort, quick-sort, heap sort and their analysis; Hashing-open and closed.

Books Recommended :

1. S.B. Lipman, J. Lajoi: C++ Primer, Addison Wesley.
2. B. Stroustrup; The C++ Programming Language, Addison Wesley.
3. C.J. Date : Introduction to Database Systems, Addison Wesley.
4. C. Ritehie: Operating Systems-Incorporating UNIX and Windows, BPB Publications.

5. M.A. Weiss, Data Structures and Algorithm Analysis in C++, Addison Wesley.

Practical Examination Scheme

Max. Marks – 30	Time Duration – 3 Hrs.
Practical (two)	20 Marks(10 marks each)
Viva	05 Marks
Sessional	05 Marks

M.Sc./M.A. Course (Third Semester)
PAPER-III (B)
Fuzzy Set Theory and Its Applications (I)

Max Marks – 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the various concept in fuzzy sets.
2. Understand the extension principle and operations on fuzzy sets.
3. Understand the fuzzy relations on Fuzzy sets.
4. Understand the fuzzy equivalence relations and relational equations.
5. Explain fuzzy measure and possibility theory.

Contents:

UNIT-I Fuzzy sets-Basic definitions, α-level sets. Convex fuzzy sets. Basic operations on fuzzy sets. Types of fuzzy sets. Cartesian products, Algebraic products. Bounded sum and difference, t-norms and t-conorms.

UNIT-II The Extension Principle- The Zadeh's extension principle. Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of fuzzy arithmetic.

UNIT-III Fuzzy Relations on Fuzzy sets, Composition of Fuzzy relations. Min-Max composition and its properties.

UNIT-IV Fuzzy equivalence relations. Fuzzy compatibility relations. Fuzzy relation equations. Fuzzy graphs, Similarity relation.

UNIT-V Possibility Theory-Fuzzy measures. Evidence theory. Necessity measure. Possibility measure. Possibility distribution. Possibility theory and fuzzy sets. Possibility theory versus probability theory.

REFERENCES :

1. H.J. Zmmemann, Fuzzy set theory and its Applications, Allied Publishers Ltd. New Delhi, 1991.
2. G.J. Klir and B. Yuan- Fuzzy sets and fuzzy logic, Prentice-Hall ol India, New Delhi, 1995.

M.Sc./M.A. Course (Third Semester)
PAPER-III (C)
Mathematical Biology (I)

Max. Marks – 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Finding the equilibria of a single-population model and their stability in continuous and discrete environment.
2. Find the fixed points and their stability in nonlinear dynamical systems.
3. Analysis and stability of equilibria of nonlinear systems in more than two variables
4. Make the mathematical model of different situations in population dynamics, ecology etc.
5. Relate mathematical notions with biological phenomena.

Contents:

Part-A: Simple Single Species Models

UNIT-I

Continuous Population Models: Phase plane analysis of ODE. Exponential Growth model, the Logistic Population Model, qualitative analysis, Harvesting in Population Models, Constant-yield harvesting, constant-effort harvesting, a case study of eutrophication of a lake.

UNIT-II

Discrete Population Models: Linear Models, graphical solution of difference equations, equilibrium analysis, period-doubling and chaotic behavior, discrete-time metered models, two-age group model and delayed recruitment, a case study of oscillation in flour beetle populations.

Part-B : Models for interacting species

UNIT-III

Introduction and Mathematical preliminaries: The Lotka-Volterra equations, the chemostat, equilibria and linearization, qualitative solutions of linear systems, periodic solutions and limit cycles, models for giving up smoking and retaining of workers by their peers.

UNIT-IV

Continuous Models for Two Interacting Populations: Species in competitions, Predator-Prey system, Kolmogorov Models, Mutualism, The community matrix, the nature of interactions between species, invading species and coexistence, a predator and two competing prey, two predators competing for prey.

UNIT-V

Harvesting in Two-Species Models: Harvesting of species in competition, Harvesing of predator-prey systems, some economic aspects of harvesting, optimization of harvesting returns.

Text Book:

1. Fred Brauer, Carlos Castillo-Chavez, Mathematical Models in Population Biology and Epidemiology, Biology, Springer (2010)

Reference Books:

1. Nicholas F. Britton, Essential Mathematical Biology, Springer-Verlag (2003)
2. J.D.Murray, Mathematical Biology I. An Introduction, Springer-Verlag (2002) 3rd Edition.
3. J.D.Murray, Mathematical Biology II. Spatial Models and Biomedical Application, Springer-Verlag (2003) 3rd Edition.

M.Sc./M.A. Course (Third Semester)

PAPER –IV (A)

Operations Research (I)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the concept of operations research and its scope. Formulate real life problems into linear programming problem and understand the simplex method.
2. Analyze duality, sensitivity in linear programming problem.
3. Understand theoretical foundation and implementation of optimization techniques available in the scientific literature.
4. Find the optimal solutions of transportation and assignment problems.
5. Understand the constriction of networks of project and optimal scheduling using CPM and PERT. Find the optimal solution for networking problems.

Contents:

Unit-I Operations Research and its Scope. Necessity of Operations Research in Industry. Linear Programming-Simplex Method. Theory of the Simplex Method.

Unit-II Duality and Sensitivity Analysis. Other Algorithms for Linear Programming-Dual Simplex Method.

Unit-III Parametric Linear Programming. Upper Bound Technique. Interior Point Algorithm. Linear Goal Programming.

Unit-IV Transportation and Assignment Problems.

Unit-V Network Analysis-Shortest Path Problem. Minimum Spanning Tree Probiem. Maximum Flow I Problem. Minimum Cost Flow Problem. Network Simplex Method. Project Planning and Control I with PERT-CPM.

Books Recommended :

1. F.S. Hillier and G.J. Ueberman. Introduction to Operations ResBareft (Sixth Edition), McGraw Hill International Edition, Industrial Engineering Series, 1995. (This book comes with a CD containing tutorial software).

2. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
3. G. Hadly, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass.
4. H.A. Taha, Operations Research -An introduction, Macmillan Publishing Co., Inc., New Yark.
5. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi
6. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network flows, John Wiley & Sons, New York, 1990.

References

1. S.S. Rao, Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.
2. Prem Kumar Gupla and D.S. Hira, Operations Research-An Introduction. S. Cliand & Company Ltd., New Delhi.
3. N.S. Kambo, Mathematical Programming Techniques, Affiliated East-West Press Pvt. Ltd., New Delhi, Madras
4. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.
5. A.D. Young, Boundary Layers, AIAA Education Series, Washington DC, 1989.
6. S.W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Private Limited, New Delhi, 1976.
7. UNDOSystems Products (Visit websHe htlp://www.Hndo.com/productsf.html)
   (i) UNDO (the linear programming solver)
   (ii) UNDO Callable Library (the premier optimisation engine)
   (iii) LINGO (the linear, non-linear, and integer programming solver with mathematical modelling language)
   (i) What's Best I (the spreadssheet add-in that solves linear, non-linear, and integer problems).

   All the above four products are bundled into one package to form the Solver Suite. For more details about any of the four products one has to click on its name.

   (i) Optimisation Modelling with UNDO (8" edition) by Linus Schrage.
   (ii) Optimisation Modelling with LINGO by Unus Schrage.

   More details available on the Related Book page York, 1979.

M.Sc./M.A. Course (Third Semester)
PAPER-IV (B)
Wavelets (I)

Max Marks – 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the basic concept of wavelet theory and ways of constructing wavelets.
2. Understand and apply unitary folding operators and the smooth projections.
3. Understand the concept of multi-resolution analysis and construction of compactly supported wavelets.
4. Understand the characterization of Lemarie-Meyer wavelets, Franklin wavelets and spline wavelets on the real line.
5. Understand and apply decomposition and reconstruction algorithms for wavelets.

Contents:

Unit-I. Preliminaries-Different ways of constructing wavelets- Orthonormal bases generated by a single function: the Balian-Low theorem. Smooth projections on $L^2(R)$.

Unit-II. Local sine and cosine bases and the construction of some wavelets. The unitary folding operators and the smooth projections.

Unit-III. Multiresolution analysis and construction of wavelets. Construction of compactly supported wavelets and estimates for its smoothness. Band limited wavelets.

Unit-IV. Orthonormality. Completeness. Characterization of Lemarie-Meyer wavelets and some other characterizations. Franklin wavelets and Spline wavelets on the real line.

Unit-V. Orthonormal bases of piecewise linear continuous functions for $L^2(T)$. Orthonormal bases of periodic splines. Periodization of wavelets defined on the real line.

REFERENCES:

1. Eugenic HernBndez and Guido Weiss, A First Course on Wavelets, CRC Press, New York, 1996.
2. C.K. Chui, An Introduction to Wavelets, Academic Press, 1992.
3. I.Daubechies, Ten Lectures on Wavelets, CBS-NSF Regional Conferences in Applied Mathematics, 61, SIAM, I 1992.
4. Y.Meyer,Wavelets, algorithms and applications (Tran.by R.D. Rayan,SIAM, 1993.
5. M.V. Wickerhauser, Adapted wavelet analysis from theory to software, Wellesley, MA, A.K. Peters, 1994.

M.Sc./M.A. Course (Third Semester)

PAPER –V (A)

Programming in C (with ANSI features) Theory and Practical (I)

Max. Marks. 100

(Theory-70 +Practical-30)

Learning Outcomes: At the end of the course, the students will be able to :

1. Understanding the basic structure, operators and statements of C language.
2. Implementing simple C program, data types, operators and console I/O functions.
3. Understand the decision control statements, loop control statements and case control statements.
4. Understand the concept of operator and expression in C.
5. Understand the declaration, implementation of array, pointers, function and structures.

Contents:

Unit-I An overview of programming. Programming language, Classification. C Essentials-Program Development. Functions. Anatomy of a C Function. Variables and Constants. Expressions. Assignment Statements. Formatting Source Files. Continuation Character. The Preprocessor.

Unit-II Scalar Data Types-Declarations, Different Types of Integers. Different kinds of Integer Constants. Floating-Point Types. Initialization. Mixing Types. Explicit Conversions-Casts. Enumeration Types. The Void Data Type. Typedefs. Finding the Address of an object. Pointers.

Unit-III Control Flow-Conditional Branching. The Switch Statement. Looping. Nested Loops. The break and continue Statements. The goto statement. Infinite Loops.

Unit-IV Operators and Expressions-Precedence and Associativity. Unary Plus and Minus operators. Binary Arithmetic Operators. Arithmetic

Assignment Operators. Increment and Decrement Operators. Comma Operator. Relational Operators. Logical Operators. Bit - Manipulation Operators. Bitwise Assignment Operators. Cast Operator. Size of Operators. Conditional Operator. Memory Operators.

Unit-V Arrays -Declaring an Array. Arrays and Memory. Initializing Arrays. Encryption and Decryption.

Books Recommended :

1. Peter A. Darnell and Philip E. Margolis, C: A Software Engineering Approach, Narosa Publishing House (Springer International Student Edition) 1993.
2. Samuel P. Harkison and Gly L. Steele Jr., C : A Reference Manual, 2nd Edition, Prentice Hall, 1984.
3. Brian W. Kernighan & Dennis M. Ritchie, The C Programme Language, 2nd Edition (ANSI Features), Prentice Hall 1989.

Practical Examination Scheme

Max. Marks – 30	Time Duration – 3 Hrs.
Practical (two)	20 Marks(10 marks each)
Viva	05 Marks
Sessional	05 Marks

M.Sc./M.A. Course (Third Semester)
PAPER-V (B)
Graph theory (I)

Max. Marks – 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the concept of topological operations on graphs.
2. Understand the concept of matrices and vector spaces in graph theory.
3. Understand the concept of coloring packing and covering in graph theory.
4. Understand the concept of combinational formulations in graph theory.
5. Understand the concept of perfect graphs, SPGC in graph theory.

Contents:

Unit-I: Operations on graphs, matrices and vector spaces: Topological operations, Homeomerphism, homomorphism, contractions, derived graphs, Binary operations.

Unit-II: Matrices and vector spaces: Matrices and vector spaces : The adjacency matrix, The determinant and the spectrum, Spectrum properties, The incidence matrix, cycle space and Bond space, Cycle bases and cycle graphs.

Unit-III: Colouring packing and covering: Vertex coverings, critical graphs, Girth and chromatic number, uniquely colourable graphs, edge-colourings, Face colourings and Beyond, The achromatic and the Adjoint Numbers.

Unit-IV: Combinational formulations: Setting up of combinational formulations, the classic pair of duals, Gallai, Norman-Rabin Theorems, Clique parameters, The Rosenfeld Numbers.

Unit-V: Perfect Graphs: Introduction to the “SPGC”, Triangulated (Chordal) graphs, Comparability graphs, Interval graphs, permutation graphs, circular arc graphs, split graphs, weakly triangulated graphs.

REFERENCES :

1. K.R.Parthasarathy, Basic graph theory, Tata Mc graw Hill publishing company limited , 1994.
2. R.J.Wilson, Introduction to graph theory, Longman Harlow, 1985.
3. John Clark, Derek Allon Holton, A first look at graph Theory, World Scientific Singapore, 1991.
4. Frank Hararary, Graph Theory Narosa, New Delhi, 1995.
5. Ronald Gould and Benjamin Cummins, Graph Theory, California.
6. Narsingh Deo, Graph Theory with applications to Engineering and Computer Science, Prentice-Hall of India Private Limited, New Delhi, 2002.

Pt. Ravishankar Shukla University, Raipur

Scheme of Examination

M.A./M.Sc. (MATHEMATICS) (Semester-IV)

2021 - 22 (Examination – May-June 2022) onwards

There shall be five papers. Two compulsory and three optional papers. Each paper shall have 100 marks. The paper which has theory and practical both, the theory part shall have 70 marks and practical part shall have 30 marks. **Overall tally of marks in theory and practical will be 500.**

Paper	Code	Description		Theory	Sessi-onal	Practical	Remark
Compulsory Papers							
I	401	Functional Analysis (II)		80	20	--	--
II	402	Partial Differential Equations & Mechanics (II)		80	20	--	--
Optional Papers							
III	403	A	Operating System and Database Management System	70	--	30	For regular students only
	404	B	Fuzzy Set Theory & Its Applications (II)	80	20	--	--
	405	C	Mathematical Biology(II)	80	20	--	--
IV	406	A	Operations Research (II)	80	20	-	--
	407	B	Wavelets (II)	80	20	-	--
V	408	A	Programming in C (with ANSI Features) (II)	70	--	30	For regular students only
	409	B	Graph Theory (II)	80	20	--	

M.Sc./M.A. Course (Fourth Semester)

PAPER -I

Functional Analysis (II)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the concept of uniform boundedness in normed linear spaces and Banach spaces.
2. Understand and apply fundamental theorems in normed linear spaces.
3. Understand the concept of Inner product spaces, Hilbert spaces, orthonormality and its properties.
4. Explain the concept of projection and reflexivity of Hilbert spaces.
5. Understand and apply general properties of linear operators in Hilbert space.

Contents:

Unit-I Uniform boundedness theorem and some of its consequences. Open mapping and closed graph theorems.

Unit-II Hahn-Banach theorem for real linear spaces, complex linear spaces and normed linear spaces. Reflexive spaces. Weak Sequential Compactness. Compact Operators. Solvability of linear equations in Banach spaces. The closed Range Theorem.

Unit-III Inner product spaces. Hilbert spaces. Orthonormal Sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity.

Unit-IV Structure of Hilbert spaces. Projection theorem. Riesz representation theorem. Adjoint of an operator on a Hilbert space. Reflexivity of Hilbert spaces.

Unit-V Self-adjoint operators, Positive, projection, normal and unitary operators. Abstract variational boundary-value problem. The generalized Lax-Milgram theorem.

Books Recommended :

1. B.Choudhary and S.Nanda, Functional Analysis with Applications. Wiley Eastern Ltd. 1989.
2. H.L. Royden, Real Analysis, Macmillan Publishing Co. Inc., New York, 4'h Edition, 1993.

References

1. Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1967.
2. Walter Rudin, Real & Complex Analysis, Tata McGraw-Hill Publishing.
3. Edwin Hewitt and Korl Stromberg, Real and Abstract Analysis, Springer-Verlag, New York.
4. Edwin Hewitt and Kenneth A. Ross, Abstract Harmonic Analysis, Vol. 1, Springer-Verlag, 1993.
5. G. Bachman and L. Narici, Functional Analysis, Academic Press, 1966.
6. N. Dunford and J.T. Schwartz, Linear Operators, Part I, Interscience, New York, 1958.
7. R.E. Edwards, Functional Analysis, Holt Rinehart and Winston, New York, 1965.
8. C. Goffman and G. Pedrick, First Course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
9. P.K. Jain, O.P. Ahuja and Khalil Ahmad, Functional Analysis, New Age International (P) Ltd. & Wiley Eastern Ltd., New Delhi, 1997.
10. R.B. Holmes, Geometric Functional Analysis and its Applications, Springer-Verlag, 1975.
11. K.K. Jha, Functional Analysis, Students' Friends, 1986.
12. L.V. Kantorovich and G.P. Akilov, Functional Analysis, Pergamon Press, 1982.
13. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
14. B.K. Lahiri, Elements of Functional Analysis, The World Press Pvt. Ltd., Calcutta, 1994.
15. A.H.Siddiqui, Functional Analysis with Applications, Tata McGraw-Hill Publishing Company Ltd. New Delhi
16. B.V. Limaye, Functional Analysis, Wiley Eastern Ltd.
17. L.A. Lustenik and V.J. Sobolev, Elements of Functional Analysis, Hindustan Publishing Corporation, New Delhi, 1971.
18. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, New York, 1963.
19. A.E. Taylor, Introduction to Functional Analysis, John Wiley and Sons, New York, 1958.
20. K.Yosida, Functional Analysis, 3'" edition Springer-Verlag, New York, 1971.
21. J.B. Conway, A Course in Functional Analysis, Springer-Verlag, New York, 1990.
22. Walter Rudin, Functional Analysis, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1973.

23. A. Wilansky, Functional Analysis, Blaisdell Publishing Co., 1964.
24. J. Tinsley Oden & Leszek F. Dernkowicz, Applied Functional Analysis, CRC Press Inc., 1996.

M.Sc./M.A. Course (Fourth Semester)
PAPER -II
Partial Differential Equations and Mechanics (II)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand nonlinear first order partial differential equation and its classification.
2. Understand representation of solution, transforms, and potential function.
3. Understand asymptotic and power series.
4. Understand the concept of Hamiltonian's principle and canonical transformations.
5. Understand and apply methods for Lagrange and Poisson brackets.

Contents:

Partial Differential Equations

Unit-I Nonlinear First Order PDE-Complete Integrals, Envelopes, Characteristics, Hamilton Jacobi Equations (Calculus of Variations, Hamilton's ODE, Legendre Transform, Hopf-Lax Formula, Weak Solutions, Uniqueness), Conservation Laws (Shocks, Entropy Condtion, LaxOleinik formula, Weak Solutions, Uniqueness, Riemann's Problem, Long Time Behaviour)

Unit-II Representation of Solutions-Separation of Variables, Similarity Solutions (Plane and Travelling Waves, Solitons, Similarity under Scaling), Fourier and Laplace Transform, Hopf-Cole Transform, Hodograph and Legendre Transforms, Potential Functions.

Unit-III Asymptotics (Singular Perturbations, Laplace's Method, Geometric Optics, Stationary Phase, Homogenization), Power Series (Non-characteristic Surfaces, Real Analytic Functions, Cauchy-Kovalevskaya Theorem).

Analytical Dynamics:

Unit-IV Hamilton's Principle. Principle of least action. Poincare Cartan Integral invariant. Whittaker's equations. Jacobi's equations. Lee Hwa Chung's theorem, canonical transformations and properties of generating functions.

Unit-V Hamilton-Jacobi equation. Jacobi theorem. Method of separation of variables. Lagrange Brackets. Condition of canonical character of a transformation in terms of Lagrange brackets and Poisson brackets, invariance of Lagrange brackets and Poisson brackets under canonical transformations.

Books Recommended :

1. L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Volume 19, AMS, 1998.
2. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975.
3. R.C.Mondal, Classical Mechanics, Prentice Hall of India

References

1. Books on Partial differential equation by I.N. Sneddon, F. John, P. Prasad and R. Ravindran, Amarnath etc.
2. A.S. Ramsey, Dynamics Part II, The English Language Book Society and Cambridge University Press, 1972.
3. H. Goldstein, Classical Mechanics (2nd edition), Narosa Publishing House, New Delhi.
4. I.M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall.
5. Narayan Chandra Rana & Pramod Sharad Chandra Joag, Classical Mechanics, Tata McGraw Hill, 1991.
6. Louis N. Hand and Janet D. Finch, Analytical Mechanics, Cambridge University Press, 1998.

M.Sc./M.A. Course (Fourth Semester)
PAPER-III (A)
Operating System and Database Management System - Theory and Practical

Max. Marks. 100
(Theory-70 +Practical-30)

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the role of database system, its architecture and data modeling
2. Understand the concept of relational algebra and relational calculus.
3. Use SQL DML/DDL commands.
4. Understand operating systems.
5. Learn I/O management.

Contents:

Unit-I Database Systems-Role of database systems, database system architecture and data modeling.

Unit-II Introduction to relational algebra and relational calculus.

Unit-III Intoduction to SQL: Basic features including views; Integrity constraints; Database design-normalization up to BCNF.

Unit-IV Operating Systems- Overview of operating system, user interface, processor management, memory management.

Unit-V I/O management, concurrency and Security, network and distributed systems.

Books Recommended :

1. S.B. Lipman, J. Lajoi: C++ Primer, Addison Wesley.
2. B. Stroustrup; The C++ Programming Language, Addison Wesley.
3. C.J. Date : Introduction to Database Systems, Addison Wesley.
4. C. Ritehie: Operating Systems-Incorporating UNIX and Windows, BPB Publications.
5. M.A. Weiss, Data Structures and Algorithm Analysis in C++, Addison Wesley.

Practical Examination Scheme

Max. Marks – 30	Time Duration – 3 Hrs.
Practical (two)	20 Marks(10 marks each)
Viva	05 Marks
Sessional	05 Marks

M.Sc./M.A. Course (Fourth Semester)

PAPER-III (B)

Fuzzy Set Theory & Its Applications (II)

Max Marks – 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand fuzzy logic and fuzzy quantifiers.
2. Understand the approximate reasoning.
3. Understand the fuzzy control and fuzzification..
4. Understand the concept of decision making in fuzzy environment.
5. Understand and solve fuzzy linear programming problems.

Contents:

Unit-I Fuzzy Logic-An overview of classical logic, Multivalued logics, Fuzzy propositions. Fuzzy quantifiers. Linguistic variables and hedges. Inference from conditional fuzzy propositions, the compositional rule of inference.

Unit-II Approximate Reasoning-An overview of Fuzzy expert system. Fuzzy implications and their selection. Multiconditional approximate reasoning. The role of fuzzy relation equation.

Unit-III An introduction to Fuzzy Control-Fuzzy controllers. Fuzzification. Defuzzification and the various defuzzitication methods.

Unit-IV Decision Making in Fuzzy Environment-Individual decision making. Multiperson decision making. Multicriteria decision making. Multistage decision making.

Unit-V Fuzzy ranking methods. Fuzzy linear programming.

REFERENCES :

1. H.J. Zmmemann, Fuzzy set theory and its Applications, Allied Publishers Ltd. New Delhi, 1991.
2. G.J. Klir and B. Yuan- Fuzzy sets and fuzzy logic, Prentice-Hall ol India, New Delhi, 1995.

M.Sc./M.A. Course (Fourth Semester)
PAPER-III (C)
Mathematical Biology (II)

Max. Marks – 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the key concepts of population models with age structure.
2. Understand population models with spatial structure, make models using diffusion equation and analysis their stability.
3. Understand the key concepts of infectious -disease transmission and control.Define the basic reproduction number, derive its expression using several methods
4. Explore models of different types of infectious disease, including influenza, TB, SARS, and vector-borne diseases.
5. Develop ad-hoc compartmental models (like the susceptible-infectious-recovered (SIR) model) to match epidemiologic surveillance data. Identify the limitations of the presented models, and conditions that may limit their use.

Contents:

Part-A: Population Models

UNIT-I

Models for population with age structure: Linear discrete models, linear continuous models, the method of characteristics, nonlinear continuous models.

UNIT-II

Models for population with spatial structure: A general metapopulation model, a metapopulation model with residence and travel, the diffusion equation, solution by separation of variables. Linear reaction-diffusion equations, nonlinear reaction-diffusion equations, two-species interactions, diffusion in two dimensions.

Part-B:Disease Transmission Models

UNIT-II

Epidemic models: Introduction to epidemic models, The logistic equation in epidemiology (1.3), simple Kermack-McKendrick epidemic model, network and compartmental epidemic models.

UNIT-IV

More complicated epidemic models: models with exposed period, treatments models, an influenza model, quarantine-isolation models.
An SIR model with a general infectious period, the age of infection epidemic model, models with disease deaths, a vaccination model, the next generation matrix.

UNIT-V

Models for endemic diseases: A model for diseases with no immunity, the SIR model with births and deaths, some applications: Herd immunity, age of infection, the inter-epidemic period, epidemic approach to endemic equilibrium, the SIS model with births and deaths, temporary immunity, diseases population control.

Text Book:

1. Fred Brauer, Carlos Castillo-Chavez, Mathematical Models in Population Biology and Epidemiology, Biology, Springer (2010)

Reference Books:

1. Nicholas F. Britton, Essential Mathematical Biology, Springer-Verlag (2003)
2. J.D.Murray, Mathematical Biology I. An Introduction, Springer-Verlag (2002) 3rd Edition.
3. J.D.Murray, Mathematical Biology II. Spatial Models and Biomedical Application, Springer-Verlag (2003) 3rd Edition.

M.Sc./M.A. Course (Fourth Semester)

PAPER –IV (A)

Operations Research (II)

Max. Marks 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Investigate the concept of dynamic programming problems.
2. Formulate and solve of linear programming model of game theory.
3. Understand integer programming problem and solve using optimization techniques.
4. Understand the queuing system. Formulate and solve the queuing theory models.
5. Extend the knowledge of programming problem from linear to nonlinear.

Contents:

Unit-I Dynamic Programming-Deterministic and Probabilistic Dynamic programming.

Unit-II Game Theory-Two-Person, Zero-Sum Games. Games with Mixed Strategies. Graphical . Solution. Solution by Linear Programming.

Unit-III Integer Programming-Pure and Mixed Integer Programming Problem, Gomory's All-I P.P. Method, Construction of Gomory's Constraints, Fractional Cut Method-All Integer LPP, Fractional Cut Method- Mixed Integer LPP, Branch and Bound Technique.

Unit-IV Queueing system: Deterministic Queueing system, probability distribution in Queueing, classification of Queueing models, Poission Queueing system.

Unit-V Nonlinear Programming-One/and Multi-Variable Unconstrained Optimization. Kuhn-Tucker Conditions for Constrained Optimization. Quadratic Programming. Separable Programming. I Convex Programming. Non-convex Programming.

Books Recommended :

1. F.S. Hillier and G.J. Ueberman. Introduction to Operations ResBareft (Sixth Edition), McGraw Hill International Edition, Industrial Engineering Series, 1995. (This book comes with a CD containing tutorial software).
2. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
3. G. Hadly, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass.
4. H.A. Taha, Operations Research -An introduction, Macmillan Publishing Co., Inc., New Yark.
5. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi
6. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network flows, John Wiley & Sons, New York, 1990.

References

1. S.S. Rao, Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.
2. Prem Kumar Gupla and D.S. Hira, Operations Research-An Introduction. S. Cliand & Company Ltd., New Delhi.
3. N.S. Kambo, Mathematical Programming Techniques, Affiliated East-West Press Pvt. Ltd., New Delhi, Madras
4. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.
5. A.D. Young, Boundary Layers, AIAA Education Series, Washington DC, 1989.
6. S.W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Private Limited, New Delhi, 1976.
7. UNDOSystems Products (Visit websHe htlp://www.Hndo.com/productsf.html)
   (i) UNDO (the linear programming solver)
   (ii) UNDO Callable Library (the premier optimisation engine)
   (iii) LINGO (the linear, non-linear, and integer programming solver with mathematical modelling language)
   (i) What's Best I (the spreadssheet add-in that solves linear, non-linear, and integer problems).

   All the above four products are bundled into one package to form the Solver Suite. For more details about any of the four products one has to click on its name.
   (i) Optimisation Modelling with UNDO (8" edition) by Linus Schrage.
   (ii) Optimisation Modelling with LINGO by Unus Schrage.

   More details available on the Related Book page York, 1979.

M.Sc./M.A. Course (Fourth Semester)
PAPER-IV (B)
Wavelets (II)

Max Marks – 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the characterizations of wavelets.
2. Ccharacaterize MRA wavelets
3. Understand and apply reconstruction formula and the Batian-Low theorem for frames.
4. Understand and apply discrete transforms and algorithms.
5. Understand and apply recomposition and reconstruction algorithms for wavelets.

Contents:

Unit-I Characterizations in the theory of wavelets-The basic equations and some of its applications.

Unit-II Characaterizations of MRA wavelets, low-pass filters and scaling functions. Non- existence of smooth wavelets in H^2 (R).

Unit-III Frames - The reconstruction formula and the Batian-Low theorem for frames. Frames from translations and dilations. Smooth frames for H^2 (R).

Unit-IV Discrete transforms and algorithms-The discrete and the fast Fourier transforms. The discrete and the fast cosine transforms.

Unit-IV The discrete version of the local sine and cosine bases. Decomposition and reconstruction algorithms for wavelets.

REFERENCES:

1. Eugenic HernBndez and Guido Weiss, A First Course on Wavelets, CRC Press, New York, 1996.
2. C.K. Chui, An Introduction to Wavelets, Academic Press, 1992.
3. I.Daubechies, Ten Lectures on Wavelets, CBS-NSF Regional Conferences in Applied Mathematics, 61, SIAM, I 1992.
4. Y.Meyer,Wavelets, algorithms and applications (Tran.by R.D. Rayan,SIAM, 1993.

5. M.V. Wickerhauser, Adapted wavelet analysis from theory to software, Wellesley, MA, A.K. Peters, 1994.

M.Sc./M.A. Course (Fourth Semester)
PAPER –V (A)
Programming in C (with ANSI features) (II)
Theory and Practical

Max. Marks. 100

(Theory-70 +Practical-30)

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand data storage classes and ANSI rules for the syntax and semantics of the storage-class.
2. Understand pointer arithmetic and various sorting algorithms.
3. Declare and call functions and the C processor.
4. Understand structure and union and dynamic memory allocation
5. Understand the I/O file operators, standard library for I/O.

Contents:

Unit-I Storage Classes-Fixed vs. Automatic Duration. Scope. Global variables. The register Specifier. ANSI rules for the syntax and Semantics of the storage-class keywords.

Unit-II Pointers Pointer Arithmetic. Passing Pointers as Function Arguments. Accessing Array Elements through Pointers. Passing Arrays as Function Arguments. Sorting Algorithms. Strings. Multidimensional Arrays. Arrays of Pointers. Pointers to Pointers.

Unit-III Functions-Passing Arguments. Declarations and Calls. Pointers to Functions. Recursion. The main Function. Complex Declarations.The C Preprocessor-Macro Substitution. Conditional Compilation. Include Facility. Line Control.

Unit-IV Structures and Unions-Structures. Dynamic Memory Allocation. Linked Lists. Unions, enum Declarations.

Unit-V Input and Output-Streams, Buffering. The <Stdio.h> Header File. Error Handling. Opening and Closing a File. Reading and Writing

Data. Selecting an I/O Method. Unbuffered I/O Random Access. The standard library for Input/Output.

Books Recommended :

1. Peter A. Darnell and Philip E. Margolis, C: A Software Engineering Approach, Narosa Publishing House (Springer International Student Edition) 1993.
2. Samuel P. Harkison and Gly L. Steele Jr., C : A Reference Manual, 2nd Edition, Prentice Hall, 1984.
3. Brian W. Kernighan & Dennis M. Ritchie, The C Programme Language, 2nd Edition (ANSI Features), Prentice Hall 1989.

Practical Examination Scheme

Max. Marks – 30	Time Duration – 3 Hrs.
Practical (two)	20 Marks(10 marks each)
Viva	05 Marks
Sessional	05 Marks

M.Sc./M.A. Course (Fourth Semester)
PAPER-V (B)
Graph theory-II

Max. Marks – 80

Learning Outcomes: At the end of the course, the students will be able to :

1. Understand the concept of perfectness, Ramsey numbers and graphs.
2. Understand the concept of graphs with groups.
3. Understand the concept of polynomials: colour, chromatic, bivariatic etc.
4. Extend the concept of graph enumeration its properties.
5. Understand the concept of digraphs and networks in graph theory.

Contents:

Unit-I: Ramsey Theory: Perfectness-preserving operations, Forbidden Subgraph orientations, Ramsey numbers and Ramsey graphs.

Unit-II: Groups: Permutation groups, The automorphism group, graphs with given group, symmetry concepts, pseudo-similarity and stability, spectral studies of the Automorphism group.

Unit-III: Polynomials and Graph Enumeration: The colour polynomials, The chromatic polynomial, The bivariate colouring polynomials.

Unit-IV: Graph Enumeration: Co-chromatic (co-dichromatic) graphs and chromatically unique graphs, Graph Enumeration.

Unit-V: Digraphs & Networks: Digraphs, Types of connectedness, Flows in Networks, Menger's and Konig's Theorem, Degree sequences.

REFERENCES :

1. K.R.Parthasarathy, Basic graph theory, Tata Mc graw Hill publishing company limited , 1994.
2. R.J.Wilson, Introduction to graph theory, Longman Harlow, 1985.
3. John Clark, Derek Allon Holton, A first look at graph Theory, World Scientific Singapore, 1991.
4. Frank Hararary, Graph Theory Narosa, New Delhi, 1995.
5. Ronald Gould and Benjamin Cummins, Graph Theory, California.
6. Narsingh Deo, Graph Theory with applications to Engineering and Computer Science, Prentice-Hall of India Private Limited, New Delhi, 2002.

CURRICULUM FRAMEWORK: TWO-YEARB.P.ED.PROGRAMME

Learning Outcomes Based Curriculum Framework
(LOCF)
For
B.P.Ed.
Undergraduate Program
2021

Preamble: Bachelor of Physical Education (B. P. Ed.) two years (Four Semesters Choice Based Credit System) programme is a professional programme meant for preparing teachers of physical education in classes VI to X and for conducting physical education and sports activities in classes XI and XII.

B. P. Ed. programme shall be designed to integrate the study of childhood, social context of Physical Education, subject knowledge, pedagogical knowledge, aim of Physical Education and communication skills. The programme comprises of compulsory and optional theory as well as practical courses and compulsory school internship.

Introduction

Physical education addressess growing problem with inactivity and its associated risk factors to all. Physical education program develops professionals to provide the best movement education, which will benefit the health of the population. Basically it is a physical education teacher education program, but it prepares individuals for careers in a variety of areas.

Physical education is a play way process of education and it teaches us about life skills, dietary habits, environmental issues etc. remarkably. In this sense, physical education is also an education where human movements are used for the overall development of human beings. The main aim of physical education addresses the all-round development and betterment of health and fitness of an individual and entire community is a core area covered under physical education.

The all-around development of human being is the main aim of physical education and improving the status of health and fitness of an individual is a core area of physical education. The curriculum framework for B.P.Ed. program is designed to meet the needs of the students as well as our educational policy. This curriculum framework will be beneficial in reviewing the outcome of the program in the light of graduate attributes, qualification descriptors, programme learning outcomes and course-level learning outcomes respectively. This curriculum is flexible and ready to incorporate innovative ideas in future. The curriculum framework will generate self employability and lead to trained graduate with special attributes.

Nature and Extent of the B.P.Ed. Degree Program

Physical education is considered to be a tool for all-round development of an individual with the help of human movement and sports activity. It is a multidisciplinary subject because it covers a wide range of topics such as sports psychology, kinensiology, biomechanics, health education, mental health, sports medicine, sports training, sports sociology, sports management etc. Physical education provides education in quite a few allied sciences and subjects. Physical education develops cognitive abilities in the form of problem-solving skills through motor movements. It is an integral part of education incorporating basic science, social sciences to create a congenial environment for personality development.

The benefits of physical education are not just limited up to physical and psychological well being but it provides a platform for sustainable growth in economic, equality, social, moral, spiritual and ethical development of future human resources of a country. A Bachelor degree in the physical education degree program is a professional training program, it leads towards a higher degree of employability. The importance of a good professional training program that is based on experiential learning is also advocated under the new educational policy.

Aims of the B.P.Ed. Program

The aim of physical education is not confined to results in terms of physical and psychological health through physical activity but it promotes life long liking and habit towards physical activity because physical education educates people about the benefits of physical activity. The overall aim of the bachelor's degree programme in physical education program is

1. To develop motor skill competence

2. To initiate, plan and implement physical education, sports and recreational activities.

3. To foster academic and personal growth for further education and career in physical education.

4. To enhance generic capacity such as communication skills, critical thinking, creativity etc.

5. To develop environmental awareness

6. To impart scientific facts about the relationship between exercise and fitness

7. To develop a positive attitude towards sports and physical activity.

8. Knowledge regarding physical, functional, emotional and overall health and fitness.

9. To deal with techniques that are used to attain physical fitness.

Graduate Attributes

Discipline

The course is designed to develop discipline through participation in various physical activities and sports .

Communication Skills

Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one"s views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups**.**

Motor Development

During the tenure of this program communication skills will be developed so that the pass out will act as a leader in neuromuscular learning.

To make capable to perform all kind of motor movements so the curriculum is designed accordingly that a graduate can develop all kind of motor movements.

Motor Problem Solving

Task-oriented learning and knowledge-oriented learning are the strategies for the development of the characteristics among the graduate in physical education.

Critical thinking: Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.The ability to think critically includes observation analysis interpretation reflection and evaluation.

Leadership readiness/qualities: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.

Cooperation/Team work: Ability to work effectively and respectfully with diverse teams;facilitate cooperative or coordinated effort on the part of a group,and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.

Ability to acquire knowledge and skills towards team building that are necessary for participating in learning activities.

Moral and ethical awareness/reasoning: Ability to embrace moral/ethical values in conducting one‟s life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.

Qualification descriptors

1. Demonstrate sound knowledge about theories and principles of physical education.

2. Demonstrate ample skills to identify and address the problems related to physical education in our society.

3. Demonstrate sound methodological know-how about data collection and its interpretation.

4. Demonstrate basic knowhow about the theories and principles of health education, yoga and allied sports sciences.

5. Demonstrate sound attitude and aptitude for teaching in a classroom.

6. Demonstrate great ability for sports coaching.

7. Able to impart knowledge to general people regarding physical activity, health education etc.

8. Demonstrate sound knowledge about allied sports sciences namely sports biomechanics, sports nutrition, applied anatomy etc.Program learning outcomes of B.P.E.S., B.A./B.Sc. degree programme in Physical Education are listed below

This would lead the students to understand historical concept of physical education and relationship between Philosophy, Education and Physical Education. The student would further understand the theoretical implications of philosophies of physical education with moderndevelopment and social aspects of Physical Education.

1. The curriculum would enable the pass out to select the inherited talented children for varioussports activities.
2. The pass out shall be able to orient children in schools with the fundamental skills of selectedsports as per their inherited potential.
3. The pass out shall be able to devise training program for athletes engaged in different sports activities
4. The curriculum shall enable them to officiate, supervise various sports tournaments and orientthem in organizing sports events at all levels.
5. The curriculum would enable the pass out students to be entrepreneur (to start their own fitness center, gym, spa etc) and device appropriate fitness program for different genders andage groups of people.
6. The curriculum would enable the pass out to devise training program for physically challenged peoples.

R. B.P.Ed. 3. The CBCS System:

All Programmes shall run on Choice Based Credit System (CBCS). It is an instructional package developed to suit the needs of students, to keep pace with the developments in higher education and the quality assurance expected of it in the light of liberalization and globalization in higher education.

R. B.P.Ed 4. Course:

The term course usually referred to, as 'papers' is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise Lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/assignments/ presentations/ self-study etc. or a combination of some of these.

R. B.P.Ed. 5. Courses of Programme:

The B.P.Ed. Programme consists of a number of courses, the term 'Course' applied to indicate a logical part of subject matter of the programme and is invariably equivalent to the subject matter of a "paper" in the conventional sense. The following are the various categories of courses suggested for the B.P.Ed. Programme.

Theory:

Core Course:

Elective Course:

Practicum:

Teaching Practices:

R. B.P.Ed.6. Semesters:

An academic year is divided into two semesters. Each semester will consist of 17-20 weeks of academic work equivalent to 100 actual teaching days. The odd semester may be scheduled from May/June to November/Decemberand even semester from November / December to May/June. The institution shall work for a minimum of 36 working hours in a week (five or six days a week).

R. B.P.Ed.7. Working days:

There shall be at least 200 working days per year exclusive of admission and examination processes etc.

R. B.P.Ed 8. Credits:

The term 'Credit' refers to a unit by which the programme is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or one and half / two hours of practical work/field work per week.The term 'Credit' refers to the weight given to a course, usually in relation to the instructional hours assigned to it. The total minimum credits, required for completing a B.P.Ed. Programme is 90 credits and for each semester 20 credits.

Semester - I

PartA:TheoreticalCourse						
Course Code	Title of the Papers	Total Hours	Credit	Internal Marks	External Marks	Total Marks
CoreCourse						
CC-101	History, Principles and foundation of Physical Education	4	4	30	70	100
CC-102	Anatomy and Physiology	4	4	30	70	100
CC-103	Health Education and Environmental Studies	4	4	30	70	100
Elective Course (Anyone)						
EC-101	Olympic Movement	4	4	30	70	100
EC-102	Officiating and Coaching					
Part–B PracticalCourse						
PC-101	Track and Field (Running Events)	**6**	**4**	30	70	100
PC-102	Swimming/Gymnastics/ Shooting	**6**	**4**	30	70	100
PC-103	Indigenous Sports: Kabaddi / Malkhambh/ lezim / March past	**6**	**4**	30	70	100
PC - 104	Mass Demonstration Activities: Kho-Kho / dumbbells / tipri / wands / hoop /umbrella	**6**	**4**	30	70	100
Total		40	32	240	560	800

Note: Total Number of hours required to earn 4 credits for each Theory Course are 68-80 hours per semester whereas 102-120 hours for each Practicum Course.

Semester - II

PartA:TheoreticalCourse						
Course Code	TitleofthePapers	Total Hours	Credit	Internal Marks	External Marks	Total Marks
CoreCourse						
CC-201	Yoga Education	4	4	30	70	100
CC-202	Educational Technology and Methods of Teaching in Physical Education	4	4	30	70	100
CC-203	Organization and Administration	4	4	30	70	100
Elective Course (Anyone)						
EC-201	Contemporary issues in physical education, fitness and wellness	4	4	30	70	100
EC-202	Sports Nutrition and Weight Management					
Part–B PracticalCourse						
PC-201	Track and Field (Jumping Events)	**6**	**4**	30	70	100
PC-202	Yoga/Aerobics/ Gymnastics/ Swimming	**6**	**4**	30	70	100
PC-203	Racket Sports: Badminton/ Table Tennis/ Squash/ Tennis	**6**	**4**	30	70	100
Part – C Teaching Practices						
TP - 201	Teaching Practices (05lessons in class room teaching and 05 lessons in outdoor activities)	**6**	**4**	30	70	100
Total		40	32	240	560	800

Note: Total Number of hours required to earn 4 credits for each Theory Course are 68-80 hours per semester whereas 102-120 hours for each Practicum Course.

Semester - III

Course Code	TitleofthePapers	Total Hours	Credit	Internal Marks	External Marks	Total Marks
PartA:Theoretical Course						
CoreCourse						
CC-301	Sports Training	4	4	30	70	100
CC-302	Computer Applications in Physical Education	4	4	30	70	100
CC-303	Sports Psychology and Sociology	4	4	30	70	100
Elective Course (Anyone)						
EC-301	Sports Medicine, Physiotherapy and Rehabilitation	4	4	30	70	100
EC-302	Curriculum Design					
Part–B Practical Course						
PC-301	Track and Field (Throwing Events)	**6**	**4**	30	70	100
PC-302	Combative Sports: Martial Art/ Karate/ Judo/ Fencing/ Boxing/ Taekwondo/ Wrestling (Any two out of these)	**6**	**4**	30	70	100
PC-303	Team Games: Baseball/ Cricket/ Football/ Hockey/ Softball/ Volleyball/ Handball/ Basketball/ Netball (Any two of these)	**6**	**4**	30	70	100
Part – C Teaching Practices						
TP - 301	Teaching Practice: (Teaching Lesson Plans for Racket Sport/ Team Games/Indigenous Sports) (out of 10 lessons 5 internal and 5 external at practicing school)	**6**	**4**	30	70	100
Total		40	32	240	560	800

Note: Total Number of hours required to earn 4 credits for each Theory Course are 68-80 hours per semester whereas 102-120 hours for each Practicum Course.

Semester - IV

PartA:TheoreticalCourse						
Course Code	TitleofthePapers	Total Hours	Credit	Internal Marks	External Marks	Total Marks
Core Course						
CC-401	Measurement and Evaluation in Physical Education	4	4	30	70	100
CC-402	Kinesiology and Biomechanics	4	4	30	70	100
CC-403	Research and Statistics in Physical Education	4	4	30	70	100
Elective Course (Anyone)						
EC-401	Theory of sports and game	4	4	30	70	100
EC-402	Sports Management					
Part–B Practical Course						
PC-401	Track and Field / Swimming / Gymnastics (Any one out of three)	**6**	**4**	30	70	100
PC-402	Kabaddi/ Kho-Kho/ Baseball/ Cricket/ Football/Hockey/Softball/ Volleyball/ Handball/ Basketball/ Netball/ Badminton/ Table Tennis/ Squash/ Tennis (Any Two of these)	**6**	**4**	30	70	100
Part – C Teaching Practices						
TP-401	Sports specialization: Coaching lessons Plans (One for Sports 5 lessons)	**6**	4	30	70	100
TP-402	Games specialization: Coaching lessons Plans (One for Games 5 lessons)	**6**	4	30	70	100
Total		40	32	240	560	800
		160	128	960	2240	3200

<u>Note:</u> Total Number of hours required to earn 4 credits for each Theory Course are 68-80 hours per semester whereas 102-120 hours for each Practicum Course.

SCHEME OF EXAMINATION
SEMESTER - I

Paper	Subject	Internal	External	Total Marks
	THEORY (400)			
CC-101	History, Principles and foundation of Physical Education	30	70	100
CC-102	Anatomy and Physiology	30	70	100
CC-103	Health Education and Environmental Studies	30	70	100
EC-101/102	Olympic Movement/Officiating and Coaching (Elective)	30	70	100
	PRACTICAL (400)			
PC-101	Track and Field (Running Events)	30	70	100
PC-102	Swimming/Gymnastics/Shooting	30	70	100
PC-103	Indigenous Sports: Kabaddi/ Malkhambh/ lezim / March past (Any of one out of these)	30	70	100
PC-104	Mass Demonstration Activities: Kho-Kho / dumbbells / tipri / wands / hoop /umbrella (Any one out of these)	30	70	100
	Total	**240**	**560**	**800**

SEMESTER -II

Paper	Subject	Internal	External	Total Marks
	THEORY (400)			
CC-201	Yoga Education	30	70	100
CC-202	Educational Technology and Methods of Teaching in Physical Education	30	70	100
CC-203	Organization and Administration	30	70	100
EC-201/202	Contemporary issues in physical education, fitness and wellness/ Sports Nutrition and Weight Management (Elective)	30	70	100
	PRACTICAL (300)			
PC-201	Track and Field (Jumping Events)	30	70	100
PC-202	Yoga/Aerobics / Swimming / Gymnastics (Any of the two out of these)	30	70	100
PC-203	Racket Sports: Badminton/ Table Tennis/ Squash/ Tennis (Any of the two out of these)	30	70	100
	TEACHING PRACTICE (100)			
TP-201	Teaching Practice (Classroom and outdoor)	30	70	100
	Total	**240**	**560**	**800**

SEMESTER –III

Paper	Subject	Internal	External	Total Marks
	THEORY (400)			
CC-301	Sports Training	30	70	100
CC-302	Computer Applications in Physical Education	30	70	100
CC-303	Sports Psychology and Sociology	30	70	100
EC-301/302	Sports Medicine, Physiotherapy and Rehabilitation/Curriculum Design (Elective)	30	70	100
	PRACTICAL (300)			
PC-301	Track and Field (Throwing Events)	30	70	100
PC-302	Combative Sports : Martial Art, Karate, Judo, Fencing, Boxing, Taekwondo, Wrestling (Any two out of these)	30	70	100
PC-303	Team Games: Baseball, Cricket, Football, Hockey, Softball, Volleyball, Handball, Basketball, Netball (Any two of these)	30	70	100
	TEACHING PRACTICE (100)			
TP-301	Teaching Practice (Teaching Lesson Plans for Racket Sport/ Team Games/Indigenous Sports)	30	70	100
	Total	**240**	**560**	**800**

SEMESTER -IV

Paper	**Subject**	**Internal**	**External**	**Total Marks**
	THEORY (400)			
CC-401	Measurement and Evaluation in Physical Education	30	70	100
CC-402	Kinesiology and Biomechanics	30	70	100
CC-403	Research and Statistics in Physical Education	30	70	100
EC-401/402	Theory of sports and games(Specifically sports and games specialization)/Sports Management (Elective)	30	70	100
	PRACTICAL (200)			
PC-401	Track and Field/Swimming /Gymnastics (Any of one out of these)	30	70	100
PC-402	Kabaddi/ Kho-Kho/ Baseball/ Cricket/ Football/Hockey/Softball/ Volleyball/ Handball/ Basketball/ Netball/ Badminton/ Table Tennis/ Squash/ Tennis (Any of one out of these)	30	70	100
	TEACHING PRACTICE (200)			
TP-401	Sports Specialization: Coaching lessons Plans Track and Field/Swimming /Gymnastics (Any of one out of these)	30	70	100
TP-402	Game specialization Coaching lessons: Kabaddi/ Kho-Kho/ Baseball/ Cricket/Football/Hockey /Softball/ Volleyball/ Handball/ Basketball/ Netball/ Badminton/ Table Tennis/ Squash/ Tennis (Any of one out of these)	30	70	100
	Total	**240**	**560**	**800**

Theory Courses

CC-101 HISTORY, PRINCIPLES AND FOUNDATION OF PHYSICAL EDUCATION

STUDENT LEARNING OUTCOMES :

1. Become familiar with the history and development of physical education in India.
2. Discuss the philosophical foundation of Physical Education .
3. To understand principles of physical education.
4. To develop understanding of developing physical education program on the basis of principles and foundation of physical education.

Unit – 1: Introduction

- Meaning, Definition and Scope of Physical Education
- Aims and Objective of Physical Education
- Importance of Physical Education in present era.
- Misconceptions about Physical Education.
- Relationship of Physical Education with General Education.
- Physical Education as an Art and Science.

Unit- 2 – Historical Development of Physical Education in India

- Indus Valley Civilization Period. (3250 BC – 2500 BC)
- Vedic Period (2500 BC – 600 BC)
- Early Hindu Period (600 BC – 320 AD) and Later Hindu Period (320 AD – 1000 AD)
- Medieval Period (1000 AD – 1757 AD)
- British Period (Before 1947)
- Physical Education in India (After 1947)
- Contribution of Akhadas and Vyayamshals
- Y.M.C.A. and its contributions.

Unit- 3- Foundation of Physical Education

- Philosophical foundation:
- Idealism, Pragmatism, Naturalism, Realism, Humanism, Existentialism and Indian Philosophy and Culture.
- Fitness and wellness movement in the contemporary perspectives
- Sports for all and its role in the maintenance and promotion of fitness.

Unit-4- Principles of Physical Education

- Biological
    - Growth and development
    - Age and gender characteristics

    - Body Types
    - Anthropometric differences
- Psychological
    - Learning types, learning curve
    - Laws and principles of learning
    - Attitude, interest, cognition, emotions and sentiments
- Sociological
    - Society and culture
    - Social acceptance and recognition
    - Leadership
    - Social integration and cohesiveness

References:

Bucher, C. A. (n.d.) *Foundation of physical education.* St. Louis: The C.V. Mosby Co.

Deshpande, S. H. (2014). *Physical Education in Ancient India*. Amravati: Degree college of Physical education.

Mohan, V. M. (1969). *Principles of physical education.* Delhi: Metropolitan Book Dep.

Nixon, E. E. & Cozen, F.W. (1969). *An introduction to physical education*. Philadelphia: W.B. Saunders Co.

Obertuffer, (1970). *Delbert physical education*. New York: Harper & Brothers Publisher.

Sharman, J. R. (1964). *Introduction to physical education*. New York: A.S. Barnes & Co.

William, J. F. (1964). *The principles of physical education*. Philadelphia: W.B. Saunders Co.

Semester I

Theory Courses

CC-102 ANATOMY AND PHYSIOLOGY

UNIT-I

- Brief Introduction of Anatomy and physiology in the field of Physical Education.
- Introduction of Cell and Tissue.
- The arrangement of the skeleton – Function - of the skeleton – Ribs and Vertebral column and the extremities – joints of the body and their types
- Gender differences in the skeleton.
- Types of muscles.

UNIT-II

- **Blood and circulatory system:** Constituents of blood and their function –Blood groups and blood transfusion, clotting of blood, the structure of the heart-properties of the heart muscle, circulation of blood, cardiac cycle, blood pressure, Lymph and Lymphatic circulation. Cardiac output.
- **The Respiratory system:** The Respiratory passage – the lungs and their structure and exchange of gases in the lungs, mechanism of respiration (internal and external respiration) lung capacity, tidal volume.
- **The Digestive system:** structure and functions of the digestive system, Digestive organs, Metabolism,
- **The Excretory system:** Structure and functions of the kidneys and the skin.
- **The Endocrine glands:** Functions of glands pituitary, Thyroid, Parathyroid. Adrenal, Pancreatic and the sex glands.
- **Nervous systems:** Function of the Autonomic nervous system and Central nervous system. Reflex Action,
- **Sense organs:** A brief account of the structure and functions of the Eye and Ear.

UNIT-III

- Definition of physiology and its importance in the field of physical education and sports.
- Structure, Composition, Properties and functions of skeletal muscles.
- Nerve control of muscular activity:
  - Neuromuscular junction
  - Transmission of nerve impulse across it.
- Fuel for muscular activity
- Role of oxygen- physical training, oxygen debt, second wind, vital capacity.

UNIT-IV

- Effect of exercise and training on cardiovascular system.
- Effect of exercise and training on respiratory system.
- Effect of exercise and training on muscular system
- Physiological concept of physical fitness, warming up, conditioning and fatigue.
- Basic concept of balanced diet – Diet before, during and after competition.

References:

Gupta, A. P. (2010). *Anatomy and physiology.* Agra: SumitPrakashan.
Gupta, M. and Gupta, M. C. (1980). *Body and anatomical science.* Delhi: Swaran Printing Press.
Guyton, A.C. (1996). Textbook of Medical Physiology, 9th edition. Philadelphia: W.B. Saunders.
Karpovich, P. V. (n.d.). *Philosophy of muscular activity.* London: W.B. Saunders Co.
Lamb, G. S. (1982). Essentials of exercise physiology. Delhi: Surjeet Publication.
Moorthy, A. M. (2014). *Anatomy physiology and health education.*Karaikudi: Madalayam Publications.
Morehouse, L. E. & Miller, J. (1967). *Physiology of exercise*. St. Louis: The C.V. Mosby Co.
Pearce, E. C. (1962). *Anatomy and physiology for nurses.* London: Faber & Faber Ltd.
Sharma, R. D. (1979). *Health and physical education,* Gupta Prakashan.
Singh, S. (1979). *Anomy of physiology and health education*. Ropar: Jeet Publications.

Semester I

Theory courses

CC-103 HEALTH EDUCATION AND ENVIRONMENTAL STUDIES

STUDENT LEARNING OUTCOMES :

1. To describe health , its aspects and components of Health Education and to become role model.
2. To learn health problems in India.
3. Key concepts in environmental studies, such as 'sustainable development and impact on development concerns.
4. Understand the complex relationships between mankind and the environment.

Unit – I Health Education

- Concept, Dimensions, Spectrum and Determinants of Health
- Definition of Health, Health Education, Health Instruction, Health Supervision
- Aim, objective and Principles of Health Education
- Health Service and guidance instruction in personal hygiene

Unit – II Health Problems in India

- Communicable and Non Communicable Diseases
- Obesity, Malnutrition, Adulteration in food, Environmental sanitation, Explosive Population,
- Personal and Environmental Hygiene for schools
- Objective of school health service, Role of health education in schools
- Health Services – Care of skin, Nails, Eye health service, Nutritional service, Health appraisal, Health record, Healthful school environment, first- aid and emergency care etc.

Unit – III Environmental Science

- Definition, Scope, Need and Importance of environmental studies.
- Concept of environmental education, Historical background of environmental education,
- Celebration of various days in relation with environment.
- Plastic recycling & probation of plastic bag / cover.
- Role of school in environmental conservation and sustainable development.

Unit – IVNatural Resources and related environmental issues:

- Water resources, food resources and Land resources
- Definition, effects and control measures of:
- Air Pollution, Water Pollution, Soil Pollution, Noise Pollution, Thermal Pollution
- Management of environment and Govt. policies , Role of pollution control board.

References:

Agrawal, K.C. (2001). *Environmental biology*.Bikaner: Nidhi publishers Ltd.

Frank, H. &Walter, H., (1976). *Turners school health education*. Saint Louis: The C.V.

Mosby Company.
Nemir, A. (n.d.). The school health education. New York:Harber and Brothers.
Odum, E.P. (1971). *Fundamental of ecology*. U.S.A.: W.B. Saunders Co.

Semester – I

Theory courses

EC-101 OLYMPIC MOVEMENT (ELECTIVE)

STUDENT LEARNING OUTCOMES :

1. The students will learn the educational and cultural values associated with Olympic movement.
2. The students knowledge will get enhanced regarding different kinds of Olympic games.
3. The students will gain knowledge regarding functions of International Olympic Committee.
4. The students will get basic structure and functions of National Olympic committee.
5. The students will get to know the laurels of Indian Olympic participants.

Unit – I Origin of Olympic Movement

- Philosophy of Olympic movement
- The early history of the Olympic movement
- The significant stages in the development of the modern Olympic movement
- Educational and cultural values of Olympic movement

Unit – IIModern Olympic Games

- Significance of Olympic Ideals, Olympic Rings, Olympic Flag
- Olympic Protocol for member countries
- Olympic Code of Ethics
- Olympism in action
- Sports for All

Unit – III Different Olympic Games

- Para Olympic Games
- Summer Olympics
- Winter Olympics
- Youth Olympic Games

Unit – IV Committees of Olympic Games

- International Olympic Committee - Structure and Functions
- National Olympic committees and their role in Olympic movement
- Olympic commission and their functions
- Olympic medal winners of India

Reference:

Osborne, M. P. (2004). *Magictree house fact tracker: ancient greece and the olympics: a nonfiction companion to magic tree house: hour of the Olympics. New York:* Random House Books for Young Readers.

Burbank, J. M., Andranovich, G. D. &Heying Boulder, C. H. (2001). Olympic dreams: the impact of mega-events on local politics: Lynne Rienner

Semester – I

Theory courses

EC-102 OFFICIATING AND COACHING (Elective)

Unit- I: Introduction of Officiating and coaching

- Concept of officiating and coaching
- Importance and principles of officiating
- Relation of official and coach with management, players and spectators
- Measures of improving the standards of officiating and coaching

Unit- II: Coach as a Mentor

- Duties of coach in general, pre, during and post game.
- Philosophy of coaching
- Responsibilities of a coach on and off the field
- Psychology of competition and coaching

Unit- III: Duties of Official

- Duties of official in general, pre, during and post game.
- Philosophy of officiating
- Mechanics of officiating – position, singles and movement etc.
- Ethics of officiating

Unit- IV: Qualities and Qualifications of Coach and Official

- Qualities and qualification of coach and official
- General rules of games and sports
- Eligibility rules of intercollegiate and inter-university tournaments, preparation of TA, DA bills
- Integrity and values of sports

Reference Books:

Bunn, J. W. (1968). *The art of officiating sports*. Englewood cliffs N.J. Prentice Hall.

Bunn, J. W. (1972). *Scientific principles of coaching.* Englewood cliffs N. J. Prentice Hall.

Dyson, G. H. (1963). *The mechanics of athletics*. London: University of London Press Ltd.

Dyson, G. H. (1963). *The mechanics of Athletics*. London: University of London Press Ltd.

Lawther, J.D. (1965). *Psychology of coaching.* New York: Pre. Hall.

Singer, R. N. (1972). *Coaching, athletic & psychology.*New York: M.C. Graw Hill.

Semester – II

Theory Courses

CC-201 YOGA EDUCATION

Unit – I: Introduction

- Meaning and Definition of Yoga
- Aims and Objectives of Yoga
- Yoga in Early Upanisads
- The Yoga Sutra: General Consideration
- Need and Importance of Yoga in Physical Education and Sports

Unit - II: Foundation of Yoga

- The Astanga Yoga: Yama, Niyama, Asana, Pranayama, Pratyahara, Dharana, Dhyana and Samadhi
- Yoga in the Bhagavadgita - Karma Yoga, Raja Yoga, Jnana Yoga and Bhakti Yoga

Unit - III Asanas

- Effect of Asanas and Pranayama on various system of the body
- Classification of asanas with special reference to physical education and sports
- Influences of relaxtive, meditative posture on various system of the body
- Types of Bandhas and mudras
- Type of kriyas

Unit – IVYoga Education

- Basic, applied and action research in Yoga
- Difference between yogic practices and physical exercises
- Yoga education centers in India and abroad
- Competitions in Yogasanas

References:

Brown, F. Y.(2000). *How to use yoga*. Delhi:Sports Publication.

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Semester – II

Theory Courses

CC-202 EDUCATIONAL TECHNOLOGY AND METHODS OF TEACHING N PHYSICAL EDUCATION

STUDENT LEARNING OUTCOMES :

1. To understand the concept of educational technology and methods of teaching.
2. To describe and use various teaching methods according to suitability.
3. To construct the lesion plans for various physical education activities.
4. To classify the types of presentation, techniques and technical preparations required for physical education lessons,
5. To understand the principles of class management and factors affecting class management.
6. To utilize effectively various teaching aids for conduct of physical education program.

Unit – I Introduction

- Education and Education Technology- Meaning and Definitions
- Types of Education- Formal, Informal and Non- Formal education.
- Educative Process
- Importance of Devices and Methods of Teaching.

Unit – II Teaching Technique

- Teaching Technique – Lecture method, Command method, Demonstration method, Imitation method, project method etc.
- Teaching Procedure – Whole method, whole – part – whole method, part – whole method.
- Presentation Technique – Personal and technical preparation
- Command- Meaning, Types and its uses in different situations.

Unit – III Teaching Aids

- Teaching Aids – Meaning, Importance and its criteria for selecting teaching aids.
- Teaching aids – Audio aids, Visual aids, Audio – visual aids, Verbal, Chalk board, Charts, Model, Slide projector, Motion picture etc
- Team Teaching – Meaning, Principles and advantage of team teaching.
- Difference between Teaching Methods and Teaching Aid.

Unit – IV Lesson Planning and Teaching Innovations

- Lesson Planning – Meaning, Type and principles of lesson plan.
- General and specific lesson plan.
- Micro Teaching – Meaning, Types and steps of micro teaching.
- Simulation Teaching - Meaning, Types and steps of simulation teaching.

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Semester – II

Theory Courses

CC-203 ORGANZATION AND ADMINISTRATION IN PHYSICAL EUCATION

STUDENT LEARNING OUTCOMES :

1. To understand the concept of organization and administration in physical education and sports.
2. To describe and use various organizational and administrative roles according to suitability.
3. To classify the types of organizational and administrative techniques required for physical education program.
4. To construct the programs of physical education and sports.

To understand the principles of organization and administration

Unit – I: Organization and administration

- Meaning and importance of Organization and Administration in physical education
- Qualification and Responsibilities of Physical Education teacher and pupil leader
- Planning and their basic principles,
- Program planning: Meaning, Importance, Principles of program planning in physical education.
- Functions of Planning, organizing, staffing, directing, communicating, co-ordination, controlling, evaluating and innovating.

Unit- II: Office Management, Record, Register & Budget

- Office Management: Meaning, definition, functions and kinds of office management
- Records and Registers: Maintenance of attendance Register, stock register, cash register, physical efficiency record, Medical examination Record.
- Budget: Meaning, Importance of Budget making,
- Criteria of a good Budget, Sources of Income, Expenditure, Preparation of Budget.

Unit-III: Facilities, & Time-Table Management

- Facilities and equipment management: Types of facilities Infrastructure-indoor, out door.
- Care of school building, Gymnasium, swimming pool, Play fields, Play grounds
- Equipment: Need, importance, purchase, care and maintenance.
- Time Table Management: Meaning, Need, Importance and Factor affecting time table.

Unit-IV:Competition Organization

- Importance of Tournament,
- Types of Tournament and its organization structure - Knock-out Tournaments, League or Round Robin Tournaments, Combination Tournament and challenge Tournament.
- Organization structure of Athletic Meet

- Sports Event Intramurals & Extramural Tournament planning

References:

Broyles, F. J. &Rober, H. D. (1979). *Administration of sports, Athletic programme: A Managerial Approach.* New York: Prentice hall Inc.

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Semester – II

Theory Courses

EC-201 CONTEMPORARY ISSUES IN PHYSICAL EDUCATION, FITNESS AND WELLNESS (ELECTIVE)

Unit – I Concept of Physical Education and Fitness

- Definition, Aims and Objectives of Physical Education, fitness and Wellness
- Importance and Scope of fitness and wellness
- Modern concept of Physical fitness and Wellness
- Physical Education and its Relevance in Inter Disciplinary Context.

Unit – II Fitness, Wellness and Lifestyle

- Fitness – Types of Fitness and Components of Fitness
- Understanding of Wellness
- Modern Lifestyle and Hypo kinetic Diseases – Prevention and Management
- Physical Activity and Health Benefits

Unit – III Principles of Exercise Program

- Means of Fitness development – aerobic and anaerobic exercises
- Exercises and Heart rate Zones for various aerobic exercise intensities
- Concept of free weight Vs Machine, Sets and Repetition etc
- Concept of designing different fitness training program for different age group.

Unit – IV Safety Education and Fitness Promotion

- Health and Safety in Daily Life
- First Aid and Emergency Care
- Common Injuries and their Management
- Modern Life Style and Hypo-kinetic Disease –Prevention and Management

References:

Difiore, J.(1998). *Complete guide to postnatal fitness.* London: A & C Black,.
Giam, C.K & The, K.C. (1994). *Sport medicine exercise and fitness.* Singapore: P.G. Medical Book.
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Sharkey, B. J.(1990). *Physiology of fitness*, Human Kinetics Book.

Semester II

Theory courses

EC-202 SPORTS NUTRITION AND WEIGHT MANAGEMENT (ELECTIVE)

STUDENT LEARNING OUTCOMES :

1. To understand specific nutritional requirement of sports person.
2. Describe role of macro and micronutrients
3. Be able to assess body composition
4. Develop insight in to role of exercise and diet in weight management by

Unit – I Introduction to Sports Nutrition

- Meaning and Definition of Sports Nutrition
- Basic Nutrition guidelines
- Role of nutrition in sports
- Factor to consider for developing nutrition plan

Unit – II Nutrients: Ingestion to energy metabolism

- Carbohydrates, Protein, Fat – Meaning, classification and its function
- Role of carbohydrates, Fat and protein during exercise
- Vitamins, Minerals, Water – Meaning, classification and its function
- Role of hydration during exercise, water balance, Nutrition – daily caloric requirement and expenditure.

Unit – III Nutrition and Weight Management

- Meaning of weight management Concept of weight management in modern era Factor affecting weight management and values of weight management
- Concept of BMI (Body mass index), Obesity and its hazard, Myth of Spot reduction, Dieting versus exercise for weight control, Common Myths about Weight Loss
- Obesity – Definition, meaning and types of obesity,
- Health Risks Associated with Obesity, Obesity - Causes and Solutions for Overcoming Obesity.

Unit – IV Steps of planning of Weight Management

- Nutrition – Daily calorie intake and expenditure, Determination of desirable body weight
- Balanced diet for Indian School Children, Maintaining a Healthy Lifestyle
- Weight management program for sporty child, Role of diet and exercise in weight management, Design diet plan and exercise schedule for weight gain and loss

References:

Bessesen, D. H. (2008). Update on obesity. *J ClinEndocrinolMetab.93*(6), 2027-2034.

Butryn, M.L., Phelan, S., &Hill, J. O.(2007). Consistent self-monitoring of weight: a key component of successful weight loss maintenance.*Obesity(Silver Spring)*. *15*(12), 3091-3096.

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Semester – III

Theory Courses

CC-301 SPORTS TRAINING

STUDENT LEARNING OUTCOMES :

1. The students will gain knowledge of meaning and definition of sports training.
2. Principles of sports training will be learnt by the students.
3. Students will have proficient knowledge about means and methods to develop speed, endurance, coordination and flexibility.
4. The basics of training load will be added to students knowledge base.
5. Students expand their knowledge of training plan and program.

Unit – I Introduction to Sports Training

- Meaning and Definition of Sports Training
- Aim and Objective of Sports Training
- Principles of Sports Training
- System of Sports Training – Basic Performance, Good Performance and High Performance Training

Unit – II Training Components

- Strength – Mean and Methods of Strength Development
- Speed – Mean and Methods of Speed Development
- Endurance - Mean and Methods of Endurance Development
- Coordination – Mean and Methods of coordination Development
- Flexibility – Mean and Methods of Flexibility Development

Unit – III Training Process

- Training Load- Definition and Types of Training Load
- Principles of Intensity and Volume of stimulus
- Technical Training – Meaning and Methods of Technique Training
- Tactical Training – Meaning and Methods of Tactical Training

Unit – IV Training programming and planning

- Periodization – Meaning and types of Periodization
- Aim and Content of Periods – Preparatory, Competition, Transitional etc.
- Planning – Training session
- Talent Identification and Development

Reference:

Dick, W. F. (1980).*Sports training principles.*London: Lepus Books.

Harre, D.(1982).*Principles of sports training.*Berlin: Sporulated.
Jensen, R. C.& Fisher, A.G. (1979). *Scientific basis of athletic conditioning*. Philadelphia: Lea and Fibiger, 2nd Edn.
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Singh, H. (1984).*Sports training, general theory and methods*.Patials: NSNIS.
Uppal, A.K., (1999).*Sports Training.*New Delhi: Friends Publication.

Semester III

Theory Courses

CC-302 COMPUTER APPLICATIONS IN PHYSICAL EDUCATION

STUDENT LEARNING OUTCOMES :

1. To understand the need and importance of communication technology (ICT).
2. To gain knowledge of the application of computer in Physical Education.
3. To acquaint the learner with different methods MS Office.
4. To understand Application of software used in Physical education and sports.
5. To correlate the of ICT & Education technology in physical education and sports concepts with the sports and athlete specific situations.

Unit – I: Introduction to Computer

- Meaning, need and importance of information and communication technology (ICT). Application of Computers in Physical Education
- Components of computer, input and output device
- Application software used in Physical Education and sports

Unit – II: MS Word

- Introduction to MS Word
- Creating, saving and opening a document
- Formatting Editing features Drawing table ,
- page setup, paragraph alignment, spelling and grammar check printing option, inserting page number, graph, footnote and notes

Unit – III: MS Excel

- Introduction to MS Excel
- Creating, saving and opening spreadsheet
- creating formulas
- Format and editing features adjusting columns width and row height understanding charts.

Unit – IV: MS Power Point

- Introduction to MS Power Point
- Creating, saving and opening a ppt. file
- format and editing features slide show , design , inserting slide number
- picture ,graph ,table
- Preparation of Power point presentations

Referances:

Irtegov, D. (2004). *Operating system fundamentals*. Firewall Media.
Marilyn, M.& Roberta, B.(n.d.).*Computers in your future*. 2nd edition, India: Prentice Hall.
Milke, M.(2007). *Absolute beginner's guide to computer basics*. Pearson Education Asia.
Sinha, P. K. & Sinha, P. (n.d.).*Computer fundamentals*. 4th edition, BPB Publication.

Semester – III

Theory Courses

CC-303 SPORTS PSYCHOLOGY AND SOCIOLOGY

STUDENT LEARNING OUTCOMES :

1. The students will acquire the knowledge regarding various stages of growth and development.
2. A. Students will come to know about psycho-social aspects of human behaviour in the context of physical education.
3. Students gain knowledge regarding the role of personality in sports performance.
4. The students will learn about various strategies such as focus, relaxation, imagery etc. about mental preparation
5. The student will become familiar with association of physical education with social science.

Unit -I: introduction

- Meaning, Importance and scope of Educational and Sports Psychology
- General characteristics of Various Stages of growth and development
- Types and nature of individual differences; Factors responsible -Heredity And environment
- Psycho-sociological aspects of Human behavior in relation to physical education and sports

Unit-II: Sports Psychology

- Nature of learning, theories of learning, Laws of learning,
- Plateau in Learning; & transfer of training
- Meaning and definition of personality, characteristics of personality,
- Dimension of personality, Personality and Sports performance
- Nature of motivation: Factors influencing motivation; Motivation and techniques and its impact on sports performance.
- Mental Preparation Strategies: Attention focus, Self- talk, Relaxation, Imaginary.
- Aggression and Sports, Meaning and nature of anxiety, Kinds of anxiety
- Meaning and nature of stress; Types of stress, Anxiety, Stress, Arousal and their effects on sports performance

Unit-III: Relation between Social Science and Physical Education.

- Orthodoxy, customs, Tradition and Physical Education.
- Festivals and Physical Education.
- Socialization through Physical Education.
- Social Group life, Social conglomeration and Social group, Primary group and Remote group.

Unit-4 Culture : Meaning and Importance.

- Features of culture,
- Importance of culture.
- Effects of culture on people life style.
- Different methods of studying Observation/ Inspection method, Questionnaire method, Interview method

References:

Ball, D. W. & Loy, J. W. (1975).*Sport and social order; Contribution to the sociology of sport.*London: Addison Wesley Publishing Co., Inc.

Blair, J.& Simpson, R.(1962). *Educational psychology*, New York:McMillan Co.

Cratty, B. J.(1968). *Psychology and physical activity*. Eaglewood Cliffs. Prentice Hall.

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Loy, J. W., Kenyon, G. S. & McPherson, B. D. (1981).*Sports culture and society.*Philadelphia: Lea &Febiger.

Mathur, S.S., (1962). *Educational psychology*. Agra.VinodPustakMandir.

Skinnner, C. E., (1984.). *Education psychology*. New Delhi: Prentice Hall of India.

William, F. O.&Meyer, F. N. (1979). A handbook of sociology. New Delhi: Eurasia Publishing House Pvt Ltd.

Semester – III

Theory Courses

EC-301 SPORTS MEDICINE, PHYSIOTHERAPY AND REHANLITATION (ELECTIVE)

STUDENT LEARNING OUTCOMES :

1. The course intends to provide advanced knowledge of the medical field related to physical activity and sports.
2. The course provides knowledge about how to prevent and rehabilitate physical exercise and sports injuries in sports persons.
3. The students learn about the principles of various muscle and skeleton injuries related to physical exercise and sports
4. The students learn about various methods of adequate examination and treatment of muscle and skeleton injuries related to physical exercise and sports.
5. The students learn about the importance of the diet when going in for sports and the importance of recovery in physical training, exercise and sports

Unit-I: - Sports Medicine:

- Sports Medicine: Meaning, Definition, Aims, Objectives, Modern Concepts and Importance.
- Athletes Care and Rehabilitation: Contribution of Physical Education Teachers and Coaches.
- Need and Importance of the study of sports injuries in the field of Physical Education
- Prevention of injuries in sports – Common sports injuries – Diagnosis –
- First Aid - Treatment - Laceration – Blisters – Contusion - Strain – Sprain – Fracture – Dislocation and Cramps – Bandages – Types of Bandages – trapping and supports.

Unit-II: Physiotherapy

- Definition – Guiding principles of physiotherapy, Importance of physiotherapy, Introduction and demonstration of treatments - Electrotherapy – infrared rays – Ultraviolet rays –short wave diathermy – ultrasonic rays.

Unit-III: Hydrotherapy:

- Introduction and demonstration of treatments of Cry therapy, Thermo therapy, Contrast Bath, Whirlpool Bath – Steam Bath – Sauna Bath – Hot Water Fomentation – Massage: History of Massage – Classification of Manipulation (Swedish System) physiological Effect of Massage.

Unit-IV: Therapeutic Exercise:

- Definition and Scope – Principles of Therapeutic Exercise – Classification, Effects and uses of Therapeutic exercise – passive Movements (Relaxed, Forced and passive -

stretching) – active movements (concentric, Eccentric and static) application of the therapeutic exercise: Free Mobility Exercise – Shoulder, Elbow – Wrist and Finger Joints – Hips, Knee, ankle and Foot joints – Trunk. Head and Neck exercises.

References:

Christine, M. D., (1999). *Physiology of sports and exercise*.USA: Human Kinetics.

Conley, M. (2000). *Bioenergetics of exercise training*. In T.R. Baechle, & R.W. Earle, (Eds.), Essentials of Strength Training and Conditioning (pp. 73-90). Champaign, IL: Human Kinetics.

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Semester – III

Theory Courses

EC-302 CURRICULUM DESIGN (Elective)

UNIT-I Modern concept of the curriculum

- Need and importance of curriculum, Need and importance of curriculum development, the role of the teacher in curriculum development.
- Factors affecting curriculum - Social factors - Personnel qualifications - Climatic consideration - Equipment and facilities -Time suitability of hours.
- National and Professional policies, Research finding

UNIT-IIBasic Guide line for curriculum construction; contest (selection and expansion).

- Focalization
- Socialization
- Individualization
- Sequence and operation
- Steps in curriculum construction.

UNIT-IIICurriculum-Old and new concepts, Mechanics of curriculum planning.

- Basic principles of curriculum construction.
- Curriculum Design, Meaning, Importance and factors affecting curriculum design.
- Principles of Curriculum design according to the needs of the students and state and national level policies.
- Role of Teachers

UNIT-IV Under-graduate preparation of professional preparation.

- Areas of Health education, Physical education and Recreation.
- Curriculum design-Experience of Education, Field and Laboratory.
- Teaching practice.
- Professional Competencies to be developed-Facilities and special resources for library, laboratory and other facilities.

Reference:

Barrow, H. M. (1983). *Man and movement: principles of physical education*. Philadelphia: Lea and Febiger.

Bucher, C. A. (1986). Foundation of physical education: St. Louis: The C. V. Mosby & Company.

Cassidy, R. (1986). *Curriculum development in physical education*. New York: Harper & Company.

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Underwood, G. L. (1983). *The physical education curriculum in secondary school: planning and implementation.*England: Taylor and Francis Ltd.

Willgoose, C.E. (1979). *Curriculum in physical education*. 3rd Ed. Englewood Cliffs.: N.J. Prentice Hall, Inc.

Semester – IV

Theory Courses

CC-401 MEASUREMENT AND EVALUATION IN PHYSICAL EDUCATION

STUDENT LEARNING OUTCOMES :

1. The students will be familiar with the need and importance of measurement and evaluation in physical education.
2. The students will understand the criteria for a good test.
3. The students will be able to understand the various types of tests and it classification.
4. They will have understanding about some important physical fitness tests.
5. The students will grasp the knowledge about some selective sports skill tests.

Unit- IIntroduction to Test & Measurement & Evaluation

- Meaning of Test & Measurement & Evaluation in Physical Education
- Need & Importance of Test & Measurement & Evaluation in Physical Education
- Principles of Evaluation

Unit- IICriteria; ClassificationandAdministration of test

- Criteria of good Test
- Criteria of tests, scientific authenticity (reliability, objectivity, validity and availabilityof norms)
- Type and classification of Test
- Administration of test, advance preparation – Duties during testing – Duties after testing.

Unit- III Physical Fitness Tests

- AAHPER youth fitness test
- National physical Fitness Test
- Indiana Motor Fitness Test
- JCR test
- U.S Army Physical Fitness Test

Unit- IV Sports Skill Tests

- Lockhart and McPherson badminton test
- Johnson basketball test
- McDonald soccer test
- S.A.I volleyball test
- S.A.I Hockey test

References:

Bangsbo, J. (1994). *Fitness training in football: A scientific approach*. Bagsvaerd, Denmark:

Ho+Storm.

Barron, H. M., &Mchee, R. (1997). *A practical approach to measurement in physical education*. Philadelphia: Lea and Febiger.

Barron, H.M. &Mchee, R. (1997). A Practical approach to measurement in physical education. Philadelphia: Lea and Febiger.

Kansal, D.K. (1996). *Test and measurement in sports and physical education*. New Delhi: D.V.S. Publications.

Mathews, D.K., (1973). *Measurement in physical education*, Philadelphia: W.B.SoundersCompnay.

Pheasant, S. (1996). *Body space: anthropometry, ergonomics and design of work*. Taylor & Francis, New York.

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Sodhi, H.S., & Sidhu, L.S. (1984). *Physique and selection of sports- a kinanthropometric study*. Patiala: Punjab Publishing House.

Semester – IV
Theory Courses

CC-402 KINESIOLOGY AND BIOMECHANICS

STUDENT LEARNING OUTCOMES :

1. The students will get knowledge regarding basics of kinensiology and biomechanics.
2. The students will learn about some fundamental concepts namely centre of gravity, equilibrium and axes etc.
3. The fundamental concept of anatomy and physiology will be added to students knowledge base.
4. The students will learn about various mechanical concepts namely force, lever etc. of biomechanics.
5. The theory of linear and angular kinematics will be learned by the students.

Unit – I Introduction to Kinesiology and Sports Biomechanics

- Meaning and Definition of Kinesiology and Sports Biomechanics
- Importance of Kinesiology and Sports Biomechanics to Physical Education Teacher, Athletes and Sports Coaches.
- Terminology of Fundamental Movements
- Fundamental concepts of following terms – Axes and Planes, Centre of Gravity, Equilibrium, Line of Gravity

Unit – II Fundamental Concept of Anatomy and Physiology

- Classification of Joints and Muscles
- Types of Muscle Contractions
- Posture – Meaning, Types and Importance of good posture.
- Fundamental concepts of following terms- Angle of Pull, All or None Law, Reciprocal Innovation

Unit – III Mechanical Concepts

- Force - Meaning, definition, types and its application to sports activities
- Lever - Meaning, definition, types and its application to human body.
- Newton’s Laws of Motion – Meaning, definition and its application to sports activities.
- Projectile – Factors influencing projectile trajectory.

Unit – IV Kinematics and Kinetics of Human Movement

- Linear Kinematics – Distance and Displacement, speed and velocity, Acceleration
- Angular kinematics – Angular Distance and Displacement, Angular Speed and velocity, Angular Acceleration.
- Linear Kinetics – Inertia, Mass, Momentum, Friction.

- Angular Kinetics – Moment of inertia ,Couple, Stability.

Reference:

Bunn, J. W. (1972).*Scientific principles of coaching.* Englewood Cliffs, N.J.: Prentice Hall Inc.

Hay, J. G. & Reid, J. G.(1982).*The anatomical and mechanical basis of human motion.* Englewood Cliffs, N.J.: prentice Hall Inc.

Hay, J. G. & Reid, J. G.(1988).*Anatomy, mechanics and human motion.* Englewood Cliffs, N.J.: prentice Hall Inc.

Hay, J. G. (1970).*The biomechanics of sports techniques*. Englewood Cliffs, N.J.: Prentice Hall, Inc.

Simonian, C.(1911).*Fundamentalsof sport biomechanics.* Englewood Cliffs, N.J.: Prentice Hall Inc.

Semester – IV
Theory Courses
CC-403 RESEARCH AND STATISTICS IN PHYSICAL EDUCATION

1. To develop understand of the basic framework of research process.
2. To identify appropriate research topics.
3. To identify various sources of information for literature review and data collection.
4. To understand and apply basic research methods including research design, data analysis, and interpretation.
5. To develop testable hypotheses, differentiate research design, evaluate aptness of research conclusions, and generalize them appropriately.
6. To know how to apply the basic aspects of the research process in order to plan and execute a research proposal and research report.

Unit-I Introduction to Research
- Definition of Research
- Need and importance of Research in Physical Education and Sports.
- Scope of Research in Physical Education & Sports.
- Classification of Research
- Research Problem, Meaning of the term, Location and criteria of Selection of Problem, Formulation of a Research Problem, Limitations and Delimitations.

Unit-II Survey of Related Literature
- Need for surveying related literature.
- Literature Sources, Library Reading
- Research Proposal, Meaning and Significance of Research Proposal.
- Preparation of Research proposal / project.
- Research Report: A group project is to be undertaken by a small batch of students under the supervision of a teacher, wherein it is expected to survey school facilities of physical education, health assessment programme evaluation, fitness status of the students, staff and other stakeholders etc. and submit the report to the institution.

Unit-III Basics of Statistical Analysis
- Statistics: Meaning, Definition, Nature and Importance
- Class Intervals: Raw Score, Continuous and Discrete Series, Class Distribution, Construction of Tables
- Graphical Presentation of Class Distribution: Histogram, Frequency Polygon, Frequency Curve. Cumulative Frequency Polygon, Ogive, Pie Diagram

Unit- IVStatistical Models in Physical Education and Sports
- Measures of Central Tendency: Mean, Median and Mode-Meaning, Definition, Importance, Advantages, Disadvantages and Calculation from Group and Ungrouped data
- Measures of Variability: Meaning, importance, computing from group and ungroup data
- Percentiles and Quartiles: Meaning, importance, computing from group and ungroup data

References:
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Bompa, T. O. &Haff, G. G. (2009). *Periodization: theory and methodology of training, 5th ed.* Champaign, IL: Human Kinetics.

Brown, L. E., &Ferrigno, V. A. (2005). Training for speed, agility and quickness, 2nd ed. Champaign, IL: Human Kinetics.

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Carl, E. K., & Daniel, D. A. (1969). Modern principles of athletes training. St. Louis: St. Louis's Mosby Company.

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Oyster, C. K., Hanten, W. P., & Llorens, L. A. (1987). *Introduction to research: A guide for the health science professional.* Landon: J.B. Lippincott Company.

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Verma, J. P. (2000). *A text book on sports statistics*. Gwalior: Venus Publications.

Semester – IV
Theory Courses

EC-401 THEORY OF SPORTS AND GAMES (ELECTIVE)

UNIT-IINTRODUCTION

General Introduction of speciliazed games and sports–

- Athletics,
- Badminton,
- Basketball,
- Cricket,
- Football,
- Gymnastic,
- Hockey,
- Handball,
- Kabaddi,
- Kho-Kho,
- Tennis,
- Volleyball and
- Yoga.

Each game or sports to be dealt under the following heads

- History and development of the Game and Sports
- Ground preparation, dimensions and marking
- Standard equipment and their specifications
- Ethics of sports and sportsmanship

UNIT-II Scientific Principles of coaching: **(particular sports and game specific)**

- Motion – Types of motion and Displacement, Speed, Velocity, Acceleration, Distance and Newton's Law of motions.
- Force – Friction, Centripetal and Centrifugal force, Principles of force.
- Equilibrium and its types
- Lever and its types
- Sports Training – Aims, Principles and characteristics.
- Training load – Components, Principles of load, Over Load (causes and symptoms).

UNIT-III Physical fitness components: (particular sports and game specific)

- Speed and its types
- Strength and its types
- Endurance and its types
- Flexibility and its types
- Coordinative ability and its types

- Training methods: - Development of components of physical fitness and motor fitness through following training methods (continuous method, interval method, circuit method, fartlek /speed play and weight training)

UNIT-IV Conditioning exercises and warming up.

- Concept of Conditioning and warming up.
- Role of weight training in games and sports.
- Teaching of fundamental skill & their mastery (technique, tactic and different phases of skill acquisition).
- Recreational and Lead up games
- Strategy – Offence and defense, Principles of offence and defense.

References:

Bunn, J. W. (1968). *The art of officiating sports*. Englewood cliffs N.J. Prentice Hall.

Bunn, J. W. (1972). *Scientific principles of coaching.* Englewood cliffs N. J. Prentice Hall.

Dyson, G. H. (1963). *The mechanics of athletics*. London: University of London Press Ltd.

Lawther, J.D. (1965). *Psychology of coaching.* New York: Pre. Hall.

Singer, R. N. (1972). *Coaching, athletic & psychology*.New York: M.C. Graw Hill.

Semester – IV

Theory Courses

EC-402 SPORTS MANAGEMENT

Unit-I

- Nature and Concept of Sports Management.
- Progressive concept of Sports management.
- The purpose and scope of Sports Management.
- Essential skills of Sports Management.
- Qualities and competencies required for the Sports Manager.
- Event Management in physical education and sports.

Unit-II

- Meaning and Definition of leadership
- Leadership style and method.
- Elements of leadership.
- Forms of Leadership.
  - Autocratic
  - Laissez-faire
  - Democratic
  - Benevolent Dictator
- Qualities of administrative leader.
- Preparation of administrative leader.
- Leadership and Organizational performance.

Unit-III

- Sports Management in Schools, colleges and Universities.
- Factors affecting planning
- Planning a school or college sports programme.
- Directing of school or college sports programme.
- Controlling a school, college and university sports programme.
  - Developing performance standard
  - Establishing a reporting system
  - Evaluation
  - The reward/punishment system

Unit-IV

- Financial management in Physical Education & sports in schools, Colleges and Universities.
- Budget – Importance, Criteria of good budget,
- Steps of Budget making
- Principles of budgeting

REFERENCES:

Ashton, D. (1968).*Administration of physical education for women*.New York: The Ronal Press Cl.

Bucher, C.A. *Administration of physical education and athletic programme.* 7th Edition, St. Louis: The C.V. Mosby Co.

Daughtrey, G. & Woods, J.B. (1976). *Physical education and intramural programmes, organisation and administration.* Philadelphia U.S.A. : W.B. Sounders Cp.

Earl, F. Z,& Gary, W. B. (1963).*Management competency development in sports and physical education*. Philadelphia: W. Lea and Febiger.

Part – B
Practical Courses

PC - 101
Track and Field:

Semester – I

Running Event

- Starting techniques: Standing start, Crouch start and its variations, Proper use of blocks.
- Finishing Techniques: Run, Through, Forward lunging, Shoulder Shrug
- Ground Marking, Rules and Officiating
- Hurdles:
  - Fundamental Skills- Starting, Clearance and Landing Techniques.
  - Types of Hurdles
  - Ground Marking and Officiating.

Relays: Fundamental Skills

- Various patterns of Baton Exchange
- Understanding of Relay Zones
- Ground Marking
- Interpretation of Rules and Officiating.

PC 102

Gymnastics: Floor Exercise

- Forward Roll, Backward Roll, Sideward Roll, different kinds of scales, Leg Split, Bridge, Dancing steps, Head stand, Jumps-leap, scissors leap.
- Vaulting Horse
- Approach Run, Take off from the beat board, Cat Vault, Squat Vault.

PC – 102

Swimming: Fundamental Skills

- Entry into the pool.
- Developing water balance and confidence
- Water fear removing drills.
- Floating-Mushroom and Jelly fish etc.
- Gliding with and without kickboard.
- Introduction of various strokes
- Body Position, Leg, Kick, Arm pull, Breathing and Co ordination.
- Start and turns of the concerned strokes.
- Introduction of Various Strokes.
- Water Treading and Simple Jumping.

- Starts and turns of concerned strokes.
- Rules of Competitive swimming-officials and their duties, pool specifications, seeding heats and finals, Rules of the races.

PC – 102

Shooting Fundamental Skills

- Basic stance, grip, Holding rifle/ Pistol, aiming target
- Safety issues related to rifle shooting
- Rules and their interpretations and duties of officials

(Any one out of three)

PC – 103 Indigenous sports:

Kabaddi: Fundamental Skills

- Skills in Raiding-Touching with hand, various kicks, crossing of baulk line, Crossing of Bonus line, luring the opponent to catch, Pursuing.
- Skills of Holding the Raider-Various formations, Catching from particular position, Different catches, Luring the raider to take particular position so as to facilitate catching, catching formations and techniques.
- Additional skills in raiding-Bringing the antis in to particular position, Escaping from various holds, Techniques of escaping from chain formation, Combined formations in offence and defense.
- Ground Marking, Rules and Officiating

PC – 103

Malkhambh and Light Apparatus:

- Lathi-Two counts exercises, Four Count exercises, eight count exercises, sixteen count exercises.
- GhatiLezuim-AathAawaaz, Bethakawaaz, AagePaon, Aagekadam, Do pherawaaz, Chau pherawaaz, Kadamtaal, Pavitra, Uchhakpavitra, Kadampavitra.
- Mass P.T. Exercises-Two count, four count and eight count exercises.
- Hindustani Lezuim-Char Awaaz, EkJagah, AantiLagaav, Pavitra, Do Rukh, Chau Rukh, Chau rukhbethak, Momiya.
- Drill and Marching
- Malkhamb-Salaami, Hold, Saadiudi, Bagaludi, Dashrangudi, Bagliudi, Veludi, Soydoro, Phirki, Padmasana, T.Balance, Pataka, Landing.
- Rope Malkhamb-Salaami, PadmasanaChadh, Katibandh1-2, Sadiadhi, Rikebpakkad, Rikebpagniadhi, Kamaradhi, Nakkikasadhi, Kamaradhi, Nakkikasadhi, Urubandhtedhi, Sadibagli, Do hatibagli, Kamarbandhbagli, nakkikasbagli, Dashrang, Hanuman pakad, Gurupakkad, various padmasana, Landing.

PC - 104

Kho Kho:

- General skills of the game-Running, chasing, Dodging, Faking etc.
- Skills in chasing-Correct Kho, Moving on the lanes, Pursuing the runner, Tapping the inactive runner, Tapping the runner on heels, Tapping on the pole, Diving, Judgement in giving Kho, Rectification of Foul.
- Skills in Running-Zig zag running, Single and double chain, Ring play, Rolling in the sides, Dodging while facing and on the back, fakes on the pole, fake legs, body arm etc, Combination of different skills.
- Ground Marking
- Rules and their interpretations and duties of officials.

PC – 104

Dumbells/ Wands/ Hoop/ Umbrella/ Tipri: Fundamentals skills

- Apparatus/ Light apparatus Grip
- Attention with apparatus/ Light apparatus
- Stand – at – ease with apparatus/ ligfht apparatus
- Exrcise with verbal command,drum, whistle and music – Two count, Four count, Eight count and Sixteen count.
- Standing Exercise
- Jumping Exercise
- Moving Exercise
- Combination of above all

STUDENT LEARNING OUTCOMES:

1. Learn skills, technique of the Game/Sport.
2. Learn the layout and marking and rules of the Game/Sport.
3. Be able to develop drills & lead up activities of Game/Sport.
4. Learn officiating of Game/Sport.
5. Develop teaching ability of Game/Sport

Semester – II

PC – 201

Track and Field

Athletics: Jumping Events

- High Jump (Straddle Roll)

- Approach Run,
- Take off
- Clearance over the bar.
- Landing

PC – 202

Gymnastics:

- Parallel Bar:
- Mount from one bar
- Straddle walking on parallel bars.
- Single and double step walk
- Perfect swing
- Shoulder stand on one bar and roll forward.
- Roll side
- Shoulder stand
- Front on back vault to the side(dismount)
- Horizontal /Single Bar:
- Grip
- Swings
- Fundamental Elements
- Dismount
- Uneven Parallal Bar:
- Grip
- Swings
- Fundamental Elements
- Dismount

PC – 202

Yoga:

- Surya Namaskara,
- Pranayams
- Corrective Asanas
- Kriyas
- Asanas
    - Sitting
    - Standing
    - Laying Prone Position,
    - Laying Spine Position

PC – 202

Swimming:

Introduction of water polo game

- Fundamental skills
- Swimm with the ball
- Passing
- Catching
- Shooting
- Goal keeping
- Rules of the games and responsibility of officials

Introduction of Diving sports.

- Basic Diving Skills from spring boards
- Basic Diving Skills from platform

PC – 202

Aerobics: Introduction of Aerobics

- Rhythmic Aerobics - dance
- Low impact aerobics
- High impact aerobics
- Aerobics kick boxing
- Postures – Warm up and cool down
- THR Zone – Being successful in exercise and adaptation to aerobic workout.

PC - 203

Badminton: Fundamental Skills

- Racket parts, Racket grips, Shuttle Grips.
- The basic stances.
- The basic strokes-Serves, Forehand-overhead and underarm, Backhand-overhead and underarm
- Drills and lead up games
- Types of games-Singles, doubles, including mixed doubles.
- Rules and their interpretations and duties of officials.

PC - 203

Table Tennis: Fundamental Skills

- The Grip-The Tennis Grip, Pen Holder Grip.
- Service-Forehand, Backhand, Side Spin, High Toss.
- Strokes-Push, Chop, Drive, Half Volley, Smash, Drop-shot, Balloon, Flick Shit, Loop Drive.
- Stance and Ready position and foot work.
- Rules and their interpretations and duties of officials.

PC – 203

Squash Fundamental Skills

- Service- Under hand and Over hand
- Service Reception
- Shot- Down the line, Cross Court
- Drop
- Half Volley
- Tactics – Defensive, attacking in game
- Rules and their interpretations and duties of officials.

PC – 203

Tennis: Fundamental Skills**.**

- Grips- Eastern Forehand grip and Backhand grip, Western grip, Continental grip, Chopper grip.
- Stance and Footwork.
- Basic Ground strokes-Forehand drive, Backhand drive.
- Basic service.
- Basic Volley.
- Over-head Volley.
- Chop
- Tactics – Defensive, attacking in game
- Rules and their interpretations and duties of officials.

STUDENT LEARNING OUTCOMES :

1. Learn and master fundamental skills,technique of the Game/Sport.
2. Learn the layout and marking, rules of the Game/Sport.
3. Be able to develop drills & lead up activities of Game/Sport.
4. To learn officiating of Game/Sport.
5. Develop teaching ability of Game/Sport

Semester – III

PC – 301

Track and fields (Throwing Events)

- Discus Throw, Javelin, Hemmer throw, shot-put
- Basic Skills and techniques of the Throwing events
- Ground Marking / Sector Marking
- Interpretation of Rules and Officiating.
- Grip
- Stance
- Release
- Reserve/ (Follow through action)
- Rules and their interpretations and duties of officials

PC – 302

Boxing: Fundamental Skills

- Player stance
- Stance - Right hand stance, left hand stance.
- Footwork – Attack, defense.
- Punches – Jab, cross, hook, upper cut, combinations.
- Defense slip – bob and weave, parry/block, cover up, clinch, counter attack
- Tactics – Toe to toe, counter attack, fighting in close, feinting
- Rules and their interpretations and duties of officials.

PC – 302

Martial Arts/Karate: Fundamental Skills

- Player Stances – walking, hand positions, front-leaning, side-fighting.
- Hand Techniques - Punches (form of a punch, straight punch, and reverse punch), Blocks (eight basic).
- Leg Techniques - Snap kicks, stretching straight leg, thrust kicks, sidekicks, round house.
- Forms - The first cause Katas.
- Self Defense - against punches, grabs and strikes, against basic weapons (knife, club sticks).
- Sparring - One step for middle punch, high punch and groin punch. (Defended by appropriate block from eight basic blocks).
- Rules and their interpretations and duties of officials.

PC – 302

Taekwondo Fundamental Skills

- Player Stances – walking, extending walking, L stance, cat stance.
- Fundamental Skills – Sitting stance punch, single punch, double punch, triple punch.
- Punching Skill from sparring position – front-fist punch, rear fist punch, double punch, and four combination punch.
- Foot Tenchniques (Balgisul) – standing kick (soseochagi), Front kick (AP chagi), Arc kick (BandalChagi), Side kick, (YeopChagi), Turning kick (DollyoChagi), Back kick (Twit Chagi), Reverse turning kick (BandaeDollyoChagi), Jump kick (TwimyoChagi),
- Poomsae (Forms) – Jang, Yi Jang, Sam Jang, Sa Jang, O Jang, Yook Jang, Chil Jang, Pal Jang (Fundamental Movement – eye control, concentration of spirit, speed control, strength control, flexibility, balance, variety in techniques)
- Sparring (Kyorugi) – One Step Sparring (hand techniques, foot techniques, self defense techniques, combination kicks), Free Sparring.
- Board Breaking (Kyokpa) – eye control, balance, power control, speed, point of attack.
- Rules and their interpretations and duties of officials.

PC – 302

Judo: Fundamental skills

- Rei (Salutation)-Ritsurei(Salutation in standing position), Zarai (Salutation in the sitting position)
- Kumi kata (Methods of holding judo costume)
- Shisei (Posture in Judo)
- Kuzushi (Act of disturbing the opponent posture)
- Tsukuri and kake (Preparatory action for attack)
- Ukemi (Break Fall)-UrhiroUkemi (Rear break Fall), Yoko Ukemi (Side Break Fall), Mae Ukemi (Front Break Fall), Mae mawariUkemi (Front Rolling break fall)
- Shin Tai (Advance or retreat foot movement)-Suri-ashi (Gliding foot), Twugi-ashi (Following footsteps), Ayumi-ashi (Waling steps.
- Tai Sabaki (Management of the body)
- NageWaze (Throwing techniques)-HizaGuruma (Knee wheel), SesaeTwurikomi-ashi (Drawing ankle throw), De ashihari (Advance foot sweep), O Goshi (Major loinm), SeoiNage (Shoulder throw).
- Katamawaze(Grappling techniques)-Kesagatame (Scaff hold), Kata gatame (Shoulder hold), Kami shihogatama (Locking of upper four quarters), Method of escaping from each hold.

PC – 302

Wrestling: Fundamental Skills

- Take downs, Leg tackles, Arm drag.
- Counters for take downs, Cross face, Whizzer series.
- Escapes from under-sit-out turn in tripped.
- Counters for escapes from under-Basic control back drop, Counters for stand up.
- Pinning combination-Nelson series(Half Nelson, Half Nelson and Bar arm), Leg lift series, Leg cradle series, Reverse double bar arm, chicken wing and half Nelson.
- Escapes from pining: Wing lock series, Dopuble arm lock roll, Cridge.
- Standing Wrestling-Head under arm series, whizzer series
- Referees positions.

PC – 302

Fencing: Fundamental Skill

- Basic Stance - on-guard position (feet and legs)
- Footwork – advance, retire, lunge, Step-lunge
- Grip – hold a foil correctly, Etiquette – salute and handshake to coaches and partners
- Hit a target (glove, mask, person) at riposte distance
- Lunge from an on-guard position.
- Attack - simple attacks from sixte – direct, disengage, doublé attack, compound attacks high line – one-two and cut-over disengage, Cut-over attack, Low line attacks
- Semi circular parries – octave and septime
- Understand the layout of a piste.
- Compound or successive parries.
- Lateral parry and direct riposte
- Fence a bout – judges etc. salutes and handshakes
- Rules and their interpretations and duties of officials.

PC 303 Team Games

PC 303

Base Ball Fundamental Skills

- Player Stances – walking, extending walking, L stance, cat stance.
- Grip – standard grip, choke grip,
- Batting – swing and bunt.
- Pitching –

- Baseball : slider, fast pitch, curve ball, drop ball, rise ball, change up, knuckle ball, screw ball,
- Softball: windmill, sling shot,
- starting position: wind up, set.
- Fielding –
  - Catching: basics to catch fly hits, rolling hits,
  - Throwing: over arm, side arm.
- Base running –
  - Base running: single, double, triple, home run,
  - Sliding: bent leg slide, hook slide, head first slide.
- Rules and their interpretations and duties of officials.

PC 303

Netball: Fundamental Skills

- Catching: one handed, two handed, with feet grounded, in flight.
- Throwing (different passes and their uses): one handed passes (shoulder, high shoulder, underarm, bounce, lob); two handed passes (push, overhead, bounce).
- Footwork: landing on one foot; landing on two feet; pivot; running pass.
- Shooting: one hand; two hands; forward step shot; backward step shot.
- Techniques of getting free: dodge and sprint; sudden sprint; sprint and stop; sprinting with change of speed.
- Defending: marking the player; marking the ball; blocking; inside the circle; outside the circle (that is, defending the circle edge against the pass in).
- Intercepting: pass; shot.
- The toss-up.
- Role of individual players
- Rules and their interpretations and duties of officials.

PC – 303

Cricket: Fundamental Skills

- Batting-Forward and backward defensive stroke
- Bowling-Simple bowling techniques
- Fielding-Defensive and offensive fielding
- Catching-High catching and Slip catching
- Stopping and throwing techniques
- Wicket keeping techniques

PC 303

Football: Fundamental Skills

- Kicks-Inside kick, Instep kick, Outer instep kick, lofted kick
- Trapping-trapping rolling the ball, trapping bouncing ball with sole
- Dribbling-With instep, inside and outer instep of the foot.
- Heading-From standing, running and jumping.
- Throw in
- Feinting-With the lower limb and upper part of the body.
- Tackling-Simple tackling, Slide tackling.
- Goal Keeping-Collection of balls, Ball clearance-kicking, throwing and deflecting.

PC 303

Hockey: Fundamental Skills

- Player stance & Grip
- Rolling the ball
- Dribbling
- Push
- Stopping
- Hit
- Flick
- Scoop
- Passing – Forward pass, square pass, triangular pass, diagonal pass, return pass,
- Reverse hit
- Dodging
- Goal keeping – Hand defence, foot defence
- Positional play in attack and defense.
- Rules and their interpretations and duties of officials.
- Rules and their interpretations and duties of officials.
- Ground Marking.

PC – 303

Softball **Fundamental Skills**

- Catching: one handed, two handed, with feet grounded, in flight.
- Throwing (different passes and their uses): one handed passes (shoulder, high shoulder, underarm, bounce, lob); two handed passes (push, overhead, bounce).
- Footwork: landing on one foot; landing on two feet; pivot; running pass.
- Shooting: one hand; two hands; forward step shot; backward step shot.

- Techniques of getting free: dodge and sprint; sudden sprint; sprint and stop; sprinting with change of speed.
- Defending: marking the player; marking the ball; blocking; inside the circle; outside the circle (that is, defending the circle edge against the pass in).
- Intercepting: pass; shot.
- The toss-up.
- Role of individual players
- Rules and their interpretations and duties of officials.

PC 303

Volleyball: Fundamental Skills

- Players Stance-Receiving the ball and passing to the team mates,
- The Volley (Over head pass),
- The Dig(Under hand pass).
- Service-Under Arm Service, Side Arm Service, Tennis Service, Round Arm Service.
- Rules and their interpretations and duties of officials.

PC - 303

Hand Ball:

- Fundamental Skills-Catching, Throwing, Ball Control, Goal Throws-Jump Shot, Centre Shot, Dive Shot, Reverse Shot, Dribbling-High and Low, Attack and Counter Attack, Simple Counter Attack, Counter Attack from two wings and centre, Blocking, Goal keeping, Defense.
- Rules and their interpretations and duties of officials.

PC – 303

Basket ball: Fundamental Skills

- Player stance and ball handling
- Passing-Two Hand chest pass, Two hand Bounce Pass, One Hand Base ball pass, Side Arm Pass, Over Head pass, Hook Pass.
- Receiving-Two Hand receiving, One hand receiving, Receiving in stationary position, Receiving while jumping, Receiving while running.
- Dribbling-How to start dribble, How to drop dribble, High dribble, Low dribble, Reverse dribble, Rolling dribble.
- Shooting-Layup shot and its variations, one hand set shot, One hand jump shot, Hook shot, Free throw.
- Rebounding-Defensive rebound, Offensive rebound, Knock out, Rebound Organization.
- Individual Defensive-Guarding the man with the ball and without the ball.
- Pivoting.
- Rules and their interpretations and duties of the officials.

STUDENT LEARNING OUTCOMES :

6. Learn and master fundamental skills,technique of the Game/SportTeaching
7. Learn the layout and marking, rules of the Game/Sport
8. Be able to develop drills & lead up activities of Game/Sport.
9. To learn officiating of Game/Sport
10. Develop teaching ability of Game/Sport

TP – 201 Teaching practices:

10 teaching practice lessons out of which 5 lessons in class-room situation and 5 lessons for out-door activities within premises on the students of B.P.Ed course.

TP – 301 Teaching practices:

10 teaching lesson plans for Racket Sport/ Team Games/ Indigeneous Sports out of which 5 lessons internal and 5 lessons external at school.

TP – 401 **Sports Specialization: Track and field / Gymnastics / Swimming**

(4 internal lesson at prcticing school and 1 final external lesson on the students of practicing school as a sports specialization of any discipline mentioned above.)

TP- 402 **Games Specialization: Kabaddi, Kho-kho, Base ball, cricket, Football, Hockey, Softball Volleyball, Handball, Basketball, Netball, Badminton, Table Tennis, Squash, Tennis**

STUDENT LEARNING OUTCOMES :

1. To develop teaching ability master Advance skills, technique of the Game/Sport Teaching
2. Learn the layout and marking, rules of the Game/Sport
3. Be able to develop drills & lead up activities of Game/Sport
4. To learn officiating of Game/Sport.
5. Develop teaching ability of Game/Sport

(4 internal lesson at prcticing school and 1 final external lesson on the students of practicing school as a games specialization of any discipline mentioned above.)

Note: Where ever details of any activities are not mentioned, it is expected to elaborate skills by the competent bodies of local Universities.

Table – 1: Semester wise distribution of hours per week

Semester	***Theory***	***Practicum***	***Teaching practice***	***Total***
I	*16*	*24*	*00*	*40*
II	*16*	*18*	*6*	*40*
III	*16*	*18*	*6*	*40*
IV	*16*	*12*	*12*	*40*
Total	*64*	*72*	*24*	*160*
Minimum of 36 teaching hours per week is required in five or six days in a week				

Table – 2: Number of credits per semester

Semester	***Theory***	***Practicum***	***Teaching practice***	***Total***
I	*16*	*16*	*00*	*32*
II	*16*	*12*	*04*	*32*
III	*16*	*12*	*04*	*32*
IV	*16*	*08*	*08*	*32*
Total	*64*	*48*	*16*	*128*
Minimum of 36 teaching hours per week is required in five or six days in a week				

Learning Outcomes based Curriculum Framework (LOCF)

for

Physical Education

Undergraduate Programme

2021

ज्ञान-विज्ञान विमुक्तये

UNIVERSITY GRANTS COMMISSION

BAHADUR SHAH ZAFAR MARG

NEW DELHI – 110 002

Foreword

UGC has been taking several initiatives for quality improvement in higher education system in the country. Curriculum revision is one of the focus areas of these initiatives. Curriculum development is defined as planned, a purposeful, progressive, and systematic process to create positive improvements in the higher educational system. The ever evolving and fast changing educational technology have posed various challenges as far as curriculum in the Higher Educational Institutions (HEIs) is concerned. The curriculum requires to be updated more often keeping in view the latest developments in the society and to address the society's needs from time to time.

The Quality Mandate notified by UGC was discussed in the Conference of Vice-Chancellors and Directors of HEIs during 26-28th July, 2018; wherein it was inter-alia resolved to revise the curriculum based on Learning Outcome Curriculum Framework (LOCF).

Learning Outcome Curriculum Framework (LOCF) aims to equip students with knowledge, skills, values, attitudes, leadership readiness/qualities and lifelong learning. The fundamental premise of LOCF is to specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study. Besides this, students will attain various 21st century skills like critical thinking, problem solving, analytic reasoning, cognitive skills, self directed learning etc.. A note on LOCF for undergraduate education is available on the UGC website www.ugc.ac.in. It can serve as guiding documents for all Universities undertaking the task of curriculum revision and adoption of outcome based approach.

To facilitate the process of curriculum based on LOCF approach, UGC had constituted subject specific Expert Committees to develop model curriculum. I feel happy to present the model curriculum to all the HEIs. Universities may revise the curriculum as per their requirement based on this suggestive model within the overall frame work of Choice Based Credit System (CBCS) and LOCF.

I express my gratitude and appreciation for the efforts put in by the Chairperson/Member/Co-opted members/experts of the committees for developing model curriculum. I also take the opportunity to thank Prof. Bhushan Patwardhan, Vice-Chairman, UGC for providing guidance to carry forward this task. My sincere acknowledgement to Prof. Rajnish Jain, Secretary, UGC for all the Administrative support. I also acknowledge the work done by Dr. (Mrs.) Renu Batra, Additional Secretary, UGC for coordinating this important exercise.

All the esteemed Vice-Chancellors are requested to take necessary steps in consultation with the Statutory Authorities of the Universities to revise and implement the curriculum based on the learning outcome based approach to further improve the quality of higher education.

DPSingh

(Prof. D. P. Singh)
Chairman
University Grants Commission

New Delhi
30th July, 2019

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Preamble

Physical Education is a form of one of the most effective means of education imparted through physical exercises, recreational activities and sports. It is an integral part of education. Which by mere participation in it gives the outcomes. These outcomes are both instant as well as have strong carry over values in the life. The children as well as the adults and the old enjoy physical activities & sports and gets benefit in the form of stronger muscles and bones, increased energy, coordination level and most importantly the decreased risk of developing chronic diseases.

The UNESCO in its General Conference in 1978 was convinced that, everyone should be free to develop and preserve his or her physical, intellectual and moral powers. Physical Education and Sport should consequently be assured and guaranteed for all human beings. Physical Education is now a regular feature in the primary and secondary schools as well as it is gaining popularity in the higher education. The course opted for this is elective as well as the core at the college and the university level in India.

The graduate level course in Physical Education and Sports contains subjects varying from foundation of Physical Education to Anatomy, Physiology, Kinesiology, Officiating & coaching, Test & Measurement, Nutrition, Rehabilitation, Psychology, Sports Training, Sports Biomechanics, Methods of Teachings etc. which are aimed to give thorough knowledge and skills to the students. Students perusing physical education courses are fit to join the jobs as physical trainers, coaches, game officials, referees, umpires, curators, gym trainers, life guards, personal trainers etc. During their course of education the students also develops the expertise to establish their own business as entrepreneurs in the field of sports, fitness, recreation, adventure sports, camping, event management etc.

Learning Outcomes-Based Curriculum Framework for B.P.E.S, B.A./B.Sc. Honors in Physical, Health and Sports Education.

1.1 Introduction

The learning outcomes-based curriculum framework for a B.P.E.S., B.A./B.Sc degree in Physical Education is intended to provide a broad framework within which Physical Education programme responds to the needs of students and requirements The framework is expected to assist in the maintenance of standard and uniformity of Physical Education degrees across the country. This will also help in periodic programme review within a broad framework of agreed expected graduate attributes, qualification descriptors, programme learning outcomes and course-level learning outcomes. The framework, does seek to bring about uniformity in syllabi for a programme of study in Physical Education, teaching-learning process as well as learning assessment procedures. However, the framework is also intended to allow flexibility and innovation in programme design.

1.2 Nature and extent of the B.P.E.S., B.A./B.Sc. degree programme

Physical Education is normally referred to as the science that aims to develop all-inclusive aspects of human personality through physical and sports activities. Physical education is a multidisciplinary subject that cannot be studied in seclusion under the scope of one or two subjects. The scope of Physical Education as a subject is very broad. It caters to the need for developing capability of the students on physical, mental and social aspects. Physical education also aims to develop activity as an alternate and prophylactic medicine. The key areas of study within the Physical Education are *'Exercise Physiology, Sports Psychology, Sports Sociology, Sports Management, Sports Journalism, Kinesiology- Biomechanics, Sports Training, Sports Medicine, Kinanthropometry* etc.

Degree program in Physical Education covers topics that overlap with the areas outlined above and that address the interfaces of Physical Education with other subjects such as Physiology, Bio-Chemistry, Physics, Physiotherapy, Psychology, Management, Sociology along with training pedagogy employed for enhancing the functional status of individuals with varied needs. As a part of the effort, to enhance the employability of graduates of Physical Education, programs include learning experiences that offer opportunities in various spheres of human existence.

1.3 Aims of the Bachelor's degree programme in Physical Education

Physical education is not only concerned with the physical outcome that accrue from participation in physical activities but also the development of knowledge and attitude conducive to lifelong learning and participation in motor activities. The overall aim of bachelor's degree programme in Physical Education is;

1. The acquisition and refinement of motor skills,
2. To equip the students with the scientific knowledge of body response to various types of exercise.
3. Maintenance of fitness for optimal health and well being,
4. Attainment of knowledge and the growth of positive attitude towards physical activity and sports.

1.4 Characteristic attributes of a graduate in Physical Education

Some of the characteristic attributes of a graduate in Physical Education may include the following;

1. ***Disciplinary Knowledge and Skills:*** The organization of physical and sports activities will develop sense of discipline in the students.
2. ***Skilled Communicator:*** Neuromuscular learning and activation requires good communicable skills on the part of the leader organizing them, which shall be developed in the students in course of their graduation program. Ability will be developed to express thoughts and ideas effectively, demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. Skills will be developed in verbal and non-verbal communication, preparation and presentation of documents/reports/PPTs. Skills of interpersonal communication and ability to work with diverse population groups, able to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources and develop digital literacy as applicable to the professional needs will also be developed.
3. ***Critical Thinker and Problem Solver:*** Ability to employ critical thinking and efficient problem solving skills through development of new strategies are expected attributing factors.

4. ***Sense of Inquiry:*** Capability for asking relevant/appropriate questions relating to the issues and problems in the field of physical education, fitness and rehabilitation.

5. ***Leadership:*** The orientation in organization of health and sports promoting physical activities develops appropriate leadership capabilities in the students.

6. ***Skilled Manager:*** Capable of identifying or mobilizing appropriate resources required for organizing fruitful training and coaching programme for athletes of various sports.

7. ***Digitally Literate:*** Capable of using computer for keeping the health related data base of the trainees. Formulating appropriate training programme for individuals as per their need. Capable of employing modern library search tools to locate, retrieve, and evaluate Physical Education& Sports related information.

8. ***Ethical Awareness and Reasoning:*** Avoiding unethical behavior and promoting fair play. Discouraging the use of drugs for performance enhancement. Promoting sports for the development of all round personality of the participants.

9. ***Lifelong Learners:*** Capable of self-paced and self-directed learning aimed at personal development.

10. ***Pursuit of Excellence:*** To have a positive attitude towards developing one's own potentials (both biological & cultural) and talents.

11. ***Respect for Diversity:*** An empathy with other's views and needs as well as respect for their elder's opinion, race or religion and also able to value different cultures and traditions.

12. ***Sense of Justice and Equity:*** To able to recognize social justice and act justly; to have a sense of fairness in life especially in sporting situation.

13. ***Cooperation and Team Work:*** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group and or a team in the interests of a common cause and work efficiently as a player.

1.6 Qualification descriptors for B.P.E.S., B.A./B.Sc. (Hon's) programme in Physical Education

The qualification descriptors for a B.P.E.S., B.A./B.Sc. (Hon's) programme in Physical Education may include the following:

1. Demonstrate (i) a systematic, extensive and coherent knowledge and understanding of the academic field of study as a whole and its applications, and links to related disciplinary areas/subjects of study; including a critical understanding of the established theories, principles and concepts, and of a number of advanced and emerging issues in the field of Physical Education; (ii) procedural knowledge that creates professionals related to the subject area of Physical Education (iii) skills in one's specialization area and current developments in the academic field of Physical Education, including a critical understanding of the latest developments and an ability to use established techniques of analysis/enquiry within the area of specialization.
2. Demonstrate comprehensive knowledge about materials and skills required for identifying Physical Education related problems and issues, including current research in Physical Education.
3. Demonstrate skills in identifying information, collection of relevant quantitative and qualitative data drawn on a wide range of sources, analysis and interpretation of data using methodologies as appropriate to the subject of Physical Education for formulating evidence-based solutions and arguments;
4. Use knowledge, understanding and skills for critical assessment of a wide range of ideas and complex problems and issues related to the academic field of Physical Education.
5. Communicate the results of the studies undertaken in the academic field of Physical Education accurately in a range of different contexts using the main concepts, constructs and techniques of the subject.
6. Address one's own learning needs relating to current and emerging areas of study relating to Physical Education. Making use of research, and professional materials as appropriate, including those related to new frontiers of knowledge in Physical Education.
7. Apply one's knowledge and understanding related to Physical Education and transferable skills to new contexts as well as to identify and analyze problems, issues and seek solutions to real-life problems.
8. Demonstrate subject-related and transferable skills that are relevant to Physical Education related jobs and employment opportunities.

1.7 Program learning outcomes of B.P.E.S., B.A./B.Sc. degree programme in Physical Education are listed below

This would lead the students to understand historical concept of physical education and relationship between Philosophy, Education and Physical Education. The student would further understand the theoretical implications of philosophies of physical education with modern development and social aspects of Physical Education.

1. The curriculum would enable the pass out to select the inherited talented children for various sports activities.
2. The pass out shall be able to orient children in schools with the fundamental skills of selected sports as per their inherited potential.
3. The pass out shall be able to devise training program for athletes engaged in different sports activities
4. The curriculum shall enable them to officiate, supervise various sports tournaments and orient them in organizing sports events at all levels.
5. The curriculum would enable the pass out students to be entrepreneur (to start their own fitness center, gym, spa etc) and device appropriate fitness program for different genders and age groups of people.
6. The curriculum would enable the pass out to devise training program for physically challenged peoples.

1.8 Teaching-learning processes

The program of study in Physical Education is designed to encourage the acquisition of subject knowledge, orientation in fundamentals skills of different sports and professional skills required for Physical Education-based professions and jobs. Learning experiences are designed and implemented to foster active/participative learning. Development of practical skills will constitute an important aspect of the teaching-learning process. A variety of approaches to teaching-learning process, including lectures, seminars, tutorials, workshops, peer teaching and learning, practicum and project-based learning, field-based learning, substantial laboratory-based practical component and experiments, open-ended project work, games, technology-enabled learning, internship in industry and research establishments etc. will be adopted to achieve this. Problem-solving skills and higher-order skills of reasoning and analysis will be encouraged through teaching strategies.

1.9 Assessment methods

The assessment of students' achievement in Physical Education will be aligned with the learning outcomes of course /program and the academic/professional skills that the programme is designed to develop. A variety of assessment methods that are appropriate within the subject area of Physical Education will be used. Learning outcomes will be assessed using the written and practical exams, project work, assignments, and presentations. Each theory subject (Core) will be of **four credits** and practical (1 game + 1 athletic/sports event of 2 credits each) would equal to **four credits,** thus total credits for each semester shall be **thirty**. This however may be adjusted according to the examination pattern of the concerned universities. **Thirty percent** of the evaluation for each theory and practical paper will be undertaken by the internal examiner through **sessional tests** and **seventy percent** of the the evaluation will be done through **end semester examination**.

Online Coaching Design and Delivery: Following four step will be taken care of while designing online coaching methods.

1. Modeling online instructional practices.
2. Instructor and student interactions
3. Transitioning pedagogical and content knowledge online.
4. Navigating instructional tools and technology.

Virtual instructional platforms such as online lectures, webcast etc. will be used. Students can participate in course work through instant messages, emails and video conferencing. Courses may also integrate DVD videos as part of the training process. Students may examine current topics in the field through the use of textbooks and physical education journals. Students can complete some portion of the education at approved testing sites for the practical components wherever necessary.

Emphasis will be laid on teaching learning process using online modes such as google class room, Cisco WebeX Meeting, OERS, Swayam Platform (www.swayam.gov.in), Swayam Prabha (www.swayamprabha.gov.in) (available on Doordarshan (free dish TV), E-Yantra (www.e-yantra.org), Virtual Labs (www.vlabs.co.in), FOSSEE (www.fossee.in), application of spoken tutorials (www.spoken-tutorial.org), National Digital Library (www.ndl.iitkgp.ac.in), electronic journals (www.ess.infibnet.ac.in) etc.

Brain Based and Machine Learning: Brain-Based Learning is simply the engagement of strategy based on body/mind/brain research and the "engagement of strategies based on principles derived from an understanding of the brain." There are many strategies , some of them include experiential learning, multiple intelligences and practical simulations.

This course engages brain based learning by using an intense strategy of:

- Mastery Learning
- Learning Styles
- Multiple Intelligences
- Cooperative Learning
- Practical Simulations
- Experiential Learning
- Problem-Based Learning
- Movement Education.

The educators will use some of the techniques suggested for increasing brain based learning in their classes :

- Creating a stress free environment as stress is the biggest inhibitors of brain development
- Reorienting students understanding of the brain like an organ that can be developed just like a muscle developed and shaped through weight training exercises.
- Giving constructive feed back as learning from mistakes is an important aspect of cognitive development.
- New ideas and innovations will be encouraged .
- Breaks in learning with recreational and other constructive activities of interest will be initiated for boosting creativity , cognitive functions and social skills

At the same time subjects like Exercise Physiology, Sport Psychology, Test measurement, Computer Applications etc. require use of machines to do various tests and body analysis which already is introduced in the given subjects. Besides that, assignments, PPTs, project work etc. requires a lot of critical thinking which of course fulfils the aim of brain based learning process.

Simulation Laboratory (for practical sports and games): Simulation based learning integrates cognitive, technical and behavioral skills into an environment where learner believes the setting is real, act as they would responding in the field, and feel safe to make mistake for the purpose of learning from them. Sports simulation laboratory is to be established to provide the students with a feasible environment where they will learn and practice sports skills using animated videos with continuous rectification of errors till exact simulation of skill is attained. Help may be taken from Youtube Streaming, Swayam Platform (www.swayam.gov.in), Swayam Prabha (www.swayamprabha.gov.in) (available on Doordarshan (free dish TV), E-Yantra (www.e-yantra.org).

1.11 The proposed semester wise distribution of courses/papers (**Theory**)is given in the following Table:

Semester	Foundational	Skill based	Discipline Specific Elective	Generic Elective	Total
I	3			1	**4**
II	2			2	**4**
III	4				**4**
IV	2	1	1		**4**
V	3		1		**4**
VI	1	1	2		**4**
Total					**24**

1.12 The proposed semester wise distribution of courses/papers (**Practical**)is given in the following Table:

Semester	Main Paper	Total
I	2	**2**
II	2	**2**
II	2	**2**
IV	2	**2**
V	2	**2**
VI	2	**2**
Total		**12**

1.13 Course wise subject breakage

<table>
<tr><th colspan="2">Courses</th><th>Subjects</th></tr>
<tr><td rowspan="2">Core</td><td>Theory</td><td>— History and Foundation of Physical Education
— Basic and Systemic Anatomy & Physiology
— Exercises Physiology
— Kinesiology & Sports Biomechanics
— Sports Psychology
— Sports Training
— Health Education
— Sports Management
— Athletic Care and Rehabilitation
— Fitness Training and Nutrition
— Officiating and Coaching-I
— Officiating and Coaching-II
— Officiating and Coaching-III
— Officiating and Coaching-IV</td></tr>
<tr><td>Practical</td><td>— Major Ball Game (which should be from the list of SGFI/AIU/IOA)
— Track & Field:Running and Jumping Event
— Major Ball Game which should be from the list of SGFI/AIU/IOA
— Track & Field: Running and Throwing Event
— Racket Game which should be from the list of SGFI/AIU/IOA
— Indigenous Activities (OR) yoga
— Combative Game which should be from the list of SGFI/AIU/IOA
— Gymnastics (OR) Swimming
— Game of Specialization which should be from the list of SGFI/AIU/IOA
— Aerobics and Dance (OR)Weight lifting
— Game of Specialization
— Power Lifting (OR) Physique Training</td></tr>
<tr><td colspan="2">Discipline Specific Elective</td><td>Sports Journalism
Talent Identification
Sports Entrepreneurship
Adapted Physical Education</td></tr>
<tr><td colspan="2">Generic Elective</td><td>Computer Applications
Environmental Science (EVS)
English
Counseling in Sports</td></tr>
<tr><td colspan="2">Skill Enhancement</td><td>Test & Measurement
Exercise Prescription / Therapeutic Exercise</td></tr>
<tr><td colspan="2">Ability Enhancement Compulsory</td><td>State Level Study Tour
National Level Study Tour</td></tr>
</table>

1.14 Course wise classes and credits are given in Table 2:

Courses	**Number**	**Classes**	**Credits** 1 credit = 1 Theory (Th) period of 1 hour 1 credit = 1 Tutorial (Tut) period of 1 hr. 1 credit = 2 practicum (P) periods of 1 hour each	**Total Credits**
Core	**14** **12**	Theory 4 Practical 2	4 2	4*14 = 56 12*2 = 24 56+24 = 80
Discipline Specific Elective	**4**	4Th+ 2p	4+2 = 6	4*6 = 24
Generic Elective	**4**	5Th + 1 Tut	5+1 = 6	4*6 = 24
Skill Enhancement	**2**	4Th+ 2p	4+2= 6	2*6 = 12
Ability Enhancement Compulsory Courses	**2**	Project Report Viva voce	2 2	2*2 = 4 2*2 = 4
Total Credits				**148**
In addition to the above courses, two **Ability Enhancement Compulsory Courses** (such as State Level Study Tour & National Level Study Tour) with 4 credits each may also be conducted. So the total credit for AECC will be 08.				

Course-level learning outcomes

The undergraduate degree program of Physical education will be of three years with six semesters. The **Course-level learning outcomes** for each course within **B.P.E.S., B.A./B.Sc (Honors) degree** programme in Physical Education are given below with content matter (detail syllabus of four units) to be taught in each unit and semester for three years:

(Learning Outcomes of each subject are written on top of each syllabus)

Index for program learning outcome tables:

Table 1 (a)

Programme outcomes	FOUNDATIONAL COURSES													
	His. & Foundation of Phy. Edu.	Basic & Systemic Anty& Physiology	Exercises Physiology	Kinesiology & Sports Biomechanics	Sports Psychology	Sports Training	Health Education	Sports Management	Athletic Care and Rehabilitation	Fitness Training and Nutrition	Officiating and Coaching-I	Officiating and Coaching-II	Officiating and Coaching-III	Officiating and Coaching-IV
Academic Competence (1.1 to 1.8)														
1.1 DisciplinaryKnowledge	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1.2 Professional Skills		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
1.3 Application of Skills to chosen specialization	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1.4 Experiential Learning &Critical Thinking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1.5 Application to Physical Education related Problems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1.6 Knowledge of e-resources & social media								✓						
1.7 Skills in scientific writing & Effective presentation skills		✓	✓	✓										
1.8 Critical evaluation of theoretical approaches	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				

Programme outcomes	TABLE 1 (b) FOUNDATIONAL COURSES													
	His. & Foundation of Phy. Edu.	Basic & Systemic Anty& Physiology	Exercises Physiology	Kinesiology & Sports Biomechanics	Sports Psychology	Sports Training	Health Education	Sports Management	Athletic Care and Rehabilitation	Fitness Training and Nutrition	Officiating and Coaching-I	Officiating and Coaching-II	Officiating and Coaching-III	Officiating and Coaching-IV
2. Personal & Behavioural Competence (2.1 to 2. 6)														
2.1 Self development& self regulation skills					✓	✓			✓	✓	✓	✓	✓	✓
2.2 Social skills (empathy) & accountability							✓		✓					
2.3 Cultural and historical sensibility	✓													
2.4 Conversational Competence & Communication skills								✓						
2.5 Appreciating Diverse perspectives	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
2.6 Ability to work in groups & teams (negotiation)						✓				✓	✓	✓	✓	✓

Programme outcomes	**TABLE 1 (c)FOUNDATIONAL COURSES**													
	His. & Foundation of Phy. Edu.	Basic & Systemic Anty& Physiology	Exercises Physiology	Kinesiology & Sports Biomechanics	Sports Psychology	Sports Training	Health Education	Sports Management	Athletic Care and Rehabilitation	Fitness Training and Nutrition	Officiating and Coaching-I	Officiating and Coaching-II	Officiating and Coaching-III	Officiating and Coaching-IV
3. Social Competence (3.1 to 3.6)														
3.1 collaboration, Cooperation & Community feel							✓				✓	✓	✓	✓
3.2 Understanding social dynamics & social problems	✓						✓							
3.3 Gender Sensitivity & awareness of gender fluidity issues		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
3.4 Ethical, Social & Ecological responsibility						✓	✓	✓	✓	✓				
3.5 Moral & Ethical Awareness & reasoning						✓	✓		✓	✓				
3.6 Multilevel						✓	✓		✓	✓				

Commitment to health & wellbeing														

TABLE 2 (a)										
Programme outcomes	**SKILL BASED COURSES**									
	Test & Measurement	Exercise Prescription / Therapeutic Exercise								
Academic Competence (1.1 to 1.8)										
1.1 Disciplinary Knowledge	✓	✓								
1.2 Professional Skills	✓	✓								
1.3 Application of Skills to chosen specialization	✓	✓								
1.4 Experiential Learning &Critical Thinking	✓	✓								
1.5 Application to physical education related Problems	✓	✓								
1.6 Knowledge of e-resources & social media	✓									
1.7 Skills in scientific writing & Effective presentation skills	✓	✓								
1.8 Critical evaluation of	✓	✓								

theoretical approaches										
TABLE 2 (b)										
Programme outcomes	**SKILL BASED COURSES**									
	Test & Measurement	Exercise Prescription / Therapeutic Exercise								
2. Personal & Behavioural Competence (2.1 to 2. 6)										
2.1 Self development&self regulation skills	✓	✓								
2.2 Social skills (empathy) & accountability	✓	✓								
2.3 Cultural and historical sensibility										
2.4 Conversational Competence & Communication skills		✓								
2.5 Appreciating Diverse perspectives	✓	✓								
2.6 Ability to work in groups & teams (negotiation)	✓	✓								

TABLE 2 (c)										
Programme outcomes	**Skill Based Courses**									
	Test & Measurement	Exercise Prescription / Therapeutic Exercise								
3. Social Competence (3.1 to 3.6)										
3.1 collaboration, Cooperation & Community feel	✓	✓								
3.2 Understanding social dynamics & social problems	✓	✓								
3.3 Gender Sensitivity & awareness of gender fluidity issues	✓	✓								
3.4 Ethical, Social & Ecological responsibility										
3.5 Moral & Ethical Awareness & reasoning	✓	✓								
3.6 Multilevel Commitment to health & wellbeing	✓	✓								

Table 3 (a)										
Programme outcomes	**ELECTIVE COURSES**									
	Sports Journalism	Talent Identification	Sports Entrepreneur ship	Adapted Physical Education						
Academic Competence (1.1 to 1.8)										
1.1 Disciplinary Knowledge	✓	✓	✓	✓						
1.2 Professional Skills	✓	✓	✓	✓						
1.3 Application of Skills to chosen specialization	✓	✓	✓	✓						
1.4 Experiential Learning &Critical Thinking	✓	✓	✓	✓						
1.5 Application to physical education related Problems	✓	✓	✓	✓						
1.6 Knowledge of e-resources & social media	✓		✓							
1.7 Skills in scientific writing & Effective presentation skills	✓		✓	✓						
1.8 Critical evaluation of theoretical approaches	✓	✓	✓	✓						

Table 3 (b)										
Programme outcomes	**ELECTIVE COURSES**									
	Sports Journalism	Talent Identification	Sports Entrepreneur ship	Adapted Physical Education						
2. Personal & Behavioural Competence (2.1 to 2. 6)										
2.1 Self development&self regulation skills	✓	✓	✓							
2.2 Social skills (empathy) & accountability	✓	✓	✓	✓						
2.3 Cultural and historical sensibility										
2.4 Conversational Competence & Communication skills	✓		✓	✓						
2.5 Appreciating Diverse perspectives	✓	✓	✓	✓						
2.6 Ability to work in groups & teams (negotiation)	✓	✓	✓	✓						

Table 3 (c)

Programme outcomes	**DISCIPLINE SPECIFIC ELECTIVE COURSES**									
	Sports Journalism	Talent Identification	Sports Entrepreneurship	Adapted Physical Education						
3. Social Competence (3.1 to 3.6)										
3.1 collaboration, Cooperation & Community feel	✓	✓	✓	✓						
3.2 Understanding social dynamics & social problems	✓	✓	✓	✓						
3.3 Gender Sensitivity & awareness of gender fluidity issues		✓		✓						
3.4 Ethical, Social & Ecological responsibility		✓								
3.5 Moral & Ethical Awareness & reasoning		✓		✓						
3.6 Multilevel Commitment to health & wellbeing	✓	✓	✓	✓						

Table 4 (a)										
Programme outcomes	**GENERIC ELECTIVE COURSE (GE)**									
	Computer Applications	Environmental Science (EVS)	English	Counseling in Sports						
Academic Competence (1.1 to 1.8)										
1.1 DisciplinaryKnowledge	✓	✓	✓	✓						
1.2 Professional Skills	✓			✓						
1.3 Application of Skills to chosen specialization	✓		✓	✓						
1.4 Experiential Learning &Critical Thinking	✓			✓						
1.5 Application to Physical education related Problems	✓			✓						
1.6 Knowledge of e-resources & social media	✓		✓							
1.7 Skills in scientific writing & Effective presentation skills	✓		✓							
1.8 Critical evaluation of theoretical approaches		✓		✓						

Table 4 (b)

Programme outcomes	**GENERIC ELECTIVE COURSE (GE)**									
	Computer Applications	Environmental Science (EVS)	English	Counseling in Sports						
2. Personal & Behavioural Competence (2.1 to 2. 6)										
2.1 Self development&self regulation skills	✓		✓	✓						
2.2 Social skills (empathy) &acountability				✓						
2.3 Cultural and historical sensibility										
2.4 Conversational Competence & Communication skills	✓		✓	✓						
2.5 Appreciating Diverse perspectives	✓	✓	✓	✓						
2.6 Ability to work in groups & teams (negotiation)				✓						

Table 4 (c)

Programme outcomes	**GENERIC ELECTIVE COURSE (GE)**									
	Computer Applications	Environmental Science (EVS)	English	Counseling in Sports						
3. Social Competence (3.1 to 3.6)										
3.1 collaboration, Cooperation & Community feel		✓		✓						
3.2 Understanding social dynamics & social problems		✓	✓	✓						
3.3 Gender Sensitivity & awareness of gender fluidity issues				✓						
3.4 Ethical, Social & Ecological responsibility		✓		✓						
3.5 Moral & Ethical Awareness & reasoning		✓		✓						
3.6 Multilevel Commitment to health & wellbeing		✓		✓						

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTHAND SPORTS EDUCATION

Semester-I

Paper-I

Title: History and Foundation of Physical Education

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. The pass out would be able to compare the relationship between general education and physical education.
2. He would be able to identify and relate with the History of Physical Education.
3. He would be able to comprehend the relationship between Philosophy, Education and Physical Education.
4. He would able to identify the works of Philosophers of Education and Physical Education.
5. He would know recent developments and academic foundation of Physical Education.

Unit-I

Introduction to Physical Education

1.1 Meaning, Definition and Scope of Physical Education

1.2 Aims and Objective of Physical Education

1.3 Importance of Physical Education in present era.

1.4 Misconceptions about Physical Education.

1.5 Relationship of Physical Education with General Education.

1.6 Physical Education as an Art and Science.

Unit-II

Historical Development of Physical Education in India

2.1 Vedic Period (2500 BC – 600 BC), Early Hindu Period (600 BC – 320 AD) and Later Hindu Period (320 AD – 1000 AD), Medieval period

2.2 Post Mughal British Period (Before 1947) Y.M.C.A. and its contributions.

2.3 Physical Education in India (After 1947)

2.4 The early history and significant stages in the revival and development of the modern Olympic movement

2.5 Educational and cultural values of Olympic movement

Unit-III

Philosophical Foundation of Physical Education

3.1 Philosophical foundation: Idealism, Pragmatism, Naturalism, Realism.

3.2 Philosophy and Culture.

3.3 Fitness and wellness movement in the contemporary perspectives

3.4 Sports for all and its role in the maintenance and promotion of fitness.

Unit-IV

Foundation of Physical Education

4.1 Biological

4.1.1 Growth and development

4.1.2 Age and gender characteristics

4.1.3 Body Types

4.2 Psychological

4.2.1 Attitude, interest.

4.2.2 Cognition, emotions and sentiments.

4.2.3 Practical suggestion from psychology.

4.3 Sociological

4.3.1 Society and culture

4.3.2 Social acceptance and recognition

4.3.3 Leadership in physical education

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Teaching Learning Strategies: The class will be taught by using lectures and demonstration, seminars, classroom discussion, videos, charts and presentations method.

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

References:

1. Bucher, C. A. (n.d.) - Foundation of physical education. St. Louis: The C.V. Mosby Co.
2. Deshpande, S. H. (2014) - Physical Education in Ancient India. Amravati: Degree college of Physical education.
3. Dash, B.N. (2003.) –Principles of Education, Neelkamal publication, Hyderabad,

4. Kamlesh, M.L. (2002) –Sociological Foundation of Physical Education, Metropolitan Book co. Pvt. Ltd., Delhi,
5. Pandey, R.S.(1991) Philosophical & Sociological Foundation of Education, Vinod PustakMandir, Agra,.
6. Bhatia, K.K. &Narang, C.L. (1984.)– Philosophical & Sociological Bases of Education, Prakash Bros., Ludhiana,
7. Adams, William.C (1991.) – Foundation of Physical Education Exercises and Sports Sciences, Lea and Febigor, Philadelphia,
8. Dr. Kamlesh M.L. (2004) - Principles and History of Physical Education and Sports, Friends Publication (India) New Delhi.
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BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-I

Paper-II

Title: Basic and Systemic Anatomy& Physiology

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning Outcomes:

1. The student will be oriented with the basic structure and function of human body by identifying, comparing and relating different systems, organs and their functional and structural units.
2. He would be able to Relate and interpret the role of exercise on body systems and its relation to well being, through literature reviews and physical conditioning exercises.
3. Adapt the art to apply the knowledge of anatomy and physiology in physical activity classes at school level.
4. Construct anatomy and physiology related pedagogical materials exploring their creative imaginations while working in group and using technology.

Unit-I

1. Validation of Anatomy and Physiology in the field of Physical Education
2. Structural and functional demonstration of human cell
3. Skeletal System- classification and functions
4. Anatomical terms related to body movements
5. Structure and types of bones, joints in human body, Effects of exercise on skeletal system

Unit-II

2.1 Structure and function of Muscle

2.2 Major classifications of Muscles

2.3 Types of muscle fiber and Sliding Filament Theory of Muscular Contraction

2.4 Types of muscular contractions (Isotonic, Isometric, Isokinetic) and their roles in physical activity.

2.5 Concept of agonist and antagonist muscles and muscle imbalance; Effect of exercise on muscular system

Unit-III

3.1 Structural and functional introduction to circulatory system

3.2 Concept of stroke volume, cardiac output and cardiac index

3.3 Respiratory System (structural and organizational overview); Functional mechanism of respiration (External and Internal Respiration)

3.4 Concept of recovery oxygen and second wind

3.5 Cardio-respiratory adaptations to long term exercise

Unit-IV

4.1 Structural units and functional mechanism of digestive system and excretory system

4.2 Effect of exercise on Digestive System and Excretory System

4.3 Classification of Nervous System on the basis of its structure and functions

4.4 Structural and Functional interpretation of neuro-muscular junction with all or none law

4.5 Effect of exercise on nervous system

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

Suggested Readings:

1. Appuseries (2012) *How the Human Body Works - Kids Animation Learn Series.* [Online] Available from: https://www.youtube.com/results?search_query=APPUSERIES+human+body+ [Accessed 20th July 2016].

2. Bannister, L. H. & et.al.(2000) *Gray'sAnatomy*.Churchill Living Stone.

3. Boone, T. (2014) *Exercise physiology*.Jones& Bartlett Learning.

4. Davidson, D.S. & Morgan, B. (2002) *Human body revealed.* Great Britian, Dorling Kindersley.

5. E Learning for kids- Founding Dreams (Date not Available) *Science- Body Parts*. [Online] Available from: http://www.e-learningforkids.org/science/lesson/body-parts/[Accessed 20th July 2016].

6. Foss, M. L., Keteyian, S. J. & Fox, E. L., (1998).*Fox's physiological basis for exercise and sport*. Boston, Mass, WCB/McGraw-Hill.

7. Get Body Smart (2016) *An online examination of human anatomy and physiology-Animated Text Narrations and Quizzes to Explain the Structures and Functions of the Human Body Systems.* [Online] Available from: http://www.getbodysmart.com/ [Accessed 20th July 2016].

8. Hall, J. E. & Guyton, A. C. (2011).*Guyton and Hall textbook of medical physiology*. Philadelphia, PA, Saunders Elsevier.

9. Jam Campus (2018) *THE PARTS OF A CELL SONG*. [online video] Available at: https://www.youtube.com/watch?v=NkC9AiJf7gI [Accessed 03 July 2018].

10. JCCCvideo (2010) *The Plasma Membrane.* [online video] Available at: https://www.youtube.com/watch?v=moPJkCbKjBs [Accessed 03 July 2018].

11. Manocchia. P. (2007) *Anatomy of Exercise-A trainer's inside guide to your workout*. New York, A & C Black.

12. Mc Ardle, W.D.; Katch, F.I. &Katch, V.L. (2010) *Exercise physiology- Nutrition, Energy, and human performance*.7th edition. Philadelphia, Wolters Klnwerand Lippincott Williams & Wilkins.

13. Musical Cells (2013) Power Pack - *The Mitochondria Rock Song.* [online video] Available at: https://www.youtube.com/watch?v=418Ul5YPVAI&index=1&list=RD418Ul5YPVAI [Accessed 03 July 2018].

14. Nucleus Medical Media (2015) *Biology: Cell Structure I Nucleus Medical Media.*[online video] Available at: https://www.youtube.com/watch?v=URUJD5NEXC8 [Accessed 03 July 2018].

15. Plowman, S.A. & Smith, D.L. (2001) *Exercise physiology for health, fitness and performance.*2nd edition. San Francisco, Benjamin Cummings.

16. Robergs, R.A. & Roberts, S. O. (2000) *Fundamental principles of exercise physiology for fitness, performance and health.* Boston, McGraw Hill.

17. Sciencemusicvideos (2011) *The Cell Song.*[online video] Available at: https://www.youtube.com/results?search_query=cell+song [Accessed 02 July 2018].

18. shenoyboy747 (2012) *Call Me Golgi (Carly Rae Jepsen Call Me Maybe PARODY).*[online video] Available at: https://www.youtube.com/watch?v=y6PUs4Xy_nw [Accessed 02 July 2018].

19. St. John Ambulance Australia (2004) *The complete home medical reference*. Gordon Cheers, OM book services.

20. Whiting, W. C., &Rugg, S. (2006). *Dynatomy: dynamic human anatomy*. Champaign, IL, Human Kinetics.

21. xglamgirl43454345x (2012) *Lysosomes and Cell Membrane Song.*[online video] Available at: https://www.youtube.com/watch?v=hrgXW0PtTjc [Accessed 03 July 2018].

22. zebras206 (2010) *Rough Endoplasmic Reticulum Song.* [online video] Available at: https://www.youtube.com/watch?v=PASnAaulK-Y [Accessed 03 July 2018].

23. Spongelab a global STEM community (no date) *BULD-A-BODY.*[Online].[Accessed 15 July 2018]. Available from: http://www.spongelab.com/game_pages/bab.cfm

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-Ist

Paper-III

Title: Computer Applications

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning Outcomes

1. The student will be oriented with the basic knowledge of computer applications.
2. The student will be able to apply the knowledge in the framing of training programs.
3. The outcome of this course will help him in gathering, storage and processing of huge information in relation to inputs, outputs and feedback of sports training programs.

Unit-I

Introduction to Computer

1.1 Information and communication technology (ICT).

1.2 Application of Computers in Physical Education

1.3 Components of computer, input and output device

1.4 Application software used in Physical Education and sports

Unit-II

Word Processing

2.1 Getting started with Microsoft Word

2.2 Creating, saving and opening a document

2.3 Formatting Editing features Drawing table.

2.4 Page Setup, Paragraph Alignment, Spelling and Grammar Check, Printing Option, Inserting Page Number, Graph and Footnote.

Unit-III

Spreadsheet Program

3.1 Getting started with Microsoft Excel

3.2 Creating, saving and opening spreadsheet

3.3 Creating formulas

3.4 Format and editing features for charting data.

Unit-IV

Presentation Software

4.1 Getting started with Microsoft Power Point

4.2 Creating, saving and opening a ppt. file

4.3 Format and editing features slide show, design, inserting slide number

4.4 Enhancing of Picture, Graph, Table

4.5 Finalizing of a presentations

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

References:

1. Irtegov, D. (2004). Operating system fundamentals. Firewall Media.
2. Frye, C. & Lambert, J.(2015). Microsoft Office 2016 Step by Step, Microsoft Press.
3. Milke, M.(2007). Absolute beginner’s guide to computer basics. Pearson Education Asia.
4. Sinha, P. K. & Sinha, P. (2004).Computer fundamentals. 4th edition, BPB Publication.

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-Ist

Paper-IV

Title: Officiating and Coaching-I

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes

1. The pass out would be oriented with the rules regulations of the chosen game.
2. The pass out would be able to lay-out and mark the dimensions of the play court.
3. Students would be able to organize the concerned sports event and officiate in it.
4. Students would be oriented in the art of coaching the sports team.
5. Students shall also be able to organize and officiate in yogic events.

Unit-I

Introduction of Officiating and coaching

1.1 Concept of officiating and coaching

1.2 Principles of officiating & Coaching

1.3 Importance of officiating and coaching.

1.4 Qualifications for Officials conducting various tournaments.

Unit-II

Rules and Layout:

2.1 Dimensions, layouts and marking of fields of chosen Ball Game –I

2.2 Rules and their interpretations of chosen Ball Game –I

2.3 Qualification and number of officials in the chosen Ball Game –I

2.4 Coaching in the chosen Ball Game –I

Unit-III:

Duties of Official:

3.1 Dimensions, layouts and marking of fields of chosen Ball Game –II

3.2 Rules and their interpretations of chosen Ball Game –II

3.3 Qualification and number of officials in the chosen Ball Game –II

3.4 Coaching in the chosen Ball Game –II

Unit-IV

Qualities and Qualifications of Coach and Official:

4.1 Layout, dimensions and markings of Track

4.2 Rules and their interpretations of running events in Track.

4.3 Yoga and its rules

4.4 Coaching in Athletics and Yoga

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Reference Books:

1. Bunn, J. W. (1968). *The art of officiating sports*. Englewood cliffs N.J. Prentice
2. Hall. Bunn, J. W. (1972). *Scientific principles of coaching.*
3. Englewood cliffs N. J. Prentice Hall. Dyson, G. H. (1963). *The mechanics of athletics*. London: University of London Press Ltd.
4. Dyson, G. H. (1963). *The mechanics of Athletics*. London: University of London Press Ltd. Lawther, J.D. (1965).
5. *Psychology of coaching.* New York: Pre. Hall.
6. Singer, R. N. (1972). *Coaching, athletic & psychology*. New York: M.C. Grew Hill.
7. Official Rule Book / Handbook of the concerned federation of sports.

Practical

1. Major Ball Game which should be from the list of SGFI/AIU/IOA)

Credit: 02

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

1. History and Development of the game at International and National level.
2. Dimensions and marking of playing area.
3. Basic requirements of the playing area.
4. Fundamental skills of the game.
5. Skill tests, scoring and arrangement of the skill tests.
6. National and international organizations / federations of the game.
7. Rules of the game with their interpretations.
8. Team selection and coaching in that game.
9. Officiating & Referee / Umpire /scorer /curatorship for self-employment.

Sports simulation laboratory- Sports simulation laboratory is to be established to provide the students with a feasible environment where they will learn and practice sports skills using animated videos with continuous rectification of errors till exact simulation of skill is attained. Help may be taken from Youtube Streaming, Swayam Platform (www.swayam.gov.in), SwayamPrabha (www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org).

2. Track &Field: Running and Jumping event

Credit: 02

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

1. History and Development of the Track and field at International and National level.
2. Basics of Athletic Track (200 & 400 Mt Track).
3. Preparation of Track area.n
4. Marking of Track, various zones, starting points etc.
5. Running Events, their process, timing and scorings.
6. Fundamental skills related to running in track. .
7. Running tests (for speed and endurance) and their administration.
8. National and international organizations / federations of the Athletics.
9. Rules and their interpretations in relation to running events.
10. Team selection, and coaching in running events.
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BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL HEALTH AND SPORTS EDUCATION

Semester-IInd

Paper I

Title: Exercises Physiology

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning Outcomes:

1. The student would be empowered with the applicable knowledge of physiology in physical activity and sports.
2. The learner would be able to incorporate this knowledge in the training and coaching programme for the betterment of his trainee's performance.

Unit-I

Functional Adaptations to Exercise

1.1 Hormonal control during exercise

1.2 Exercise and neuromuscular system

1.3 Metabolic adaptations to exercise

1.4 Cardio-respiratory changes

1.5 Effects of exercise and training on health and fitness

Unit-II

Energy Continuum and Recovery Process

2.1 Metabolism and exercise

2.2 Recovery from exercise

2.3 Replinishment of energy stores during recovery process

2.4 Removal of excess lactic acid produced during exercise

2.5 Restoration of myoglobin oxygen stores

Unit-III

Exercise in hot and cold environment

3.1 Body temperature regulations

3.2 Physiological responses to exercise in the heat

3.3 Acclimatization to exercise in heat

3.4 Physiological responses to exercise in cold

3.5 Health risks during exercise in the cold

Unit-IV

Altitude and physiology

4.1 Exercise performance at altitude

4.2 Physiological responses to acute altitude exposure

4.3 Chronic altitude exposure and acclimatization

Aging process and Ergogenics

4.4 Age related changes and exercise

4.5 Ergogenic aids and physical activity

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

References:

1. W. Larry Kenney, Jack H. Wilmore, David L. Costill, 2012, Physiology of Sports and Exercises.
2. Robert A. Robergs, Scott O. Roberts, 2000, Fundamental Principles of Exercise Physiology for Fitness, Performance, and Health.
3. Larry G. Shaver, 1982, Essentials of Exercise Physiology.
4. Dr. Sandhya Tiwari, 2006, Exercise Physiology.
5. M. Dena Gardiner, 1985, The Principles of Exercise Therapy.
6. Edward L. Fox, Richard W. Bowers, Merle L. Foss, 1981, The Physiological Basis of Physical Education and Athletics.
7. Michael S. Bahrke, Charles E. Yesalis, 2002, Performance – Enhancing Substances in Sport and Exercises.

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-IInd

Paper-II

Title: English

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. The course will develop fundamental knowledge of English Language.

2. The literary texts shall enable students to inculcate creative & aesthetic sensitivity and critically comprehend, appreciate and analyze it.

3. The students will be familiarized with the basics of language and its structure.

Unit-I

Vocabulary

Use of Dictionary, Use of Words: Diminutives, Homonyms & Homophones

Unit-II

Essentials of Grammar – I

1. Articles
2. Parts of Speech
3. Tenses

Unit-III

Essentials of Grammar – II

1. Sentence Structure
2. Subject -Verb agreement
3. Punctuation

Unit-IV

Spoken English Communication, Short Stories

1. Speech Drills
2. Pronunciation and Accent
3. Stress and Intonation
4. The Necklace, by Guy de Maupassant,
5. A Shadow, by R.K. Narayan,
6. The Luncheon, by Somerest Maugham

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Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

Text:

Ramon & Prakash, Business Communication, Oxford.

Sydney GreenBaum Oxford English Grammar, Oxford.

Successful Communications, MalraTreece (Allyn and Bacon)

Effective Technical Communication, M. Ashraf Rizvi.

Reference:

1. Guffey, Ellen Mary, Business Communication, Thomson (South Western)

2. Dale Carnegie: Quick and Easy way of Public Speaking.

Additional Reading:

Newspapers and Journals

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-IInd

Paper-III

Title: Environmental Science (EVS)

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. The course shall develop in student the scientific background needed to understand how the earth works and how we, as human beings, fit into that.
2. At the end of the course, it is expected that students will be able to identify and analyze environmental problems as well as the risks associated with these problems.

Unit-I

Multidisciplinary Nature of Environmental studies

Descriptors/Topics

1. Introduction to environmental studies with their importance.
2. Need for public awareness.
3. Sensitization and participation.
4. Swatch Bharat Abhiyan.

Unit-II

Natural Resources

Descriptors/Topics

1. Types of natural resources and their importance.
2. Food resources: World food problems and related aspects.
3. Land resources, Water resources, Forest resources- use and overuse
4. Minerals and Energy resources- importance of renewable and sustainable energy.
5. Equitable use of resources for sustainable lifestyles
6. Role of an individual in conservation of natural resources

Unit-III

Ecosystems

Descriptors/Topics

1. Concept of an ecosystem,
2. Types of ecosystem,
3. Structure and function of an ecosystem, Producers, consumers and decomposers.
4. Energy flow in the ecosystem, Food chains, food webs and ecological pyramids.
5. Ecological succession.
6. Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem and Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries)

Unit-IV

Biodiversity

Descriptors/Topics

1. Introduction - Definition: genetic, species and ecosystem diversity
2. Bio-geographical classification of India

3. Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values
4. Bio-diversity at global, national and local levels, India as a megadiversitynation
5. Hot-spots of biodiversity,
6. Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts
7. Endangeredand endemic species of India
8. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

Text & References:

1. Khaushik & Khaushik, “Fundamentals of Environmental Studies’’
2. Somvanshi & Dhupper “Fundamentals of Environmental Studies’’
3. Gauba & Bisht“Environmental Studies, Challenges & Solutions A quick Compendium
4. Asthana & Asthana “ A textbook of Environmental Studies”

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-IInd

Paper-IV

Title: Officiating and Coaching-II

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes

1. The pass out would be oriented with the rules regulations of the chosen game.
2. The pass out would be able to lay-out and mark the dimensions of the court.
3. Students would be able to organize the concerned sports event and officiate in it.
4. Students would be oriented in the art of coaching the sports team.
5. Students shall also be able to organize and officiate in yogic events.

Unit-I

Officiating and coaching in Chosen ball game -III

1.1 Dimensions, layouts and marking of fields of chosen Ball Game –III

1.2 Rules and their interpretations of chosen Ball Game –III

1.3 Qualification and number of officials in the chosen Ball Game –III

1.4 Coaching in the chosen Ball Game –III

Unit-II

Officiating and coaching in Chosen ball game -IV

2.1 Dimensions, layouts and marking of fields of chosen Ball Game –IV

2.2 Rules and their interpretations of chosen Ball Game –IV

2.3 Qualification and number of officials in the chosen Ball Game –IV

2.4 Coaching in the chosen Ball Game –IV

Unit- III

Officiating and coaching in Athletics & Yoga

3.1 Layout, dimensions and marking in Field Events of Athletics.

3.2 Rules and their interpretations in Field Events of Athletics.

3.3 Yoga- Pranayama and Meditation.

3.4 Coaching in Field events of Athletics and Practice of-Pranayama & Meditation

Unit-IV

Major tournaments of Athletics:

4.1 Major tournaments / Trophies of chosen Ball Game –III

4.2 Major tournaments / Trophies of chosen Ball Game –IV

4.3 Major tournaments / Competitions of Athletics

4.4 Yoga and its tournament.

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

Reference Books:

1. Bunn, J. W. (1968). *The art of officiating sports*. Englewood cliffs N.J. Prentice
2. Hall. Bunn, J. W. (1972). *Scientific principles of coaching.*
3. Englewood cliffs N. J. Prentice Hall. Dyson, G. H. (1963). *The mechanics of athletics*. London: University of London Press Ltd.
4. Dyson, G. H. (1963). *The mechanics of Athletics*. London: University of London Press Ltd. Lawther, J.D. (1965).
5. *Psychology of coaching.* New York: Pre. Hall.
6. Singer, R. N. (1972). *Coaching, athletic & psychology*. New York: M.C. Graw Hill.
7. Official Rule Book / Handbook of the concerned federation of sports.

Practical

1. Major Ball Game which should be from the list of SGFI/AIU/IOA)

Credit: 02

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

1. History and Development of the game at International and National level.
2. Dimensions and marking of playing area.
3. Basic requirements of the playing area.
4. Fundamental skills of the game.
5. Skill tests, scoring and arrangement of the skill tests.
6. National and international organizations / federations of the game.
7. Rules and their interpretations of the game.
8. Team selection and coaching in that game.
9. Officiating & Referee / Umpire /scorer /curatorship for self-employment.

Sports simulation laboratory - Sports simulation laboratory is to be established to provide the students with a feasible environment where they will learn and practice sports skills using animated videos with continuous rectification of errors till exact simulation of skill is attained. Help may be taken from Youtube Streaming, Swayam Platform (www.swayam.gov.in), SwayamPrabha (www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org).

2. Track & Field: Running and Throwing

Credit: 02

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

1. Basics of jumping events in Athletics.
2. Long jump- Basics, jumping pit, take of board, approach run and skills.
3. Triple jump- Basics, jumping pit, take of board, approach run and skills.
4. High jump -Basics of high jump, jumping pit, approach run and skills /styles.
5. Pole vault -Basics, jumping pit, equipment, approach run and skills.
6. Marking of jumping arena.
7. Jumping tests and their arrangements.
8. Rules, scoring and their interpretations in relation to all jumping events.
9. Team selection and coaching in jumping events.
10. Officiating & Referee / Umpire /scorer /curatorship for self-employment.

Sports simulation laboratory - Sports simulation laboratory is to be established to provide the students with a feasible environment where they will learn and practice sports skills using animated videos with continuous rectification of errors till exact simulation of skill is attained. Help may be taken from Youtube Streaming, Swayam Platform (www.swayam.gov.in), SwayamPrabha (www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org).

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-IIIrd

Paper-I

Title: Kinesiology & Sports Biomechanics

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes

11. The student would be Oriented with the skeletal structure of human body by identifying the origin and insertion of various muscles.
12. Orient the students in basic structure and functions of primary joints of the body.
13. Relate and interpret the role of various mechanical principles in human movement.

Unit-I

Introduction to Kinesiology and Sports Biomechanics

1.1 Meaning and Definition of Kinesiology and Sports Biomechanics

1.2 Importance of Kinesiology and Biomechanics in sports and physical activities

1.3 Origin and Insertion on bones and Action of major Muscles

1.4 Types of joints with their structure and functions

Unit-II

Mechanical Concepts

2.1 Speed/ Velocity/ Acceleration

2.1.1 Velocity as a Vector Quantity

2.1.2 Determining the Direction of the Velocity Vector

2.1.3 Calculating Average Speed, Average Velocity and average Acceleration

2.1.4 Average Speed versus Instantaneous Speed

2.2 Distance, Displacement (Calculating average distance and displacement)

1. Fundamental concepts of following terms –

2.3.1 Fluid résistance

2.3.2 Buoyancy

2.4 Newton's Laws of Motion – and their application to sports activities.

Unit-III

Kinetic/Kinematics Concept for Analysis Human Motion

3.1 Fundamental concepts of following terms –

3.2 Axes and Planes

1. Centre of Gravity
2. Equilibrium
3. Line of Gravity

3.3 Basic Concept related to kinetics

3.3.1 Inertia

3.3.2 Mass

3.3.3 Force

3.3.4 Centre of Gravity

3.3.5 Pressure

3.3.6 Density

3.3.7 Torque

3.3.8 Impulse

3.3 The Biomechanics of the Human Upper Extremity.

3.4 The Biomechanics of the Human Lower Extremity.

Unit-IV

Qualitative/ Quantitative Analysis

4.1 Angular Kinematics of Human Movement.

4.2 Linear Kinetics of Human Movement

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

References:

1. Anthony J. Blazevich (2017). Sports Biomechanics: The Basics: Optimising Human Performance: bloomsburry

2. By Peter M. (2013), Biomechanics of Sport and Exercise: Human Kinetics

3. Amrit Kumar, R, Moses. (1995). Introduction to Exercise Physiology. Madras: Poompugar Pathipagam.
4. BeotraAlka, (2000) Drug Education Handbook on Drug Abuse in Sports: SportsAuthority of India Delhi.
5. Clarke, D.H. (1975). Exercise Physiology. New Jersey: Prentice Hall Inc., Englewood Cliffs.
6. David, L Costill. (2004). Physiology of Sports and Exercise. Human Kinetics.
7. Fox, E.L., and Mathews, D.K. (1981).The Physiological Basis of Physical Education and Athletics. Philadelphia: Sanders College Publishing.
8. Guyton, A.C. (1976). Textbook of Medical Physiology. Philadelphia: W.B. Sanders co.
9. Richard, W. Bowers.(1989). Sports Physiology. WMC: Brown Publishers.
10. Sandhya Tiwaji. (1999). Exercise Physiology.Sports Publishers.
11. Shaver, L. (1981).Essentials of Exercise Physiology. New Delhi: Subject Publications.
12. Vincent, T. Murche. (2007). Elementary Physiology. Hyderabad: Sports Publication.
13. William, D. McAradle. (1996). Exercise Physiology, Energy, Nutrition and Human
14. Performance. Philadelphia: Lippincott Williams and Wilkins Company.

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-IIIrd

Paper-II

Title: Sports Psychology

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. The study would orient the student in basic concepts of psychology.
2. The student would be oriented in identifying factors determining one's overall personality.
3. He would understand various laws of learning and their relevance in teaching learning process.
4. The study would orient him in getting through with the psychology of sports person.

Unit-I

Introduction of Sports Psychology:

1.1 Meaning and nature of Sports Psychology.

1.2 Historical Evolution of Sports Psychology

1.3 Relevance of Sports Psychology in Physical Education and coaching.

1.4 Psychological factors affecting sports performances.

Unit-II

Personality and Sports:

2.1 Meaning and nature of Personality.

2.2 Theories of personality in sports

2.3 Dimensions of personality and development of personality

Motivation

2.4 Types of motivation and condition of developing achievement motivation.

Unit-III

Learning

2.1 Meaning nature and principles of Learning, Types of Learning.

2.2 Laws of learning, Transfer of learning

2.3 Factors affecting learning

2.4 Learning curve, Plateau

Unit-IV

Sports Sociology and Leadership:

4.1 Nature of Sports Sociology.

4.2 Importance of Sports Sociology in Physical Education.

4.3 Socialization and value education through Physical Education.

4.4 Impact of society on sports and vice versa

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

References:

1. Alison and Robinson. (2018), Excelling in Sport Psychology: Planning, Preparing, and Executing Applied Work, Sean Fitzpatrick
2. Taylor, Jim, (2018), Assessment in Applied Sport Psychology, Human kinetics
3. Coumbe-Lilley , (2018), Complex Cases in Sport Psychology, Routledge
4. Ball, D. W. & Loy, J. W. (1975).Sport and social order; Contribution to the sociology of sport. London: Addison Wesley Publishing Co., Inc.
5. Kamlesh, M.L. (1998). Psychology in physical education and sport. New Delhi: Metropolitan Book Co.
6. Loy, J. W., Kenyon, G. S. & McPherson, B. D. (1978). Sport and social system. London: Addison Wesley Publishing Company Inc.
7. Loy, J. W., Kenyon, G. S. & McPherson, B. D. (1981).Sports culture and society. Philadelphia: Lea &Febiger.
8. Skinnner, C. E., (1984.). Education psychology. New Delhi: Prentice Hall of India.

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-IIIrd

Paper-III

Title: Sports Training

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning Outcomes:

1. The learners will be able to identify the fundamental concepts, theories and principles of human body training related to sports performance.
2. The learners will be able to demonstrate the skills to train different fitness components and related planning.
3. The learners will be able to understand the organization to achieve high performance in sports.

Unit-I

Introduction to Sports Training

1.1 Meaning and nature of Sports Training

1.2 Aim and Objective of Sports Training

1.3 Principles of Sports Training

1.4 Characteristics of Sports Training

Unit-II

Training Components

2.1 Strength: its type and means methods employed for developing them

2.2 Speed: its type and means methods employed for developing them

2.3 Endurance: its type and means methods employed for developing them

2.4 Flexibility: its type and means methods employed for developing them

2.5 Coordinative abilities: means methods employed for developing them

Unit-III

Load

3.1 Principles of load and its components

3.2 Determination of Optimum load,

3.3 Overload its causes and identification

3.4 Tackling Over Load.

Unit-IV

Training programming and planning

4.1 Periodization and its types of Periodization.

4.2 Aim and Content of Periods–Preparatory, Competition, Transitional period.

4.3 Planning: Meaning and types.

4.4 Principles of Planning.

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Prabha(www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org), Virtual Labs (www.vlabs.co.in), FOSSEE (www.fossee.in), application of spoken tutorials (www.spoken-tutorial.org), National Digital Library (www.ndl.iitkgp.ac.in), electronic journals (www.ess.infibnet.ac.in) etc. are to be used. . Courses may also integrate DVD videos as part of the training process

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

Reference:

1. Dick, W. F. (1980).Sports training principles. London: Lepus
2. Books. Harre, D.(1982).Principles of sports training. Berlin: Speculated.
3. Jensen, R. C.& Fisher, A.G. (1979). Scientific basis of athletic conditioning. Philadelphia: Lea and Fibiger, 2nd Edn.
4. Mathyew, L.P. (1981).Fundamental of sports training. Moscow: Progress Publishers.
5. Singh, H. (1984).Sports training, general theory and methods. Patiala: NSNIS.
6. Uppal, A.K., (1999).Science of Sports Training. New Delhi: Friends Publication.
7. SchlichMonfred(2003), Circuit Training for all sports, sports book publisher Toronto.
8. Dr. Sharad Chandra Mishra 92006), Sports Training, Sports Publication.

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-IIIrd

Paper-IV

Title: Officiating and Coaching-III

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes

1. The pass out would be oriented with the rules regulations of the chosen game
2. The pass out would be able to lay out and mark the dimensions of the court
3. He would be able to organize the concerned sports event and officiate in it
4. He would be oriented in the art of coaching the sports team
5. He shall also be able to organize and officiate in yogic events

Unit-I

Officiating and coaching in chosen Racket game- I

1.1 Dimensions, layouts and marking of fields of chosen Racket Game –I

1.2 Rules and their interpretations of chosen Racket Game –I

1.3 Qualification and number of officials in the chosen Racket Game –I

1.4 Coaching in the chosen Racket Game –I

Unit-II

Officiating and coaching in chosen Racket game- II

2.1 Dimensions, layouts and marking of fields of chosen Racket Game –II

2.2 Rules and their interpretations of chosen Racket Game –II

2.3 Qualification and number of officials in the chosen Racket Game –II

2.4 Coaching in the chosen Racket Game –II

Unit-III

Indigenous Activities:

3.1 Concept of Indigenous activities.

3.2 History of Indigenous activities.

3.3 Principles and Importance of indigenous activities.

3.4 Various types of activities with different equipment.

Unit-IV

Swimming Activities:

4.1 Swimming activities and its outcome.

4.2 Swimming pools, their dimensions and rules of swimming.

4.3 Maintenance of swimming pools.

4.4 Coaching and training in swimming.

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

Reference Books:

1. Bunn, J. W. (1968). *The art of officiating sports*. Englewood cliffs N.J. Prentice
2. Hall. Bunn, J. W. (1972). *Scientific principles of coaching.*
3. Englewood cliffs N. J. Prentice Hall. Dyson, G. H. (1963). *The mechanics of athletics*. London: University of London Press Ltd.
4. Dyson, G. H. (1963). *The mechanics of Athletics*. London: University of London Press Ltd. Lawther, J.D. (1965).
5. *Psychology of coaching.* New York: Pre. Hall.
6. Singer, R. N. (1972). *Coaching, athletic & psychology*. New York: M.C. Graw Hill.
7. Official Rule Book / Handbook of the concerned federation of sports.

Practical

1. Racket Game which should be from the list of SGFI/AIU/IOA)

Credit: 02

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

1. History and Development of the game at International and National level.
2. Dimensions and marking of playing area.
3. Basic requirements of the playing area.
4. Fundamental skills of the game.
5. Skill tests, scoring and arrangement of the skill tests.
6. National and international organisations / federations of the game.
7. Rules and their interpretations of the game.
8. Team selection and coaching in that game.
9. Officiating & Referee / Umpire /scorer /curatorship for self-employment.

Sports simulation laboratory - Sports simulation laboratory is to be established to provide the students with a feasible environment where they will learn and practice sports skills using animated videos with continuous rectification of errors till exact simulation of skill is attained. Help may be taken from Youtube Streaming, Swayam Platform (www.swayam.gov.in), SwayamPrabha (www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org).

2. Indigenous Activities (OR) Yoga

Credit: 02

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

1. History and Development of the indigenous activities in the country.
2. Aim, Objectives and Principles of Indigenous activities.
3. Individual, group and team indigenous activities.
4. Marking in Indigenous activities.
5. Indigenous activities with equipment.
6. National organisations / federations of the Indigenous games.
7. Rules and their interpretations of the activities.
8. Team selection and coaching for indigenous activities.
9. Officiating & Referee / Umpire /scorer /curatorship for self-employment.

1. Indigenous activities for Mass Demonstrations.
2. Indigenous activities for National Events- Republic day, Independence day etc.
3. Indigenous activities for developing coordination and movements in young's.
4. Preparing Cheer leaders through Indigenous activities.
5. Inculcating improvisations in Indigenous activities/mass demonstrations.
6. Rules and their interpretations of the activities.
7. Team/group selection and coaching for indigenous activities.
8. Officiating & Referee / Umpire /scorer /team leaders for self-employment.

(OR)

Yoga

1. Meaning and concept of Yoga
2. History and Development of the Yoga in India and abroad
3. Various Asanas in sitting position and their advantages
4. Various Asanas in standing position and their
5. Various Asanas in lying position and their advantages Suryanamaskar and its benefits.
6. Yogasana for treating various body ailments.

1. Suryanamaskar- Practice and advantages.
2. Meaning and concept of Pranayama.
3. Various types of Pranayama, their principles and practice. Effect of Pranayama on body and their role in correcting health disorders.
4. Meditation – Types and techniques.
5. Officiating and scoring in Yoga competitions.
6. Coaching and career opportunities in Yoga.

Yoga simulation laboratory –Yoga simulation laboratory is to be established to provide the students with a feasible environment where they will learn and practice yogic asanas and kriyas using animated videos with continuous rectification of errors till exact simulation of skill is attained. Help may be taken from Youtube Streaming, Swayam Platform (www.swayam.gov.in), SwayamPrabha (www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org).

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-IVth

Paper-I

Title: Health Education

Credits: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning Outcome:

1. The student will be able to identify and synthesize the factors that influence health
2. The student will be able to recognize the health related challenges in current time and able to apply the preventive measures.
3. The student will be able to identify the role of peers, community and media in health promotion and protection.
4. The student will be able to demonstrate the expertise in above stated domains in a school setup.
5. The student will be able to value the knowledge and skills required to preserve community health and well-being.

Unit – I

Health Education and Services

1.1 Concept, Dimensions, Spectrum and determinants of Health

1.2 Health Education and Principles of Health Education

1.3 Nature and Scope of Health Education in Physical Education

1.4 Health Services in India

Unit – II

Global Health Issues

2.1 Communicable, Non-Communicable disease and their prevention

2.2 Malnutrition, Food Adulteration, Environmental Pollution and Sanitation, Population and their management.

2.3 Physical Activity and Nutrition, Overweight and Obesity, Mental Health

2.4 Prime causes of death: cardiovascular disease, chronic respiratory disease, Diabetes, Mental Disorders, Nutritional Deficiencies and their prevention through physical activity

Unit – III

Health Education in Schools

3.1 Need and scope of health education in schools

3.2 Preventing alcohol, tobacco and other drugs abuses in schools

3.3 Personal Health and Wellness: Healthy eating, Mental and Emotional health, and Violence prevention

3.4 Physical activity, Safety, First Aid and Emergency procedures

Unit – IV

Health Supervision and Evaluation in Schools

4.1 Health Instruction and Health Supervision

4.2 Assessing personal and peers health risk taking

4.3 Analyzing the influence of family, peers, culture and media on health behavior

4.4 Consumer Healthand Comprehensive Health Education

Teaching Learning Strategies: The class will be taught by using lectures and demonstration, seminars, classroom discussion, videos, charts and presentations method.

Virtual instructional platforms such as **online lectures,** webcast etc. are to be used. Students can participate in coursework through instant messages, emails and video conferencing. Google class room, Cisco WebeX Meeting, OERS, Swayam Platform (www.swayam.gov.in), SwayamPrabha (www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org), Virtual Labs (www.vlabs.co.in), FOSSEE (www.fossee.in), application of spoken tutorials (www.spoken-tutorial.org), National Digital Library (www.ndl.iitkgp.ac.in), electronic journals (www.ess.infibnet.ac.in) etc. are to be used. . Courses may also integrate DVD videos as part of the training process

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

References:

1. Agrawal, K.C. (2001). Environmental biology. Bikaner: Nidhi publishers Ltd.
2. Bensley, R. J. and Fisher, J. B (2009). Community Health Education Methods. Massachusetts: Jones and Bartlett Publishers.
3. Edward, J. T. (2006). Health and Disease, New Delhi: Sports Publication.
4. Anspaugh, D. J. and Ezell, G. (2003). Teaching today's Health. USA: Allyn& Bacon.
5. McKenzie, J. F. and Smeltzer, J. L (2001). Planning, Implementing, and EvaluatingHealth Promotion Programs: A Primer, USA: Allyn& Bacon.

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-IVth

Paper-II

Title: Test & Measurement

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. The students will be able to recognize and relate the concept of test, measurement and evaluation in the context of Physical Education.
2. The students will be able to construct and conduct the physical fitness and sports skill test.
3. The students will be able to implement the criteria of test selection.

The syllabus would orient the students in the art of applications of test, measurement and evaluation in physical and sports activities with simultaneous development of practical competency in conducting physical fitness and sports skill tests.

Unit-I

Introduction to Test & Measurement & Evaluation

1.1 Meaning of Test, Measurement & Evaluation in Physical Education.

1.2 Importance of Test, Measurement & Evaluation in Physical Education.

1.3 Criteria of selecting an appropriate test.

1.4 Type and classification of test

Unit-II

Construction and Administration of Test

2.1 Administration of testing programme.

2.2 Construction of Physical Fitness / Efficiency Test

2.3 General types of sports skill test items

2.4 Construction of sports skill test

Unit-III

Physical Fitness Tests

3.1 Youth Physical Fitness Test.

3.2 Tuttle Pulse Ratio Test

3.3 Newton Motor Ability Test

3.4 Phillips JCR Test

Unit-IV

Sports Skill Tests

4.1 Lockhart and McPherson Badminton test

4.2 Johnson Basketball test

4.3 McDonald soccer test

4.4 S.A.I Hockey test

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

References:

1. Bangsbo, J. (1994). *Fitness training in football: A scientific approach*. Bagsvaerd, Denmark:Ho+Storm.
2. Barron, H. M., &Mchee, R. (1997). *A practical approach to measurement in physical education*.Philadelphia: Lea and Febiger.
3. Barron, H.M. &Mchee, R. (1997). A Practical approach to measurement in physical education.Philadelphia: Lea and Febiger.
4. Kansal, D.K. (1996). *Test and measurement in sports and physical education*. New Delhi:D.V.S. Publications.

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-IVth

Paper-III

Title: Adapted Physical Education

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. The knowledge would enable the students to understand the activity requirements of various levels of physically challenged persons.

2. The knowledge would thus enable the students to prepare and organize worthwhile activity programs for various levels of physically challenged persons.

Unit-I

Introduction

1. Meaning, Definition and Importance of Adapted Physical Education and Sports
2. Purpose, Aims and Objectives of Adapted Physical Education and Sports
3. Program organization of Adapted Physical Education and Sports
4. Organizations addressing and giving opportunities to people with disabilities.
5. Adapted Sports- Para Olympics and other Opportunities

Unit-II

Development of Individual Education Program (IEP)

2.1 The student with a disability

2.2 Components and Development of IEP.

2.3 Principles of Adapted Physical Education and Sports

2.4 Role of Physical Education teacher

Unit-III

Developmental Considerations of an Individual

3.1 Motor development

3.2 Perceptual Motor development

3.3 Early childhood and Adapted Physical Education

3.4 Teaching style, method and approach in teaching Adapted Physical Education

Unit-IV

Individual with unique need and activities

4.1 Behavioral and Special learning disability

4.2 Visual Impaired and Deafness

4.3 Health Impaired students and Physical Education

4.4 HRPF and its development for Individual with unique need

4.5 Role of games and sports in Adapted Physical Education

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

Reference

1. Beverly, N. (1986). Moving and Learning. Times Mirror/Mosby College Publishing.
2. Cratty, B.J. Adapted Physical Education in the Mainstream. (4th Edition) Love Publishing Company.
3. Houner, L.D. Integrated Physical Education- A guide for the elementary classroom teacher.
4. Winnick, J. P. (2005). Adapted Physical Education and Sports. Human Kinetics (4th Edition). 5. Pangrazi, R.P. and Dauer, V. P. Dynamics Physical

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-IVth

Paper IV

Title: Officiating and Coaching-IV

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes

1. The pass out would be oriented with the rules regulations of the indigenous game and Gymnastics.
2. The pass out would be able to lay out and mark the dimensions of the court.
3. He would be able to organize the concerned sports event and officiate in it.
4. He would be oriented in the art of coaching the sports team.

Unit-I

Officiating and coaching in Chosen Combative Sports- I

1.1 Dimensions, layouts and marking of fields of Chosen Combative Sports- I

1.2 Rules and their interpretations of Chosen Combative Sports- I

1.3 Qualification and number of officials in the Chosen Combative Sports- I

1.4 Coaching in the Chosen Combative Sports- I

Unit-II

Officiating and coaching in Chosen Combative Sports- II

2.1 Dimensions, layouts and marking of fields of Chosen Combative Sports –II

2.2 Rules and their interpretations of Chosen Combative Sports –II

2.3 Qualification and number of officials in the Chosen Combative Sports-II

2.4 Coaching in the chosen Combative Sports –II

Unit- III

Indigenous Activities:

3.1 Indigenous activities for developing motor abilities.

3.2 Markings of Indigenous activities.

3.3 Indigenous activities for special occasions.

3.4 Outcomes and benefits of indigenous activities.

Unit-IV

Gymnastics Activities:

4.1 Introduction to Gymnastics..

4.2 Various Gymnastic activities and their Equipment.

4.3 Qualification, duties of officials and scoring in gymnastics.

4.4 Coaching and training in Gymnastics.

Teaching Learning Strategies: The class will be taught by using lectures and demonstration, seminars, classroom discussion, videos, charts and presentations method.

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SwayamPrabha(www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org), Virtual Labs (www.vlabs.co.in), FOSSEE (www.fossee.in), application of spoken tutorials (www.spoken-tutorial.org), National Digital Library (www.ndl.iitkgp.ac.in), electronic journals (www.ess.infibnet.ac.in) etc. are to be used. . Courses may also integrate DVD videos as part of the training process

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

Reference Books:

1. Bunn, J. W. (1968). *The art of officiating sports*. Englewood cliffs N.J. Prentice
2. Hall. Bunn, J. W. (1972). *Scientific principles of coaching.*
3. Englewood cliffs N. J. Prentice Hall. Dyson, G. H. (1963). *The mechanics of athletics*. London: University of London Press Ltd.
4. Dyson, G. H. (1963). *The mechanics of Athletics*. London: University of London Press Ltd. Lawther, J.D. (1965).
5. *Psychology of coaching.* New York: Pre. Hall.
6. Singer, R. N. (1972). *Coaching, athletic & psychology*. New York: M.C. Graw Hill.
7. Official Rule Book / Handbook of the concerned federation of sports.

Practical

1. Combative Game which should be from the list of SGFI/AIU/IOA)

Credit: 02

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

1. History and Development of the game at International and National level.
2. Dimensions and marking of playing area.
3. Basic requirements/ equipment of the game.
4. Fundamental skills of the game.
5. Skill tests, scoring and arrangement of the skill tests.
6. National and international organisations / federations of the game.
7. Rules and their interpretations of the game.
8. Team selection and coaching in that game.
9. Officiating & Referee / Umpire /scorer for self-employment.

Sports simulation laboratory - Sports simulation laboratory is to be established to provide the students with a feasible environment where they will learn and practice sports skills using animated videos with continuous rectification of errors till exact simulation of skill is attained. Help may be taken from Youtube Streaming, Swayam Platform (www.swayam.gov.in), SwayamPrabha (www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org).

2. Gymnastics (OR)Swimming

Credit: 02

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Gymnastics

1. History and Development of the Gymnastics at International and National level.
2. Various forms / types of gymnastic activities.
3. Basic requirements/ equipment for the gymnastics.
4. Fundamental skills/movements in the gymnastics.
5. National and international organisations / federations of gymnastics.
6. Rules, scoring and their interpretations in gymnastic competitions.
7. Team selection and coaching in gymnastics.
8. Officiating & Referee / Umpire /scorer for self-employment.

OR

Swimming

1. History and Development of the swimming at International and National level.
2. Dimensions and other aspects of swimming pools.
3. Basic swimming skills/ styles..
4. Swimming tests, scoring and arrangement of the skill tests.
5. National and international organisations / federations of swimming.
6. Rules and their interpretations of the swimming events and competitions.
7. Team selection and coaching in swimming.
8. Officiating & Referee / Umpire /scorer / life guards training for self-employment.

Sports simulation laboratory - Sports simulation laboratory is to be established to provide the students with a feasible environment where they will learn and practice sports skills using animated videos with continuous rectification of errors till exact simulation of skill is attained. Help may be taken from Youtube Streaming, Swayam Platform (www.swayam.gov.in), SwayamPrabha (www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org).

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-Vth

Paper-I

Title: Sports Management

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. The student would understand the importance of management of Physical Education.
2. He shall gain knowledge regarding management of Physical Education and Sports at different level.
3. He will be able to organize various Physical Education program.
4. He would know about various schemes and policies of State &Central Government.
5. He would know about planning of facility and financial management.

Unit-I

The Management Process:

1. Definition, Principles, Nature and Concept of Sports Management.
2. Progressive concept of Sports management.
3. The purpose and scope of Sports Management.
4. Essential skills of Sports Management.
5. Qualities and competencies required for the Sports Manager.
6. Event Management in physical education and sports.

Unit-II

Leadership in Sports Management Process:

2.1 Meaning and Definition of leadership.

2.2 Leadership style and method.

2.3 Elements of leadership.

2.4 Forms of Leadership.

- 2.4.1 Autocratic
- 2.4.2 Laissez-faire
- 2.4.3 Democratic
- 2.4.4 Benevolent Dictator

2.5 Qualities of administrative leader.

2.6 Preparation of administrative leader.

2.7 Leadership and Organizational performance.

Unit-III

Planning and Management of sports at Institutional level:

3.1 Sports Management in Schools, colleges and Universities.

3.2 Factors affecting planning

3.3 Planning a school or college sports programme.

3.4 Directing of school or college sports programme.

3.5 Controlling a school, college and university sports programme.

- 3.5.1 Developing performance standard
- 3.5.2 Establishing a reporting system
- 3.5.3 Evaluation
- 3.5.4 The reward/punishment system

Unit-IV

Financial Management in Sports:

4.1 Financial management in Physical Education & sports in schools, Colleges and Universities.

4.2 Objectives and scope of financial planning.

4.3 Management of Infrastructure, finance and personal

4.4 Mechanics of purchase and audit.

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Course Learning Outcomes:

1. Understanding of the theoretical concept of sports management.
2. Understanding of the practical & theoretical implications of financial planning and personnel management
3. Knowledge of sport event management and their Evaluation process.
4. Understanding of the competencies and skill of sport manager.

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

References:

1. Bucher, C.A.(2002). Management of Physical Educational and Sports.(12th Ed.). USA :McGarw Hill Co.
2. Chakrarborti, S.(2007). Sports Management. New Delhi: Friends Publication.
3. Frosdick, S., &Walley, L. (2003). Sports and Safety Management. USA: A division of Reed Education and Professional Publishing Ltd.
4. Govindrajulu, .N. (2005). Management of Physical Education and Sports Programme. New Delhi : Friends Publication.
5. Kamlesh, M. L. (2000). Management Concepts in Physical Education and Sports. New Delhi : B.V. Gupta Publication.
6. Mastoralexis, L.P., & Barr, C.A. (1998). Principles and Practice of Sports Management. Maryland: Aspen Publication.
7. Roy, S. S. (2002). Sports Management. New Delhi: Friends publication.
8. Horine., Larry. (1985). Administration of Physical Education and Sports Programmes. New York :Saundress college publication.

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-Vth

Paper-II

Title: Sports Journalism

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:-

1. The students will be oriented in basic art of mass communication and reporting of sports events through various mediums.

Unit-I

Introduction

1. Meaning and Definition of Journalism
2. Ethics of Journalism
3. Sports Ethics and Sportsmanship
4. Reporting Sports Events
5. National and International Sports News Agencies.

Unit-II

Sports Bulletin

2.1 Concept of Sports Bulletin

2.2 Types of bulletin

2.3 Journalism and sports education

2.4 Structure of sports bulletin – Compiling a bulletin

2.5 General news reporting and sports reporting.

Unit-III

Mass Media

3.1 Mass Media in Journalism: Radio and T.V.

3.2 Commentary – Running commentary on the radio – Sports expert's comments.

3.3 Role of Advertisement in Journalism.

3.4 Sports Photography

3.5 Editing and Publishing.

Unit-IV

Report Writing on Sports

4.1 Brief review of Olympic Games, Asian Games, Common Wealth Games World Cup, National Games and Indian Traditional Games.

4.2 Preparing report of an Annual Sports Meet for Publication in Newspaper.

4.3 Organization of Press Meet.

4.4 Practical assignments to observe the matches and prepare report and news of the same.

4.5 Visit to News Paper office and TV Centre to know various departments and their working

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

Reference:

1. Ahiya B.N. (1988) Theory and Practice of Journalism: Set to Indian context Ed3. Delhi: Surjeet Publications
2. Ahiya B.N. Chobra S.S.A. (1990) Concise Course in Reporting. New Delhi: Surjeet Publication
3. Bhatt S.C. (1993) Broadcast Journalism Basic Principles. New Delhi. Haranand Publication
4. Dhananjay Joshi (2010) Value Education in Global Perspective. New Delhi: Lotus Press.
5. Kannan K (2009) Soft Skills, Madurai: Madurai: Yadava College Publication
6. MohitChakrabarti (2008): Value Education: Changing Perspective, New Delhi: KanishkaPublication,.
7. Padmanabhan. A &Perumal A (2009), Science and Art of Living, Madurai: Pakavathi Publication
8. Shiv Khera (2002), You Can Win, New Delhi: Macmillan India Limited.
9. Varma A.K. (1993) Journalism in India from Earliest Times to the Present Period. Sterling publication Pvt. Ltd.
10. Venkataiah. N (2009) Value Education,- New Delhi: APH Publishing Corporation. 43

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B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-Vth

Paper-III

Title: Fitness Training and Nutrition

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. Will develop skills to establish daily caloric requirement and to design the diet plan.
2. Will acquaint student with principles of sports nutrition.
3. Will orient the student to the role of food on Physical performance.
4. Would make the student understand and prepare weight management plans.

Unit-I

Introduction to Sports Nutrition

1.1 Meaning and Definition of Sports Nutrition

1.2 Basic components of Nutrition

1.3 Factor to consider for developing nutrition plan

1.4 Balance diet and its components, Nutritional deficiencies.

1.5 Understanding of malnutrition and nutritional supplements.

Unit-II

Nutrients: Ingestion to energy metabolism

2.1 Carbohydrates, Protein, Fat – Meaning, classification and its function

2.2 Role of carbohydrates, Fat and protein during exercise

2.3 Vitamins, Minerals, Water – Meaning, classification and its function

2.4 Role of hydration during exercise

2.5 Establishing daily caloric requirement and expenditure

Unit-III

Nutrition and Weight Management

3.1 Obesity – Definition, meaning, types and causes of obesity; Health risks associated with Obesity and Solutions for Overcoming Obesity

3.2 Concept of BMI (Body mass index), Dieting versus exercise for weight control,

3.3 Common Myths about Weight Loss

3.4 Concept of weight management in modern era, Factor affecting weight management

Unit-IV

Steps of planning of Weight Management

4.1 Determination of desirable body weight

4.2 Daily calorie intake and expenditure in weight management

4.3 Role of diet and exercise in weight management

4.4 Designing diet plan and exercise schedule for weight gain and loss

4.5 Balanced diet for Indian School Children.

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Course Learning Outcomes:

5. Understanding of the theoretical and practical concept of sport nutrition and weight management.
6. Understanding towards the theoretical and practical concept of obesity and desirable body weight for physical fitness.
7. Understanding of the modern development in area of sport nutrition and weight management.

Teaching Learning Strategies: The class will be taught by using lectures and demonstration, seminars, classroom discussion, videos, charts and presentations method.

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Self-Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

References:

1. Bessesen, D. H. (2008). Update on obesity. *J ClinEndocrinolMetab.93*(6), 2027-2034.
2. Butryn, M.L., Phelan, S., &Hill, J. O.(2007). Consistent self-monitoring of weight: a key component of successful weight loss maintenance.*Obesity(Silver Spring)*. *15*(12), 3091-3096.
3. Chu, S.Y. & Kim, L. J. (2007). Maternal obesity and risk of stillbirth: a metaanalysis. *Am J ObstetGynecol*, *197*(3), 223-228.
4. DeMaria, E. J. (*2007).* Bariatric surgery for morbid obesity. *N Engl J Med,356*(21), 2176-2183.
5. Dixon, J.B., O'Brien, P.E., Playfair, J. (n.d.). Adjustable gastric banding and conventional therapy for type 2 diabetes: a randomized controlled trial. *JAMA. 299*(3), 316-323.
6. Bates M. (2008). Health Fitness Management (2nd Ed.) USA: Human Kinetics.

7. Fink, H.H., Burgoon,L.A., &Mikesky, A.E. (2006). Practical Applications in Sports Nutrition. Canada : Jones and Bartlett Publishers.

8. Lancaster S. &Teodoressu, R. (2008). Athletic Fitness for Kids. USA: Human Kinetics.

9. Michael J. Gibney (2002) – Human Nutrition, Atlantic publication, New Delhi.

10. Martin Estwood (2005) – Principle of human nutrition, Atlantic publication, New Delhi.

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-Vth

Paper-IV

Title: Athletic Care and Rehabilitation

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. He would understand the Prevention, Treatment and Rehabilitation of Athletic Injuries.

Unit-I

Corrective Physical Education:

1.1 Definition and Objectives of Corrective Physical Education.

1.2 Posture and Body Mechanics, Standards of Standing Posture.

1.3 Value of Good Posture, Drawbacks and Causes of Bad Posture.

1.4 Posture Test – Examination of the Spine.

Unit-II

Posture and Rehabilitation Exercises:

2.1 Normal Curve of the Spine and its Utility.

2.2 Deviations in Posture- Kyphosis, Lordosis, Flat Back, Scoliosis, Round Shoulders, Knock Knee, Bow Leg, Flat Foot.

2.3 Causes for Deviations and Treatment Including Exercises.

2.4 Passive, Active, Assisted, Resisted Exercise for Rehabilitation.

Unit-III

Massage:

3.1 Brief History of Massage, Massage as an Aid for Relaxation, Points to be Considered in giving Massage

3.2 Physiological, Chemical, Psychological Effects of Massage, Indication /Contra Indication of Massage

3.3 Classification of the Manipulation used Massage and their Specific Uses in the Human Body.

3.4 Stroking Manipulation, Effleurage, Pressure Manipulation, Percussion Manipulation, Cupping, Poking, Shaking Manipulation, Deep Massage.

Unit-IV

Sports Injuries Care, Treatment and Support:

4.1 Principles Pertaining to the Prevention of Sports Injuries.

4.2 Care and Treatment of Exposed and Unexposed Injuries in Sports.

4.3 Principles of apply Cold and Heat, Infrared Rays, Ultrasonic Therapy, Short-wave Diathermy Therapy.

4.4 Principles and Techniques of Strapping and Bandages.

Note*: Each student shall submit Physiotherapy record of attending the Clinic and observing the cases of athletic injuries and their treatment procedure.(To be assessed internally)*

Teaching Learning Strategies: The class will be taught by using lectures and demonstration, seminars, classroom discussion, videos, charts and presentations method.

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SwayamPrabha(www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org), Virtual Labs (www.vlabs.co.in), FOSSEE (www.fossee.in), application of spoken tutorials (www.spoken-tutorial.org), National Digital Library (www.ndl.iitkgp.ac.in), electronic journals (www.ess.infibnet.ac.in) etc. are to be used. . Courses may also integrate DVD videos as part of the training process

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

References:

1. Dohenty. J. Meno.Wetb, Moder D (2000) Track & Field, Englewood Cliffs, Prentice Hal Inc.
2. Lace, M. V. (1951) Massage and Medical Gymnastics, London: J & A Churchill Ltd.
3. Mc Ooyand Young (1954) Tests and Measurement, New York: Appleton Century.
4. Naro, C. L. (1967) Manual of Massage and, Movement, London: Febra and Febra Ltd.
5. Rathbome, J.l. (1965) Corrective Physical education, London: W.B. Saunders & Co.
6. Stafford and Kelly, (1968) Preventive and Corrective Physical Education, New York.

Practical

1. Game of Specialization which should be from the list of SGFI/AIU/IOA)

Credit: 02

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

1. Basic skills of the game.
2. Dimensions and preparation of playing area.
3. Drills for skill development.
4. Skill tests, their administration and scoring.
5. Rules of the game and their interpretations.
6. Officiating and coaching in the game.
7. Maintenance of equipment of the game.

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2. Aerobics (0R)Weight lifting

Credit: 02

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Aerobics

1. Introduction of Aerobics.
2. Aerobics activities without music and equipment.
3. Aerobics for fitness and health.
4. Aerobics for mass demonstration.
5. Aerobics with equipment and music.
6. Judging and scoring in aerobics.
7. Coaching, officiating and starting careers in aerobics.
8. Skill Practice of the Aerobics.
9. Skill lessons of Aerobics.
10. Coaching lessons of Aerobics.
11. Advance coaching and training of Aerobics (try for certification of coaching from district/state/national federation/online).
12. Officiating of Aerobics (Try for certification from concerned district/state/national federation for self employment)

OR

Weight lifting

1. History and Development of the weight lifting
2. Fundamental principles and procedures of weight lifting.
3. Weight lifting for competition purpose and general purpose.
4. Team selection and coaching in gymnastics.

5. Gym management and maintenance of equipment.
6. Officiating & Referee / Umpire /scorer for self-employment.
7. Starting own gym for self-employment.
8. Skill Practice of the Weight lifting.
9. Skill lessons of Weight lifting.
10. Coaching lessons of Weight lifting.
11. Advance coaching and training of Weight lifting(try for certification of coaching from district/state/national federation/online).
12. Officiating of Weight lifting (Try for certification from concerned district/state/national federation for self employment)

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BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/ B.A./ B.Sc. HONOURS IN PHYSICAL HEALTH AND SPORTS EDUCATION

Semester-VIth

Paper-I

Title: Counseling in Sports

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. The student would be able to Counsel athletes in matters of handling success and failure. He would also be able to orient the athletes in future opportunities.

Unit-I

Counselling in Physical Education and Sports

1.1 Meaning, definition and scope of Counselling in sports.

1.2 Aims and Objective of Counselling in sports.

1.3 Principles of Counselling

1.4 Need and importance of Counselling.

Unit-II

Stress & Anxiety in Sports

2.1 Meaning and definition of stress and anxiety.

2.2 Types of stress and anxiety.

2.3 Symptoms and effects of stress, anxiety and competition anxiety.

2.4 Management of stress and anxiety.

Unit-III

Motivation and Sports Performance

3.1 Meaning and definition of Motivation.

3.2 Types and techniques of motivation

3.3 Principles and Importance of motivation

3.4 Role of coach / teacher /government in motivation

Unit-IV

Counselling to Athletes

4.1 Counselling on injuries and rehabilitation..

4.2 Counselling on handling success and failure in sports.

4.3 Counselling on drugs in sports.

4.4 Counselling on job opportunities and life after retirement from sports.

Teaching Learning Strategies: The class will be taught by using lectures and demonstration, seminars, classroom discussion, videos, charts and presentations method.

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Activities: Lecture/ Project Work/ Seminars/ Term Papers/Assignments/ Presentations/ Study etc.

Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

Reference:

1. Rechard Nelson-Jones, Basic Counselling Skills, Sage Publication, New Delhi.
2. Dr. M L Kamlesh, Psychology in Physical Education and Sports, Educational Publishers and Distributors.
3. An Introduction to Counselling- McGraw-Hill Education.
4. Understanding Psychology- McGraw Hill Book.

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-VIth

Paper-II

Title: Exercise Prescription / Therapeutic Exercise

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. The student would be able to understand the type of exercise requirement for different groups of people as per their needs.
2. Students would be able to devise effective exercise program as par the need of the individual.

Unit-I

Exercises and their Types

1. Meaning and definition of exercise
2. Types of exercises- Aerobics, Anaerobic and Conditioning
3. Importance of warming up, cooling down and stretching
4. Therapeutic exercises and their principles.

Unit-II

Weight management & Gym Exercises

2.1 Understanding body weight, components of body weight and ideal weight.

2.2 Fat burning exercises and their variations.

2.3 Gym training exercises for weight loss and strengthening

2.4 Dance, Aerobics, cycling and swimming for weight loss.

Unit-III

Exercises and Elderly People

3.1 Understanding aging and characteristics

3.2 Need and importance of exercises in aged people.

3.3 Principles and precautions while giving exercises to elderly people.

3.4 Type of exercises and recreational activities for elderly people.

Unit-IV

Exercises for special needs

4.1 Exercises for rehabilitations after injuries.

4.2 Exercise for diabetics, Exercises during & after Pregnancy

4.3 Exercises for casuals and weekenders.

4.4 Exercises for recreations and kids.

Teaching Learning Strategies: The class will be taught by using lectures and demonstration, seminars, classroom discussion, videos, charts and presentations method.

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References :-

1. Robert A. Robergs, Steven J. Keteyian (2003), Fundamentals of Exercise Physiology: For Fitness, Performance, and Health, Volume 1- McGraw-Hill
2. Dympna Pearson (2012), Weight Management: A Practitioner's Guide, ISBN- 1405185597
3. ASCM and Arnold Schwarzenegger (2003), ASCM Fitness Book
4. David Nordmark (2015), Workout Routines- Exercise workout routines.
5. Frederic Delavier (2010), Strength Training Anatomy
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BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-VIth

Paper-III

Title: Talent Identification

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. The student would be oriented with the inherited signs and symptoms that make one adept for excellence in a particular sports.
2. The student would be able to quantify those signs and symptoms through specific tools and techniques and thus guide the individual to that sports activity for which his/her physique is best suited.

Unit-I

Introduction,Meaning, Concept and scope of talent identification in sports

1. Need and Importance of talent identification.
2. Principles of talent identification.
3. Scope of Talent identification.
4. Role of Physical Education teacher / coach in talent identification.

Unit-II

Understanding Human Body

2.1 Genetics and Environment and their role in sports performance.
2.2 Body types and their relation to sports.
2.3 Basic Anthropometry
2.4 Anthropometric assessment and data recording.

Unit-III

Fitness Tests

3.1 AAPHER youth fitness test
3.2 JCR test
3.3 Coopers 12 minute run/walk test
3.4 Harvard Step test.

Unit-IV

Skill Tests for talent identification

4.1 Skill tests for Ball games
4.2 Skill test for Racket games.
4.3 Skill test for Athletic abilities
4.4 Psychological tests related to sports abilities.

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Reference:-

1. Russell K. Athletic talent: from detection to perfection. Sci Period Res Technol Sport 1989; 9 (1): 1–6Google Scholar
2. Williams AM, Reilly T. Talent identification and development in soccer. J Sport Sci 2000; 18 (9): 657–67
3. Bartmus U, Neumann E, de Marées H. The talent problem in sports. Int J Sports Med 1987; 8 (6): 415–6
4. Barron, H.M. &Mchee, R. (1997). A Practical approach to measurement in physical education.Philadelphia: Lea and Febiger.
5. Kansal, D.K. (1996). *Test and measurement in sports and physical education*. New Delhi:D.V.S. Publications

BACHELOR OF PHYSICAL EDUCATION AND SPORTS (B.P.E.S.)/

B.A./ B.Sc. HONOURS IN PHYSICAL, HEALTH AND SPORTS EDUCATION

Semester-VIth

Paper-IV

Title: Sports Entrepreneurship

Credit: 04

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Learning outcomes:

1. The knowledge would enable students to set up their own enterprise, catering to various demands of sports industry.

Unit-I

1. Meaning and Definition of Entrepreneurship
2. Concept and characteristics Entrepreneurship.
3. Need and Importance of entrepreneurship in sports
4. Understanding Sports Business industry.

Unit-II

1. Understanding the entrepreneurial process.
2. Types of Entrepreneurs.
3. Risk and Rewards in entrepreneurship.
4. Leading sports companies and media channels.

Unit-III

1. Identifying the areas of business.
2. Understanding financial aspects of the business.
3. Government and private Organizations supporting entrepreneurships in India
4. Generating / arranging funds for the business.

Unit-IV

4.1 Entrepreneurship in the sports Goods / Equipment.
4.2 Entrepreneurship in Sports wears.
4.3 Entrepreneurship in Sports management / Event management.
4.4 Entrepreneurship in Sports software/fitness / Nutrition.

Teaching Learning Strategies: The class will be taught by using lectures and demonstration, seminars, classroom discussion, videos, charts and presentations method.

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Assessment Rubric: Classroom Test, Project Work, Assignments, Presentations

Reference:-

1. Peter Thiel, Zero to One: Notes on Start Ups, or How to Build the Future, 0804139296 (ISBN13: 9780804139298)
2. Guy Kawasaki (2004), The Art of the Start: The Time-Tested, Battle-Hardened Guide for Anyone Starting Anything, 1591840562 (ISBN13: 9781591840565)
3. Roger Cowdrey, Creating an Entrepreneurial Mindset-Failure IS an Option!

Practical

1. Game of Specialization –I

Credit: 02

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

1. Skill Practice of the game.
2. Skill lessons of the game.
3. Coaching lessons of the game.
4. Advance coaching and training of the game (try for certification of coaching from district/state/national federation/online).
5. Officiating of the game (Try for certification from concerned district/state/national federation for self-employment)

Sports simulation laboratory - Sports simulation laboratory is to be established to provide the students with a feasible environment where they will learn and practice sports skills using animated videos with continuous rectification of errors till exact simulation of skill is attained. Help may be taken from Youtube Streaming, Swayam Platform (www.swayam.gov.in), SwayamPrabha (www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org).

2. Power Lifting (OR) Physique Training

Credit: 02

Max. Marks: 100

Sessional Marks: 30

End semester exam marks: 70

Power Lifting

1. History and Development of the power lifting.
2. Power lifting for competition purpose and general purpose.
3. Fundamental principles and procedure for power lifting.
4. Team selection and coaching in gymnastics.
5. Gym management and maintenance of equipment.
6. Officiating & Referee / Umpire /scorer for self-employment.
7. Starting own gym for self-employment.

OR

Physique Training

1. Skill Practice of the power lifting and Physique.
2. Skill lessons of power lifting and Physique.
3. Coaching lessons of power lifting and Physique.
4. Advance coaching and training of power lifting and Physique (try for certification of coaching from district/state/national federation/online).
5. Officiating of power lifting and Physique (Try for certification from concerned district/state/national federation for self employment)

Sports simulation laboratory - Sports simulation laboratory is to be established to provide the students with a feasible environment where they will learn and practice sports skills using animated videos with continuous rectification of errors till exact simulation of skill is attained. Help may be taken from Youtube Streaming, Swayam Platform (www.swayam.gov.in), SwayamPrabha (www.swayamprabha.gov.in) (available on Doordarshan(free dish TV), E-Yantra (www.e-yantra.org).

State Level Study (Semester-III)

04 Credits

Marks 100

Project Report: 70 marks

Viva-Voce: 30 marks

Studentswillvisit the**districts** of the state to do survey on availability of sports infra-structure in concerned schools, and submit an individual project report of 02 credits and will be assessed by a viva voce of 02 credits.

National Level Study (Semester-VI)

04 Credits

Marks 100

Project Report: 70 marks

Viva-Voce: 30 marks

Students will visit a few **Universities/Institutions** of the different states of the country to do survey on availability of sports infra-structure in concerned universities/institutions, and submit an individual project report of 02 credits and will be assessed by a viva voce of 02 credits.

Key Words

Physical education

Sports

Anatomy

Physiology

Kinesiology

Officiating & coaching

Test & measurement

Nutrition

Rehabilitation

Psychology

Sports training

Sports biomechanics

Coaches

Game officials

Gym trainers

Personal trainers

Entrepreneurs

Fitness

Recreation

Adventure sports

Camping

Event management

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Prof. Brij Bhushan Singh, Head, Department of Physical Education, Aligarh Muslim University, Aligarh – 202 002.

Prof. B.C. Kapri, Head, Department of Physical Education, Banaras Hindu University, Varanasi – 221 005.

Prof. Vishan Singh Rathore, Head, Department of Physical Education, Guru Ghasidas University, Bilaspur (CG)

Prof. K. Balasubramanian, Head, Department of Physical Education & Health Sciences, Alagappa University, Karaikudi – 630 003.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK (LOCF)

POSTGRADUATE PROGRAMME IN PHYSICAL EDUCATION

JANUARY 1, 2020

SCHOOL OF STUDIES IN PHYSICAL EDUCATION

SCHOOL OF STUDIES IN PHYSICAL EDUCATION

Pt. Ravishankar Shukla University
Raipur 492 010, Chhattisgarh

Syllabus

MASTER OF PHYSICAL EDUCATION

M.P.Ed
(Semester System)

Session

2020-2021

Preamble

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2.2	Aims of Master's Degree Programme in Physical Education	
3	Postgraduate Attributes in Physical Education	
4	Qualification Descriptors for MPEd	
5	Programme Learning Outcomes for MPEd	
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6.3	Semester-wise Course/Paper and Credit Distribution	
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7	Teaching-Learning Process	
8	Assessment Methods	
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1. INTRODUCTION

In the contemporary age of technology and science, Physical Education programme occupies an important place in the education system. This high-tech epoch has mechanised the human life and curbed the manual labour to its bare minimum. In context to the vibrant and contextual changes of the world it is essential to assimilate the Physical Education curriculum in the Courses. The increasing rate of physical inactivity in alarming are has an urge to call for such curriculum to decrease the rate and prevalence of disease in the modern era. Moreover, the pace of growth of research and development in each facet of the society has increased the leisure to its greatest extent. In this scenario, all round development including physical, mental, emotional and cultural is inescapable. Hence, Physical Education is given a prime importance in school as well in higher education. To create awareness towards physical fitness and make the students socially active is a prime importance of the Physical Education. Physical Education is focused towards developing healthy lifestyles and physical fitness among the students via emerging their physical competence, knowledge about safety and confidence.

The wide range of activities of physical education fraternity can merge physiological, psychological and sociological environment in totality to nurture a harmonic community It is very much vital to devise a significant programme of Physical Education in the beginning of the session and then accomplish it effectively in an organized way. The physical education program is steadfast to make physically, mentally and socially stable students who will be proven as the nation builders and allocate their efforts to construct a new and healthy society.

The aim of Physical Education programme is to make healthy, physically fit, socially active and morally stable builders of a new society and true defenders of their nation. The aim of Physical Education programmes is imparting health, comprehensive and harmonious development of human body and their functions.

There is heartfelt necessity of constituting a well-defined curriculum of Physical Education and execute in wider level to promote with specialized human knowledge.

2. LEARNING OUTCOME BASED APPROACH TO CURRICULUM PLANNING IN PHYSICAL EDUCATION.

The learning outcome of Physical Education is tending towards wide range of activities. In addition to developing lifelong physical competence it is supposed to inculcate positive values, generic skills and positive attitude in the students. It should motivate the students to engage in routine physical activities. To enable the students to demonstrate their knowledge about physical fitness and to maintain a health enhancing level of fitness. It is expected that students will understand the basic principles of lifetime wellness and disseminates this to the community and society. Students will learn new curriculum considering new educational trend and comply with technology.

2.1 NATURE AND EXTENT OF M.P.Ed. PROGRAMME IN PHYSICAL EDUCATION

Physical education imparts knowledge through physical mode or in other words, learning in physical context is the basic nature of physical education. To develop physical competence through specific knowledge and skills. It affords a holistic vision of societal, personal and environmental health. The extent of physical education is the following:

- Skills Development including developing skills like agility, IQ, Strength, Speed, endurance, flexibility and complete fitness

- Developing good health through physical and recreational activities
- Sportsmanship -through including yoga, games of teamwork etc.
- Integration of physical, social, mental and spiritual activities.

2.2 AIMS OF MASTER'S DEGREE PROGRAM IN PHYSICAL EDUCATION

Physical Education integrates the education process by principally converging on body or physique without which the education of a child is incomplete. Following are the aims:

1. Master's degree level Physical education program is determined towards developing consciousness towards health and accountable for developing physical, mental and social domain of an individual.
2. To ensure global competitiveness by developing national and international generic skills through facilitating teaching modes.
3. 2. It strives to make a perfect balance between and curricular and co-curricular activities. It not only develops progressive change within an individual but also instruct team spirit in them.
4. Unceasingly leading individuals towards attaining better life the field of physical education is inspiring young minds to develop better and healthy nation by sustaining the challenges of life.
5. The master's degree program assimilates physical education with communication skills, media knowledge, research considering new pedagogies and social context to maintain its relevance in current scenario.
6. Overall, it aims to indulge to perfectly blend the amalgamation of recreational activities with academics to enhance the inclusive qualities of young minds and bodies.

3. Post Graduate Attributes in Physical Education

A Postgraduates (physical education) are expected to have the following attributes:

(a) In-depth knowledge

The post graduate program of physical education provides thorough understanding of the subjects along with allied areas related to physical education and sports. It provides important linkage between theory and practice of various issues in physical education and sports. Additional knowledge of the subject matter is also provided with this post graduate program.

(b) Academic literacy

The post graduate attribute of post graduate program encompass advanced professional and skill related knowledge in the field of physical education and sports so that it provides a base to be an expert and imminent member of a particular community.

(c) Impressive communication

It is essential to gather information in such a way that it can be analysed and organised properly. It is also essential for a student to communicate ideas in an effective manner both in written and spoken form. It also includes the ability to communicate own idea to even a general population. The added part is the capacity to use information technology as means of effective communication.

(d) Logical and analytical thinking

A postgraduate program entails student to make aware about relevant problems associated with a particular field and then use logical and analytical thinking to solve it by providing new insight such as training scheduled preparation, program for all age groups.

(e) Research oriented mindset

The program inculcates research oriented mindset, allowing for original ideas and ability to use to well established norms in research and enquiry to propound new theory or ideas for community health and fitness.

(f) Judgment

The program allows student to deal with complex issues with sound judgment without proper background data and then able to put forth conclusions effectively. The students also deal with judgement of capacity and ability of sports performance.

(g) Employability

The program attributes also encompasses employment related issues with transferable skills that are necessary for employment purpose. It enhances employment related options while improvement in professional development. It also includes self governing learning ability for life long professional development. The program can develop ability for self employment.

(f) Independence and creativity

Students are expected to display creativity in work while doing it independently. They are also expected to show adaptability in changing atmosphere and environment.

(h) Ethical consciousness

Students are expected to show sound social responsibility. They apprise philosophical and social issue in the context of physical education and sports. They are expected to show respect in terms of cultural diversity.

(i) Collaboration / Team work :

Students will demonstrate the aptitude to work as as a team and respect other team members views and ideas. They will demonstrate the ethics of group culture and work for the common interest of that particular group. Students also develop team work and collaboration for event management.

(j) Leadership :

Students will demonstrate ability to take challenges of coaching, training of budding sportspersons apart from showing the skills to formulate training plan for sportsperson.

(k) Contribution to society:

Students will demonstrate ability to work with physically / mentally challenged sportsperson. They also demonstrate special ability to work for geriatric population for their physical and mental welfare.

4. Qualification Descriptors for M.P.Ed. Course in Physical Education

1. Demonstrate transferable skills and particular subject related know-how that is conducive for grabbing employment opportunities.
2. Ability to solve real life problems by virtue of subjects knowledge and transferrable skills and search of solution of a problem area.
3. Able to know the own learning requirements in new trends, knowledge base area, research or professional material.
4. Able to select appropriate methodology for quantitative and qualitative research as well as providing scientific evidence of problem with the help of analysis of data from various sources.
5. Able to develop self evaluation while planning and managing classroom teaching in physical education.
6. A thorough knowledge in specialized area with keen interest in gaining information on latest development in specialized field.
7. Demonstrate systematic knowledge and principles of areas under curriculum while able to clearly analyse scientific facts regarding area of study.
8. Demonstrate an understanding of important theories, principles and concepts.
9. Aptitude to apply fundamental concepts and principles outside the background in which they were first studied as well as aptitude to apply fundamental concepts and principles in an employment perspective.
10. Demonstrate skills to carry out SWOT analysis of own performance.

11. Demonstrate capacity to improve own knowledge base in the area of coaching and preparing training plan for sportsperson.

12. Demonstrate capacity to conduct coaching and prepare training plan for physically challenged sportsperson.

13. Demonstrate clear understanding to prepare and execute plan for elderly population.

5. Programme Learning Outcomes for M.P.Ed. Course in Physical Education

1. Demonstrate a clear, methodological and scientific knowledge of the academic field of physical education and knowledge of different allied branches of physical education with its application along with link of these branches with other allied areas.
2. An in-depth knowledge about producing physical education professionals that suits the need of research, government and private sector, education etc.
3. Demonstrate the capacity to apply the knowledge of various theories and principles in identifying problems in physical education, sports organization, sports coaching and then solve these problems with apt use of knowledge.
4. Ability to use qualitative and quantitative data for betterment of society.
5. Ability to solve problems in interdisciplinary research.
6. Demonstrate and practice ethical behaviour by providing correct scientific information while creating safe research environment for participants.
7. Ability to respect intellectual, copyright issues and environmental issues.
8. Demonstrate unbiased attitude towards sportspersons while preparing them for competition.

9. Ability to work with physically challenged sportsperson.

10. To use their indepth knowledge for welfare of geriatric population.

2020-21

SCHEME OF EXAMINATION FOR SESSION 2020-2022				
SCHOOL OF STUDIES IN PHYSICAL EDUCATION **PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR** **MPEd (Semester I to IV)**				
July 2020-December 2020				
First Semester	**Paper**	**Title of Paper**	**Marks**	
			(External)	**(Internal)****
	I	Professional Preparation and curriculum designs	**80**	**20**
	II	Test Measurement and evaluation in Physical Education	**80**	**20**

	III	Exercise physiology	80	20
	IV	Management of physical education	80	20
	P-1	Practical Officiating in Sports/Games	100	100
		Total	**600**	
January 2021-June 2021				
Second Semester	**Paper**	**Title of Paper**	**(External)**	**(Internal)**
	I	Training methods	80	20
	II	Biomechanics	80	20
	III	Statistics and Computer	80	20
	IV	Research Process	80	20
	P-I	Practical – Performance Testing	100	100
July 2021-December 2021				
Third Semester	**Paper**	**Title of Paper**	**(External)**	**(Internal)**
	I	Scientific Coaching Methods	80	20
	II	Sports Psychology	80	20
	III	Sports Medicine	80	20
	IV	Specialization theory	80	20
	P-I	Practical Advanced Coaching lesson	100	100
		Total	**600**	
January 2022-June 2022				
Fourth Semester	**Paper**	**Title of Paper**	**(External)**	**(Internal)**
	I	Health education	80	20

	II	Psychology of coaching and counseling	**80**	**20**
	III	Sports physiotherapy	**80**	**20**
	IV	Project/Foundation of physical education and current trends	**80**	**20**
	P-I	Practical – Physiological and Psychological assessment	**80**	**20**
		Total	**600**	
Grand total [Semester I + II + III + IV]			**2400**	

Detailed Syllabus for

Master of Physical Education Course

Semester I: Paper I

Professional Preparation and Curriculum designs

Learning Outcome

- To understand the ever evolving curriculum of physical education
- To develop opportunities to construct & design the curriculum of PE in broader aspects realizing the age group, gender consideration and physiological basis.
- To know about that intramural and extramural tournaments
- To Know about the role of curriculum design for effective teaching and learning in physical education

UNIT-I

Foundation of professional preparation

1. Ideals of Indian Democracy: Contribution of Physical Education.

2. Forces and factor effecting Education Policies and programs – social, religious, economic and political. Education and professional preparation in physical education in India with those in USA, USSR and UK.

UNIT-II

1. Under graduate preparation of professional areas of health education, physical education and recreation. Purpose of under graduate preparation.
   Administration, curriculum, laboratory experiences, field experiences, Laboratory Experiences, Field Experiences, Teaching Practice and Professional competences to be developed. Facilities and special resources for Library.

2. Post Graduate preparation of professional personnel: Purposes of post graduate studies, admission requirements, sports, curriculum, area of specialization and concentration on core areas, Research requirement, Methods of instruction.

3. In service education of professional personnel: Nature and scope of in service education; Responsibility for in service training, Role of administration, Physical Education Training Institute, Supervisors, the professional, and in – service training programmes. In service through individual efforts, apprenticeship on the job projects. Survey and reports, critical appraisal of existing types of post graduate programs.

UNIT-III

1. Importance of Curriculum Development Factors affecting curriculum, changing needs of student, national and professional policies

2. The Role of the teacher in curriculum development.

3. Principles of Planning: Understanding the capacity characteristics and needs of the learner. Evaluation and follow up.

4. selecting material for instruction – classification of activities for different age group and sexes. Progress in cariculam. Cultural influences in the choice of activities flexibility of programme material.

UNIT-IV

Selecting methods of teaching

1. Grouping of students for instruction, lecture, projects, activities, demonstration,
2. Block of period, total time allotment do a given activity, teaching aids, conditioning
3. Special gadgets to concentrate on development of particular skills or activity, provision for individual differences.

Development program for different levels of education: Kindergarden, elementary school, Middle School, High School and Higher Secondary School, College and University, Special institution (Technical School & orphan hostel) special days, national days etc.

UNIT V

1. Co-education in physical education – Interrelating the Programs for boys and girls. Activities suitable for co-education, levels at which co-education is desirable, spcial provision for development of girls programme.
2. Evaluation and follow up process in physical education – nature, importance and procedure for evaluation in physical education, follow- up: curriculum followed in colleges of physical education – BPE, MPEd, BPEd. In physical Education, M. Phil. Etc. committees recommendation: NCE – CBSE, UGC recommendation on curriculum for schools and colleges.

Semester I: Paper II

M. P. Ed. Semester I: Paper II

Test Measurement and Evaluation in Physical Education

STUDENT LEARNING OUTCOMES :

1. The students will learn the concept of testing.
2. The clarification regarding measurement and evaluation will be learnt by students.
3. The students will learn the assessment process of basic fitness components.
4. The students will learn about assessment of skill from different games.
5. The students will learn how to assess psycho-social elements of sportsperson.

UNIT-I

1. Meaning of evaluation.
2. Nature and scope of evaluation program.
3. Need and importance of evaluation in the field of physical education.
4. Principles of Evaluation.

UNIT-II

1. Criteria of test selection (reliability, validity, objectivity and norms), Administrative feasibility and educational application,
2. Classification of test, standardized tests (objective and subjective test).
3. Construction of test, Knowledge tests (written and skill tests).
4. Suggestions for administering test - Medical Examination, Testing Personnel, Time of testing, Economy of testing, Test record, Preparation of reports, Construction of tables & graphs and Purpose of reporting.

UNIT-III

Measurements of Organic Function Motor fitness and General Motor Ability.

1. Organic function: Cardiovascular respiratory function.

a. Cooper's 12 minute continuous run / walk test.
b. Tuttle's pulse ration test.
c. Harvard step test and its modification.

2. Motor Fitness –

a. Oregon motor fitness test
b. JCR test
c. Canada fitness test
d. AAHPER youth fitness test.
e. Fitness gram

3. General motor ability-

General motor ability test.

UNIT-IV

1. Test for strength:

a. Strength, Roger's physical fitness index and suggested changes
b. Kraus-Weber test

2. Test for skills:

a. Tests Volleyball-Brady test, Russell and Lange test
b. Basket ball-Johnson test, Knox test
c. Soccer-Mc Donald test, Johnson test
d. Field Hockey-Harbans Singh field hockey test
e. Badminton-Miller test,
f. Dyer tennis test.

UNIT-V

1. Measures of posture-IOWA posture test
2. Behaviour rating scale
3. Mental health
4. Sociometric
5. Motor educability
6. Personality inventory
7. Somatotype

Semester I: Paper III

Exercise physiology

STUDENT LEARNING OUTCOMES :

1. Understand the bases of movement and physiology and muscular movement.
2. Understand aerobic and anaerobic components of exercise.
3. Learn to plan diet for athlete and understand importance of nutrition and drug for athelete.
4. Should be able to assess and monitor effect of exercise on different systems of body.
5. Able to understand physiological aspect of training to plan training program.

UNIT-I

1. Skeletal Muscle, Structure, function and Characteristics
2. Chemical composition of skeletal muscle
3. Gross structure of Skeletal Muscle ,Muscle fiber type
4. Microscopic structure, structure of the myofibril.
5. Contractile mechanism, Molecular basis of the contraction of skeletal muscle, Heat production and thermo-dynamics of muscle contraction

UNIT-II

Neuro-muscular concepts

1. Neuron and motor unit transmission of nerve impulses, bio-electrical potentials

2. Nerve to nerve synapse, Neuro muscular junction and transmission of nerve impulse across it.
3. Propioception and kinesthesis. Tone, posture and Equilibrium.
4. Effect of exercise/training on neuro-muscular system

UNIT-III

Bio-energetics

1. Fuel for muscular work. Aerobic and anaerobic metabolism
2. Energy for muscular contraction and biochemical changes during muscular contraction, short duration high intensity exercise, long duration exercise.

UNIT-IV

Physiological changes due to exercise. Effect of exercise and training on:

1. Heart and circulatory systems.
    a. Blood circulation and functioning of the heart
    b. Blood supply to heart and skeletal muscle
    c .Regulation of blood flow during exercise.
2. Respiratory system
    a. Function of respiratory system
    b .Oxygen debt & recovery rate, Second wind.
    c. Effect of exercise on respiratory system.
3. A brief discussion on effect of exercise on other systems.

UNIT-V

1. Other physiological aspects of exercise and sports
2. Concept of physical fitness and physical training, warming up conditioning and fatigue
3. Energy cost of various sports activity.

Semester I: Paper IV

Management of physical education

STUDENT LEARNING OUTCOMES :

1. To describe organization and administration of sports programme.
2. To analyze and interpret sports philosophy, business systems, sports management, public administration and marketing techniques.
3. To develop decision-making, and problem-solving skills required for their role in the profession of physical education and sports.
4. To know about how to organize sports competition
5. To demonstrate the applicability of the concept of Financial Management in sport.
6. To explain the concept of Supervision and its application in sports.

UNIT-I

1. Review of principle and philosophy in of Education, Physical Education, Recreation and Health education.
2. Progressive concept of administration/ management. General administration theories.
3. Personal and material management programming for instruction and activities.
4. Hierarchy of education administration in Central, State local authorities and Individual Institution in India.

UNIT-II

1. Responsibilities of General Administration, technical Experts & Professionals.
2. Selected problems in Management / Administration
3. Professional preparation, professional ethics class discipline, student teaching.

UNIT-III

1. Budget and Finance: Budget heads principles of accounting financial power of different authorities, Sources of income auditing, terms of sanctions and purpose.
2. Staff job analysis, qualifications, requirement, supervision, training, leave, retirement deputation fringe benefits and staff meetings.
3. Office management's gathering data, programming and scheduling (Calendar, Timetable, thing that requires periodical attention) storing data (Filling), General office procedure like correspondence interview.

UNIT-IV

1. Management of sports in school, college & universities, Inter-University, District State & National level.
2. Indian and International Olympic association, SAI.
3. Public relation and promotional activities including-press relations, publications, Public speeches, assemblies, exhibitions demonstration, special events, staff, student welfare.

UNIT-V

SUPERVISION

1. Definition of Supervision
2. Scope of Supervision
3. Guiding Principles of supervision
4. Method of Supervision:
    a. Visitation
    b. Conference
    c. Bulleting
    d. Demonstration

Functions of Supervisions

1. Administrative duties

2. Duties pertaining to facility & Equipment

3. Duties pertaining to instruction

5. Duties pertaining to supervision

6. Duties pertaining to professional Growth

Practical -Officiating in Sports and Games

Semester II: Paper I

Paper I -Training methods-

STUDENT LEARNING OUTCOMES :

1. The students will become skillful for preparing training schedule.
2. The students will become proficient in designing training plan.
3. The student will learn to frame exercise sequence for development of different fitness component.
4. The assessment of training load and periodization planning will be learnt by the students.
5. The evaluation and the results of sportsperson progress can be presented by students through graphics.

UNIT-I

1. Brief historical sketch of development of Competitive sports in India.

2. Introduction to motor development.

3. Sports training.

4. Its aims, Tasks and characteristics.

5. Principles of sports training.

UNIT-II

1. Training Load: Important features of training load [Intensity, Density, Duration and Frequency].

2. Principles of Training load, Relationship between load and adaptation, conditions of adaptation, principles of over load. Causes and symptoms of over load, tackling of over load.

3. Training plans long term and short term plans,

4. Periodisation (Single double and triple). Cyclic process of training. Training session.

UNIT-III

Training for Important Motor Components

1. **Strength** – Forms of strength, characteristics of strength,, principle of strength, strength training, means and methods, strength training for children and women.

2. **Endurance** – Forms of endurance, characteristics of endurance, endurance training, means and methods.

UNIT-IV

1. **Flexibility** – Form of Flexibility, Methods of development of flexibility.

2. **Coordinative abilities** – Characteristics of coordination abilities, importance of coordinative abilities. Classification of coordinative abilities, Training means and methods.

3. **speed** – form of speed, characteristics of speed, basis of speed, training means and method.

UNIT-V

1. Planning and organization of training, Importance of Planning, Principles of planning, Contents for various periods of training.

2. Evaluation of training, Items to be included in evaluation programme, Forms of diagram and graphical presentation for evaluation and checking progress.

Semester II: Paper II

Biomechanics

STUDENT LEARNING OUTCOMES :

1. The students will learn the fundamentals of biomechanics applied in sports condition.
2. They will also learn the meaning and concept of linear and angular motion.
3. The students will understand the application of biomechanical principles.
4. They will also learn to carry out biomechanical analysis of sportsperson movements.
5. The role of fluid mechanism in sports will also be learnt by the students.

UNIT-I

Introduction

1. Meaning of Bio-mechanics, Bio-mechanics in Physical Education, Sports and Research
2. Fundamental Skills - Basic and Specific
3. Movement Analysis - Kinensiological Analysis, Mechanical Analysis and Bio-mechanical Analysis.

UNIT-II

1. Linear, angular and general motion
2. Distance and Displacement (Linear and Angular)
3. Space and Velocity (Linear and Angular) Acceleration (Linear and Angular Uniform Motion)
4. Units of Relationship of Linear and Angular motion, Centrifugal and Centripetal Forces
5. Newton's Laws of motion as applicable to Linear and Angular Motion.
6. Lever and its application.

UNIT-III

1. Force **–** Meaning, Units of Force, Effects of Force, Sources of Force, Components and Resultant, Friction Pressure.
2. Work, Power and Energy
3. Movement of Force, Movement of Inertia

UNIT-IV

1. Freely falling bodies, Projectiles, Momentum and Impact
2. Stability (Static and Dynamic), Initiating Rotation in the Air.
3. Spin, Impact and Elasticity.
4. Fluid Mechanics, Air Resistance and Water resistance.

UNIT-V

1. Analysis of fundamental skills – Walking Running, Throwing, Lifting, Pulling, Catching and Climbing
2. Analysis of Sports Skills of games & sports: Athletics, Basket ball, Volley ball, Badminton, Foot ball, Cricket etc.

Semester: II
Statistics and Computers
Paper: III

STUDENT LEARNING OUTCOMES :

1. To explain and evaluate various measures of central tendency.
2. To evaluate and interpret the outcomes of correlation matrix, i.e. correlation coefficient, strength, direction and significance level.
3. To train the students to apply the different statistical tests for hypothesis testing.
4. Students shall be able to use and apply a wide variety of specific statistical methods.
5. To interpret a set of descriptive statistics and understand the limitations of each measure.
6. To Know about the MS Office Applications in physical education

Unit – I:

- Meaning and definition of Statistics
- Need and Importance of Statistics in Physical Education
- Basic Concept of following terminologies:
  - Populations
  - Samples
  - Sample frame
  - Sampling Techniques
- Scales of Measurements (Nominal, Ordinal, Interval and Ratio)
- Types of Variables

Unit – II:

- Frequency Distribution
  - Simple Frequency Distribution
  - Cumulative Frequency
- Different types of Graphs
- Measures of Central Tendency

  Meaning, characteristics of good measures of central tendency and uses
- The Mean

  Meaning, characteristics, uses and calculation from ungrouped and grouped data
- The Median

Meaning, characteristics, uses and calculation from ungrouped and grouped data

- The Mode

Meaning, characteristics, uses and calculation from ungroup and grouped data

Unit – III:

- Measures of Variability
  Meaning, characteristics of good measures of variability and uses
- The Range
  Meaning, characteristics, uses and calculation from ungrouped and grouped data
  Relative and absolute measures
- The Quartiles Deviations
  Meaning, characteristics, uses and calculation from ungrouped and grouped data
  Relative and absolute measures
- The Mean Deviation
  Meaning, characteristics, uses and calculation from ungrouped and grouped data
  Relative and absolute measures
- The Standard Deviation
  Meaning, characteristics, uses and calculation from ungrouped and grouped data
  Relative and absolute measures

- The Normal Curve

Definition, Characteristics, Divergence from normality (Skewness and Kurtosis)

Unit –IV:

Making Inferences

- Basic Concept of following terminologies:
  - Hypothesis
  - Types of Hypothesis
  - Types of Error
  - Degrees of Freedom
  - Level of Significance
- Independent Sample *t* -test
- Related Sample *t* -test
- One Way Analysis of Variance (One Way ANOVA)
- Pearson Correlation Coefficient
- Spearman Correlation Coefficient
- Scale for construction of Norms
  - T- Scale

6 **σ** Scale
7 **σ** Scale

Unit – V:

- Introduction to computers
- Types of Computers
- Hardware and Software of Computer
- Working with internet and basic software
- Basic introduction of data analysis software

Semester II: Paper IV

Research Process

STUDENT LEARNING OUTCOMES :

1. To understand the research perspective in physical education and sports.
2. Develop ability to understand research process and to frame research problems independently.
3. Students learn to use print and electronic library resources effectively and appropriately, understand and apply data collection tools.
4. Able to prepare research proposal and research report following standard methods.
5. To develop capacity to successful conduct research in physical education and sports and publish scientific articles.

UNIT-I

Meaning of research, Need and importance and its scope in physical education. Type of research, survey of related literature, need for library search, library sources, Preparation of Bibliography and abstract.

UNIT II

Formulation and development of research problem: location of research problem. Criteria in selecting the research problem. Formulation of hypothesis.

UNIT III

a) Historical research: scope of historical research in Physical Education. Historical evidence, validity of historical data.

b) Philosophical Research: Brief Introduction.

UNIT IV

Survey studies: Place of survey Research in Physical Education. Tools of survey research, questionnaire and interviews, case studies. Definition of case studies, Importance of case studies. Characteristics of case studies, data collection in case studies.

UNIT V

Experimental Research

a) Meaning, scope, and nature. Control of experimental factors. Experimental designs.

b) Research Proposal and preparation of research report.

Practical:

Part A

Assessment of:

1. Cardiovascular fitness
2. Motor fitness
3. Motor educability
4. Health related fitness
5. Strength
6. Somatotype
7. Body composition
8. Body proportion

Part B

Field Work: a candidate has to conduct one test on at least 10 subject and prepare a report.

Seminar:2 Seminar to be presented on field work

Semester III: Paper I

Scientific Coaching Methods

STUDENT LEARNING OUTCOMES :

1. The student will develop to design preparation of technique learning.
2. The students will have more confidence in their knowledge of the subject matter related to tactics development.
3. The students will demonstrate the ability to resolve problems related to long term and short term training plan.
4. The students will learn to develop training session.
5. The students will learn to prepare plan related to psychological training for sportsperson.

UNIT-I

1. Historical development of coaching schemes in India.
2. Philosophy of coaching and qualities of coach.
3. Introduction to motor development, stages of motor development.

UNIT II

1. Technical preparation – Fundamental methods for the development of technique in sports. Stages of technical development, grounding, causes and correction of faults.
2. Tactical preparation – Tactical concepts, methods of tactical training.

UNIT III

Psychological preparation

1. Psychology of a coach and his trainees
2. Individual differences, psychological potentiality
3. Development of will power, stress, anxiety, frustration control
4. Planning for competitions. Main and build up competition. Frequency, preparation for competition.

UNIT IV

1. Preparation for competition. Competition system. Competition frequency.

2. Preparation for competition – Long term and Short term plans.
3. Arrangement of training session. Post competition plan.

UNIT V

1. Diet for sportsmen during training and pre-post competition, time for diet.
2. Use of drugs and their ill effects. Ergogenic aids – its use in competitive sports.
3. Talent identification, steps for talent identification.

Semester III: Paper II

Sports Psychology

STUDENT LEARNING OUTCOMES :

1. The students will acquire the knowledge about applied psychology.
2. A Students will come to know about basic concept of sports psychology.
3. Students will understand the methods of investigation used in sports psychology.
4. The students will gain knowledge about the pre, during and post completion psychological preparation.
5. The students will learn to assess psychological problems of sportsperson through testing.

UNIT-I

1. The meaning, nature and scope of sports psychology.
2. Development of sports psychology.
3. Relationship of sports psychology with other sports sciences.
4. Importance of sports psychology for physical education.

UNIT II

1. Methods of investigation in sports psychology, its importance.
2. Various methods used in sports psychology.
3. Different test to be used in sports psychology.

UNIT III

1. Growth and development, factor affecting growth and development.
2. Individual differences and their influence on physical activity.
3. Psychological aspects of action regulation.
4. Importance of action regulation in physical activities, psychological characteristics of physical activities.

UNIT IV

1. Psychological aspects of competition, psychology of sports competition.

2. Psychological characteristics of pre-competition, competition and post competition.

3. Motivation, meaning of motive, role of motive, attitudes, interest for physical activity, importance of motivation in peak performance.

UNIT V

1. Cognitive process in physical activities, characteristics of cognitive process in sports.

2. The importance of perception in physical activities.

3. The function of thinking and imagination in physical activity.

4. The role of memory in physical activities.

5. The importance of attention in sports and its relationship with cognitive process.

Semester III: Paper III

Sports Medicine

STUDENT LEARNING OUTCOMES :

1. Understand the basic various components of sports medicine and athletic care.
2. Learn to plan diet for athlete and understand importance of nutrition and drug for athlete.
3. Should be able to assess body composition, understand its relation to performance and understand environmental stress on performance.
4. Learn to develop exercise regime for all.
5. Learn extension services of sports medicine for special population.

UNIT-I

1. Definition of sports medicine, it's aims and objectives
2. Brief History, of sports medicine.
3. Physiological, pathological and psychological problems of sportsmen.

UNIT II

1. Nutrition: Athletic nutrition malnutrition, low cost High calorie diet role of vitamins, minerals, salts. Carbohydrate loading. Diet before competition and after competition
2. Doping: Agents, effect, dope test and sanctions. Role of WADA and NADA

UNIT III

1. Work capacity under different environmental conditions. Thermoregulation and sports.
2. Physique and performance. Somatotypes.

UNIT IV

1. Prophylactic health-care. Health related fitness.
2. Aging & sports.
3. Women in sports. Pregnancy and exercises.

UNIT V

1. Common old age problems namely – arthritis, heart diseases and diabetes. Role of exercise in rehabilitation.
2. Obesity and weight control.
3. Adapted physical Education – Physically & Mentally challenged persons.
4. Exercise prescription.

Semester III: Paper IV

Specialization

STUDENT LEARNING OUTCOMES :

1. Learn advance concepts of games and sports.
2. Learn the layout and construction of Game/Sports ground/Courts.
3. Learn the mechanics of the Game/Sports.
4. Learn to develop training methods related to Game/Sports.
5. Develop coaching skill for advance skill/strategies of Game/Sports.

UNIT-I

Skills, Techniques and strategies:

1. Advance skills of games / sports.
2. Techniques, Tactics and strategies of game / sports.

UNIT II

Officiating of games / sports.

1. Rules and their interpretation.
2. Mechanics of officiating.

UNIT III

Play field, Sports bodies and Organization.

1. Construction, layout and maintenance of play field and equipment.

2. Structure and function of Federation and Associations.
3. National and International competition.
4. Organization of competitions and coaching camps.

UNIT IV

1. Skill test, Mechanics of games / sports.
2. Analysis of scientific principles applied to different skills / techniques.

UNIT V

1. Training Method: for improving the performance in games / sports.
2. Training Schedule.

Practical -Advanced Coaching Lesson

Semester IV: Paper I

Health education

STUDENT LEARNING OUTCOMES :

1. Understand the health system of India.
2. Develop understanding of various aspects of school health.
3. Develop understanding on effect of environment on health.
4. To get acquainted with communication Diseases.
5. Learn causes prevention and rehabilitation of non-communication diseases.

UNIT-I

1. Health
   a. Concept of health
   b. Various level of health care in India
   c. Role of heredity and genetics in achieving positive health
2. Health education
   a. Meaning of health education
   b. Aim and content of health education
   c. Approaches of health education
   d. Latest trend in health education

UNIT-II

1. School health services
   a. Meaning and objectives of school health services and school health programs aspect of school health services
2. Healthful school environment

UNIT-III

1. Community and environmental sanitation

a. Housing

b. Pollution, light, noise and temperature

    i. Population policy, population dynamic and population explosion

        ii National family welfare program

    ii. Sex education

UNIT-IV

1. Communicable diseases

    a. Meaning of epidemiological approach of communicable diseases brief description of following communicable diseases and their prevention

        i. Tuberculoses

        ii. Chicken pox, measles, mumps

        iii. Malaria and filarial

        iv. Rabies

        v. STD and AIDS

        vi. Hepatitis (Jaundice)

UNIT-V

1. Non-communicable diseases

    a. Meaning of non communicable diseases

    b. Brief description of following non communicable diseases and their prevention: Heart diseases, Cancer, diabetes.

    c. Stress assessment and management through exercise.

Semester IV: Paper II

Psychology of coaching and counseling

STUDENT LEARNING OUTCOMES :

1. Students will become familiar with the concept of guidance and counseling.
2. Students will be acquainted with the assessment of psychological potential of sports person.
3. The student will be able to understand counseling process.
4. The concept of group counseling will learnt by the students.
5. The student will learn about diagnosis of psychological problems in sportsperson.

UNIT-I

Psychological assessment of the players, capacity of the player psychological preparation for pre, during and post competition. Pep talk, Self confidence. Emotional maturity. Emotional intelligence.

UNIT-II

Counseling process introduction. Preparation for counseling.

a. Readiness
b. Pre counseling interview
c. Case history
d. Process of counseling
e. The first interview

f. Reassurance

g. Winning confidence

h. Advising

Counseling relationship – content and process. Physical setting. Privacy value orientation. Acceptance. Understanding. Report. Communication and empathy. Attentiveness. Counseling relationship. Counseling process.

UNIT-III

Psychological testing and diagnosis – introduction. Limitation of the use of psychological tests. Type of psychological tests. Test used in counseling situations. Test interpretation in counseling. Not – test client appraisal techniques. Autobiography. Anecdotal records. Rating Scale. Cumulative records. Pupil data questionnaires. Case studies. Psychodiagnostics, limitation of diagnosis. Common diagnostic classification systems in counseling.

UNIT-IV

Counseling interview – introduction, interviewing its essential aspects association of ideas contained within interview. Shifts in conversation, Opening and closing remark, recurrent reference, Inconsistencies and gaps. Review, Non verbal communication in interview. Counselee. Counsellof relationship. Interviewing techniques in counseling. Structuring the counseling relationship degree of lead, silence. Relationship techniques. Sharing of experience.

UNIT-V

Group counseling – Introduction. Case for group counseling, emerging field of group counseling. Structuring groups, limitation and assumptions of group counseling. Mechanisms of group counseling. Types of groups. Group counseling – its value. The process of group counseling. Individual and group counseling similarities. Differences between individual and group counseling.

Special areas in counseling – Introduction, family group consultation

Counseling families. Counseling with parents, counseling the delinquent, counseling reluctant clients, structuring. Counseling women.

Semester IV: Paper III

Sports physiotherapy

STUDENT LEARNING OUTCOMES :

1. Student will learn about injuries and rehabilitation.
2. Apply therapeutic modalities and exercise therapy.
3. Student will learn and apply preventive and curative aspect of sports injuries.
4. help to learn to…
5. Interpret the concept toward positive lifestyle.

UNIT-I

Introduction

1. Review of anatomy and physiology of various muscles, joints and their function and action, physiological changes due to exercise – cardio-respiratory muscles, nervous systems.

2. Causes of injuries – intrinsic, excentric factors

3. Types of sports injury

4. Load deformation curve, response to stress, inflammation healing.

UNIT-II

Common regional injuries

1. Mechanism of injury clinical feature of injuries

2. Injuries of head, neck and face

3. Injury involving upper limbs

4. injuries involving thorax, abdomen and back

5. injuries involving lower limbs

UNIT-III

Common sports injuries

1. Common injuries found in various sports

2. Mechanism of injuries in various sports activity

3. Basic on field assessment and management, RICE, first aid, moving the injured athlete

4. Bandaging, crape.

UNIT-IV

1. Sports massage

2. Core stability

3. Protective equipment

4. Injury in children, women and elderly

Practical demonstration

1. Uses of crape bandage, banding technical

2. Electrical modulation

3. Use of thera band, exercise ball, Medicine ball

4. Visit to health club / fitness camps

5. Visit to sauna bath / steam bath

Semester IV: Paper IV

Foundation of physical education and current trends

STUDENT LEARNING OUTCOMES :

1. To understand principles and philosophies of physical education and cultivate positive values and attitudes for the development of an active and healthy lifestyle.
2. To acquire good health, physical fitness and bodily coordination through participating
regularly in physical activity.
3. To promote desirable moral behaviors, cooperation in communal life, ability to make
decisions, and the appreciation of aesthetic movement
4. To Know the importance of sports journalism and mass media for sports.
5. To established the relationship of Yoga and Sports.

UNIT-I

Philosophical foundation of physical education

1. Idealism
2. Pragmatism
3. Naturalism
4. Existentialism and other philosophies

UNIT-II

1. Journalism & Sports journalism
    a. Meaning, concept, scope
    b. Basic principles of sports reporting, source of sports news
    c. News gathering process
2. Reporting for print media and electronic media
3. Editing, writing for various media
4. Layout and design for print media

UNIT-III

Adapted physical education

1. Introduction to adapted physical education – meaning, definition, aims and objectives.
2. Classification of disabilities
3. Development of adapted physical education program
    a. Guiding principles
    b. Special adapted physical education program for different categories

UNIT-IV

Communication skills. Types of communication. Methods of communication. Official communication. Reports, minutes and agenda. Circular, notice, office orders, note sheet and memo etc.

Press release, media conferencing and invitation

Verbal and non verbal communication

UNIT-V

Yoga and fitness

1. Introduction to Yoga: The concept, Meaning, definition and tradition of Yoga.
2. Meaning, definition and importance of Yoga and Health in life. Theories of Health, Various exercises benefits of Yoga- asanas and their values vis-à-vis other systems.

~~3.~~ Life pattern and Yoga,Effects of yoga upon bodily function, Role of yoga asanas in modern living.

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~~4.~~3.

Practical: Physiological and Psychological assessment

Part A

Physiological assessment of:

1. Heart Rate
2. Respiratory Rate
3. Peak flow Rate
4. Hemoglobin
5. Blood Pressure
6. Nutritional Assessment

PART B

Psychological assessment:

1. Paper pencil test
2. Psychomotor test

Field Work: a candidate has to conduct one test on at least 10 subject and prepare a report.

Seminar: 2 Seminar to be presented on field work

7.TEACHING -LEARNING PROCESS

It is crucial to decide the style of teaching and match it with the style and need of learners. To set an appropriate balance between physical, social, psychological, and psycho-motor abilities of the learners is a challenge for the teacher. The teacher itself should be competent enough to gain the knowledge and execute at the level of learners' end. The teacher should be capable to foresee the difference in the different types of learners before deciding the process or style of teaching. Moreover, the teacher should elucidate and determine the factors affecting learning.

The purpose of teaching learning method would be fulfilled if the learner would understand what the teacher is teaching or if the teacher would understand what the requirement of learners is.

The following methods of teaching are suggested here-

a. Question-answer session
b. Learning through E-Resources
c. Class tests
d. Teaching through Models/prototypes
e. Group Discussion
f. Project work
g. Group or team-based activity
h. Internship
i. Educational Tours
j. Industrial visits
k. Student/Faculty Exchange Program
l. Self-Study
m. Online Classes
n. Online Quiz
o. Project Work etc.
p. Presentations
q. Case Studies

Following are steps proposed for the process of teaching-

1. Interactive Session- students should be encouraged to speak or communicate with their fellows in the class about the pre decided topics related to curriculum.

2. Group Discussion- on a topic of a lesson group discussion can be conducted among selected students within a limited time frame to explore about the topic.

3. Question Answer Session- The Students can be encouraged to ask their doubts in the classroom to boost their morale and to get-rid-of their confusions.

4. Class Tests- Scheduled or Unscheduled Class Tests can be taken in the classroom. Unscheduled tests will analyse how much student prepare himself in the past few days.

5. Presentations- Preparing students for classroom presentations related to the classroom topic will empower them to understand the other students' requirement and develops an empathetic vision towards teacher in the classroom. Presentation will also lift teaching skills in the student and improves confidence in the class.

6. Case Studies- Through Real and Imaginary Cases to be taught in the classroom, the students may develop their decision making and managerial skills.

7. Assignments- After the class, the assignment can be given to the students as a supportive mode of teaching. They will explore some of the tasks from themselves to enhance their learning habits. This may increase the regular habit of learning among the students.

8. Study Material Distribution- The teacher before taking the class may distribute the study materials through mail or other online mode. This will help students to prepare themselves before the class for better understanding.
9. Teaching through Audio-Visual Learning- Using Teaching Aids are always better than lecture method. The audio-visual mode of learning prevents the monotony of lecture method and retains the contents for longer time in the mind of learners.

10. Collecting feedback from learners- collecting feedback about the content, teaching mode, teacher, etc. from the learners will facilitate the teacher to realize the needs of the students. Teachers may improve their performance based on this feedback.

SoS in Physics and Astrophysics
Pt. Ravishankar Shukla University Raipur, 492010

Programme outcome:

The students will be able to:

- Apply theoretical knowledge and concepts of Physics to practical problems.
- Use mathematical techniques and interpret mathematical models of physical behavior.
- To acquire the skills in handling scientific instruments, planning and performing in laboratory experiments. Analyze the given scientific data critically and systematically.
- Develop subject expertise, confidence, communication skills and scientific discussions to perform in National and International platform.
- Continue research at the higher degree (Ph D) level.
- Obtain employment in research and development in the scientific labs and engineering industries.
- Develop necessary skills and ability to opt more general carrier choices such as public services, banking, IT, government and private sectors etc.

Programme specific outcome: M.Sc. Physics

- Understanding the basic concepts of Physics i.e. classical mechanics, quantum mechanics, statistical mechanics and electrodynamics and plasma physics through logical and mathematical reasoning.
- Understand the basic concepts of other fields such as nuclear and high energy physics, atomic and molecular physics, solid state physics, astrophysics, general theory of relativity.
- Develop experimental skills in front line areas of Physics such as solid state physics, nanoscience, lasers, electronics, astronomy and astrophysics.
- Gain expertise to work in applied fields.
- Study of Physics develops a critical attitude and logical reasoning that can be applied to various fields.

Course specific outcome of M. Sc. Physics

S. No.	Name of Papers	Outcomes The students will be supervised, experienced and be able to:
1.	Mathematical Physics	• Understand the basic ideas, tools and methods of Mathematical Physics. • Use of Vector Space, Matrices and complex variables in different areas of Physics. • Solve Differential equations and learn their applications. • Familiar with in Physical Sciences, Special functions and their applications. • Utilize Series Expansion and Fourier transform in Physical problems.
2.	Classical Mechanics	• Understand the Newtonian Mechanics, Lagrangian and Hamiltonian Formulation. • Have a deep understanding of the central force problem and rigid body dynamics. • Use of Mechanics to solve various Physical problems.
3.	Electrodynamics & Plasma Physics	• Understand Maxwell equations and its implication to Electromagnetic fields and waves. • Learn the production of Electromagnetic radiations through various radiation processes. • Understanding the plasma state, concepts of Debye screening and collective behavior. • Get knowledge of Plasma Kinetic Theory, MHD and confinement scheme.
4.	Electronics	• Get knowledge of Operational Amplifier circuits, frequency response and its applications. • Understand the combinational and sequential logic circuits and their various applications in digital electronics. • Have understanding of 8085 Microprocessor and its programming.
5.	Quantum Mechanics-I	• Gain knowledge of non-relativistic quantum mechanics. • Solve time dependent and time independent Schrodinger Equations for simple potentials. • Apply time independent perturbation theory to solve simple problems. • Understand the concept of angular momentum and central force problems.

6.	Statistical Mechanics	• Develop concept of macroscopic, microscopic states and ensembles in statistical mechanics. • Formulation of classical and quantum Statistics i.e. MB, BE and FD. • Implication of statistics in various Physical problems.
7.	Electronic & Photonic Devices and Optical Modulators	• Understand unipolar and bipolar devices and their applications in various fields. • Develop special microwave devices and their applications in many fields. • Gain the knowledge of Photonic Devices, Optical Modulators and Display Systems.
8.	Computational Physics & Computer Programming	• Get knowledge of computational methods in Physics. • Learn the FORTRAN Language. • Use FORTRAN Programming to solve various equations. • Perform Interpolation and curve fittings through various tools.
9.	Quantum Mechanics-II	• Use the variation method, WKB approximation and Time dependent Perturbation theory to solve questions in atomic Physics. • Learn the principle of scattering processes. • Gain knowledge of relativistic quantum mechanics, explain the Dirac equation and it's free particle solutions.
10.	Atomic & Molecular Physics	• Learn one electron and two electron atomic systems. • Understand role of Pauli's exclusion principle and coupling mechanism of angular momentum. • Learn the effect of electric and magnetic fields on atomic system, its energy levels and spectral lines. • Understand the interaction mechanism of molecules with radiation. • Learn to explain IR, Microwave and Raman Spectroscopy.
11.	Solid State Physics-I	• Develop theoretical and experimental approach to give fundamental insights into Solid State Physics. • Gain knowledge of characteristic behavior of electrons in solids and its consequences. • Understand the Fermi Surfaces and Lattice Dynamics. • Get basic ideas of superconductivity and semiconductor crystals.
12.	Astronomy & Astrophysics-I	• Understand the various astrophysical parameters and get elementary ideas of astronomy and astrophysics. • Formulate basic equations of stellar structure to understand stellar interiors. • Learn the process of stars' formation; understand their evolution and study of their end products i.e. white dwarfs, neutron starts and Black hole. • Get a deep insight into Solar Physics and related phenomena.

		• Learn and perform the measurement techniques used in astronomy and astrophysics.
13.	Physics of Nano-material-I	• Get basic ideas of Nano structure materials and carbon nano tubes. • Learn methods of preparing nanostructure using different techniques. • Understand Structural and chemical characterization of nano structure.
14.	Nuclear & Particle Physics	• Understand the nucleon-nucleon interaction through Deuteron and scattering theory. • Able to understand nuclear reactions and energetics. • Study of nuclear decays and related Physics. • Develop nuclear models to explain nuclear properties. • Understand the fundamental interactions, elementary particles, Quarks and standard models.
15.	Laser Physics and Applications	• Learn the working mechanism of Laser and its applications. • Develop knowledge of population inversion, Q-factor and threshold conditions. • Gain knowledge of different types of lasers. • Understand the production of giant laser, multi photon process and their applications.
16.	Solid State Physics - II	• Gain the basic knowledge of Physics of plasmons and polaritons. • Understand the dielectric and ferroelectric properties of solids. • Have quantum mechanical exemplification of the diamagnetic, paramagnetic, ferro and anti-ferromagnetic properties of solids. • Develop knowledge of optical process and defects in solids.
17.	Astronomy & Astrophysics-II	• Learn various types of galaxies through Hubble Sequence and get detail knowledge of Milky Way galaxy. • Understand the accretion on to a super massive B.H. and Active Galactic Nuclei. • Understand failure of Newtonian Gravity and need of General Relativity. • Construct Cosmological Models of the Universe and their verification through observational techniques.
18.	Physics of Nano-material-II	• Understand the basic knowledge of electrical transport properties in Nano structure. • Different application of CNT and Polymeric nanofibers. • Get knowledge of sustainable nano technology and human health. • Understand principle of nano lithography and their applications.

School of Regional Studies and Research
Pt. Ravishankar Shukla University, Raipur (C.G.)

M.A. in Rural Development
M.A. Semester 1st

Paper -I

Rural Development: Indian Context

Course Code: RD 101

Learning Outcomes:

At the end of the course the students are expected to:

1.understand the meaning, scope and historical background of rural development

2.know the various programmes of rural development

3.gain knowledge of rural development in Indian context and Asian countries

Paper -II

Rural Development Planning and Management

Course Code: RD 102

Learning Outcomes:

At the end of the course the students are expected to:

1.identify the role of planning in rural development

2. meaning of projects and projectevolution and development of planning in India

3. identify the factors affecting implementation of projects

4.understand the concept and scope of rural development management

Paper -III

Rural Development Programme& Evaluation

Course Code:RD 103

Learning Outcomes:

At the end of the course the students are expected to:

1.explain what impact the various programmes have had on the poor and the rural areas

2. outline the landmarks in educational development in rural areas

3.understand the main objectives of the Drought Prone Areas programme (DPAP) and the Desert Development Programme (DDP)

Paper -IV

Rural Social Problem

Course Code: RD 104

Learning Outcomes:

At the end of the course the students are expected to:

1.understand the problems of inequality and tribal issues

2. know the role and status of women and violence against women

3.identify the problems of land and displacement

Paper - V

Panchayati Raj and Rural Administration

Course Code: RD 105

Learning Outcomes:

At the end of the course the students are expected to:

1.understand the evolution of rural development programmes, policies and acts.

2. know the thrust areas of rural development and Agricultural Extension Services

3.understand the functions of panchayat raj system

M.A. Semester 2nd

Paper – I

Urban Planning

Course Code: RD 201

Learning Outcomes:

At the end of the course the students are expected to:

1.understand the meaning, goals and objectives of urban planning

2. know the theories of urbanization and concepts of compact city approach

3.identifymethods of urban and regional problems

Paper - II

Rural Economy & Industrializatio

Course Code: RD 202

Learning Outcomes:

At the end of the course the students are expected to:

1.understand the concept and basic needs of rural economy and rural industrialization

2. know the policies & programmes for rural industrial development during planning era

3.measure the rural poverty and rural employment

Paper - III

Rural Health Care

Course Code: RD 203

Learning Outcomes:

At the end of the course the students are expected to:

1.understand the concepts and components of health and health care services in rural India

2. learn about various diseases and its prevention and controls

3.get information about planning and management of rural health care services

Paper - IV

Scientific Research Methodology in Rural Development

Course Code: RD 204

Learning Outcomes:

At the end of the course the students are expected to:

1.explain the meaning, importance and purpose of research

2. describe the nature of research and identify the areas of rural development in which research is being increasinglyundertaken

3.describe the steps in the sampling process and the various methods of sampling anddefine a probability sample and describe the various types of probability sample

4. write a research report

Paper – V

Tribal Development(With special reference to Chhattisgarh)

Course Code: RD 205

Learning Outcomes:

At the end of the course the students are expected to:

1.know the geographical distribution of tribal population

2. understand the concept and objectives, plans, programmes of tribal development

3.critically review the forest policies of tribal and identify the problems of tribe.

M.A. Semester 3rd

Paper-I

Course Code: RD 301

Communication and Extension in Rural Development

Learning Outcomes:

At the end of the course the students are expected to:

1.understand the meaning, concept and communication process

2. describe the principles of extension for effective execution of extension programme and list out
the general and specific objectives of extension

3.describe communication support in the context of rural development

Paper – II

Rural Social Development

Course Code: RD 302

Learning Outcomes:

At the end of the course the students are expected to:

1.understand the overall status of rural women in India

2. identify indicators that are commonly used to describe the health, nutrition and educational status
of children

3.describe the constitutional status of scheduled castes andassess their social and economic status in society

4. describe the main aspects related to the development of scheduled castes and indicate their representation in services

Paper – III

Voluntary Action in Rural Development(With special reference to Chhattisgarh)

Course Code: RD 303

Learning Outcomes:

At the end of the course the students are expected to:

1.understandthe essence and meaning of voluntarism and identify the theoretical assumptions of voluntarism

2. make a critical assessment of the interrelations between market economy, voluntary effort and rural development.

3.identify the global voluntary effort in rural development and case studies of voluntary organizations in India

Paper – IV

Land Reforms and Rural Development

Course Code: RD 304

Learning Outcomes:

At the end of the course the students are expected to:

1.understanding the meaning of land reform, its scope and importance and understand the need of land reform in rural development

2. knowthe contributions of land reform in rural development and identify various issues concerning land reform

3.describe the administration of land revenue, Panchayati Raj and land reforms

Paper – V

Dissertation: Project Report based on Field Work

Course Code: RD 305

Learning Outcomes:

The completed dissertation should provide proof of students' understanding of:

1.research design as applicable to a specific topic

2. issues concerning sampling, quantitative and qualitative analysis of data

3.compile the analyzed data and present in the form of a report

M.A. Semester 4th

Paper – I

Entrepreneurship and Rural Development

Course Code: RD 401

Learning Outcomes:

At the end of the course the students are expected to:

1.identify and respond to rural entrepreneurship needs.

2.learn about broader rural socio-economic issues and its impact on rural communities.

3.understand strategies incorporated in various plans to promote entrepreneurship in rural areas

4. analyze the outcomes of the policies and strategies for promoting entrepreneurship in rural areas

Paper – II

Natural Resources and Sustainable Development

Course Code: RD 402

Learning Outcomes:

At the end of the course the students are expected to:

1.identify the meaning and types, importance of natural resources of natural resources

2.understand the meaning and conceptsustainable development.

3.know the forest resources and distribution, major forest types and water resources and its traditional management

Paper – III

Resources and Livelihood Management

Course Code: RD 403

Learning Outcomes:

At the end of the course the students are expected to:

1.understand the resources and rural livelihood management

2. know the various government scheme for rural livelihood

3.identify the resources and utilize it for sustainable livelihood

Paper – IV

Internship

Course Code: RD 403

Learning Outcomes:

Through internship students will –

1. Get experience in actual work situation.
2. Practice skills of guidance and counseling already learned during the course.
3. Develop an insight into the causal relationships in the problems of students, regarding school environment.
4. Develop the ability to co-ordinate at work place.

   Duration of Internship will be 1.5-3 months.

During the internship period students will identify the problems, identify strengths and weaknesses, develop and execute programmefor enhancing the abilities motivation etc. They will also handle the problem cases ofvaried types as referred to them. The students will maintain the record of their work during internship; get it signed by their supervisor from time to time. In the end, they willhave to produce a certificate of successful completion of internship signed by the Head ofthe Institution/ Principal and the authorities where internship has been done and also by the Head of the department.

RD 404: Presentation based on Internship

Learning Outcomes:

At the end of the course the students are expected to:

1. learn public speaking and good presentation skills

RD 405: Viva based on Internship

Learning Outcomes:

At the end of the course the students are expected to:

1. learn how to face interview

Choice Based Credit System for students of other department

Research Methodology

Course Code: CBCS101

Learning Outcomes:

At the end of the course the students are expected to:

1. explain the meaning, importance and purpose of research

2. describe the nature of research andidentify the areas of rural development in which research is being increasinglyundertaken

3.describe the steps in the sampling process and the various methods of sampling and define a probability sample and describe the various types of probability sample

4. The course will helpful to provide field training write a research report

Corporate Social Responsibility

Course Code:CBCS 102

Learning Outcomes:

At the end of the course the students are expected to:

1.understand the meaning and definition of corporate social responsibility

2. know the implementation and impact of CSR practices on development

3. understand the act, policies and laws of corporate social responsibility

Post Graduate Diploma in Regional Planning and Development

Paper-I
Course Code: PGDRPD 101
Title: Regional Planning and Development

Learning Outcome :

At the end of the course the students are expected to:
1.understand the concept, scope and objectives of regional planning
2. know the theories, approaches and strategies of regional planning
3. understand the five year plans of regional policies and 12^{th} five year plan

Paper-II
Course Code: PGDRPD 102
Title: Research methods and Computer Application

Learning Outcome :

At the end of the course the students are expected to:
1.understand the meaning, importance and purpose of research
2. describe the nature of research and identify the areas of rural development in which research is being increasingly undertaken
3.know the uses of computer application for research work
4. write a research report

Paper-III
Course Code: PGDRPD 103
Title: Tribal Development(with special reference to Chhattisgarh)

Learning Outcome :

At the end of the course the students are expected to:

1. know the geographical distribution of tribal population
2. understand the concept and objectives, plans, programmes of tribal development
3. critically review the forest policies of tribal and identify the problems of tribes

Paper-IV
Course Code: PGDRPD 104

Title: Dissertation: Field based Minor project on Urban Planning

Learning Outcomes:

The completed dissertation should provide proof of students' understanding of:

1.research design as applicable to urban planning

2. issues concerning sampling, quantitative and qualitative analysis of data

3. compile the analyzed data and present in the form of a report

Semester- II

Paper-I
Course Code: PGDRPD 201
Title: Research and Development based Regional Needs

Learning Outcomes:

At the end of the course the students are expected to:
1.understand the meaning, importance and purpose of human resources
2. describe the nature of research and identify the areas of rural development in which research is being increasingly undertaken
3.know the Role and Importance of Statistics in Research

Paper-II
Course Code: PGDRPD 202
Title: Rural Marketing & Finance

Learning Outcomes:

At the end of the course the students are expected to:

1.understand the concept, characteristics and scope of rural marketing and agriculture marketing

2. know the agencies, mediators of rural marketing and agriculture marketing

3.identify the rural finance institutions and agencies

Paper-III
Course Code: PGDRPD 203
Title: Dissertation /Field Report

Learning Outcomes:

The completed dissertation should provide proof of students' understanding of:

1.research design as applicable to a specific topic

2. issues concerning sampling, quantitative and qualitative analysis of data

3. compile the analyzed data and present in the form of a report

Paper – IV
Course Code: (PGDRPD 204)
Title: Seminar &Viva

Learning Outcomes:

At the end of the course the students are expected to:

1.learn public speaking and good presentation skills

2. learn how to face interview

PT. RAVISHANKAR SHUKLA UNIVERSITY: RAIPUR
SCHOOL OF STUDIES IN STATISTICS

Outcomes
Of
M.A./M.Sc. (Statistics) Syllabus, 2020-21

SEMESTER-I
Paper-I: Real Analysis

(i) Course learning outcome:

The course gives mathematical background to understand tools and techniques of mathematical Statistics.

(ii) The detail content of this course and references and suggested books:

Recap of elements of set theory; Introduction to real numbers, Introduction to n-dimensional Euclidian space; open and closed intervals (rectangles), compact sets, Bolzano - Weirstrass theorem, Heine - Borel theorem. Sequences and series and their convergence.

Real valued function, Properties of real valued continuous function on R^n , Uniform continuity, Sequences and series of functions, Uniform convergence. Power series and radius of convergence.

Differentiation, maxima - minima of functions; functions of several variables, constrained maxima - minima of functions. Multiple integrals and their evaluation by repeated integration, Dirichlet and Lioulle's Theorem. Change of variables in multiple integration.

Reimann-Stieltjes integral of real valued function & its properties, Mean value theorem, Integration by parts and change of variables, Term by term integration, Differentiation & integration under the integral sign. Improper integral, Uniform convergence in improper integrals, Test for absolute and conditional convergence.

REFERENCES

1. Apostol, T.M. (1985). Mathematical Analysis, Narosa, Indian Ed.
2. Courant, R. and John, F. (1965). Introduction to Calculus and Analysis, Wiley.
3. Miller, K.S. (1957). Advanced Real Calculus, Harper, New York.
4. Rudin, Walter (1976). Principles of Mathematical Analysis, McGraw Hill.
5. Hewitt and Stromberg : Real and Abstract Analysis.
6. G. Das and S. Pattanayk : Fundamental of Analysis, TATA Mc Graw Hill.
7. Shanti Narayan: A course of mathematical analysis. S. Chand & Co. Ltd.

Paper-II
Statistical Methods

(i) Course learning outcome:

This course gives basic knowledge of statistical tools and data analysis applied in various disciplines of study like Sociology, Psychology, Economics, Commerce, Management, Agriculture, Medical and Pharmaceutical Sciences.

(ii) The detail content of this course and references and suggested books:

Frequency distribution, measures of location, dispersion and skewness, Moments and cumulats, moment generating function.
Simple correlation coefficient, Multiple and Partial Correlation. Linear and Multiple Regression, and their application, Intra class correlation, Correlation ratio.

Testing of hypothesis, Level of significance, degrees of freedom, Central and Non-central chi-square, t and F- distributions, their properties and related tests. Sampling distributions of mean and variance of a sample from a normal population, sampling distribution of simple correlation coefficient in null case.

Definition of probability, Bayes' theorem, Basic distribution function probability mass function, probability density function, joint, marginal and conditional p.m.f. . Random Variables and its mathematical expectations, conditional Expectation, Expectation of sum and multiplication of random variables, Markov Holder-Jensen and Liapounov inequalities.
Standard Discrete Distributions- Bernoulli, Binomial, Poisson, Geometric, Hyper geometric and Multinomial distribution. Limiting form of Binomial and Poisson distributions.

Standard continuous distributions-Uniform, Exponential, Normal Beta, Gamma and Cauchy distributions. Order Statistics-their distributions and properties. Joint & Marginal distributions of Order-Statistics.

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1. Dudewicz, E.J. and Mishra, S.N.(1988) : Modern Mathematical Statistics, Wiley, Int'I Student's Edition.
2. Rohatgi, V.K. (1984) : An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
3. Rao, C.R. (1973) : Linear Statistical Inference and its Applications, 2/e, Wiley Eastern.
4. Weather ,Burn,C.E. : A first Course in Mathematical Statistics.
5. Keany,J.F. and Keeping,E.S. : Mathematics of Statistics Pt. I and II
6. Kendall,M.G. and stuart A : Advanced Theory of Statistics.
7. Mood ,gybrill and Boes : Introduction to theory of Statistics
8. Hogs and Craig : Mathematical Statistics
9. Goon,gupta and Dasgupta : Fundamental of Mathematical statistics Vol.I

Paper –III

PROBABILITY AND MEASURE

(i) Course learning outcome:

This course gives an idea of probabilistic approach of happening of events and their convergence.

(ii) The detail content of this course and references and suggested books:

Random experiment, Definition of Probability, Additive and multiplicative theorems of probability, Axiomatic approach to probability, Bayes Theorem. Classes of sets, fields, sigma-fields, minimal sigma-field, Borel sigma-field in R_k, sequence of sets, limsup and liminf of a sequence of sets. Measure, Probability measure, properties of a measure, Lebesgue and Lebesgue- Steljes measure on R_k.

Measurable set, Measurable functions, Random variables, sequence of random variables, almost sure convergence, convergence in probability (and in measure). Convergence in r^{th} mean Integration of a measurable function with respect to a measure **Convergence in distribution,** Convergence in R Monotone convergence theorem, Fatou's lemma, Dominated convergence theorem.

Borel-Cantelli Lemma, Independence, Weak law and strong law of large numbers for iid sequences, Definition and examples of Markov dependence, Chebychev's Inequality, Probability generating function with examples.

Characteristic function and its properties uniqueness theorem, Levy's continuity theorem (statement only), CLT for a sequence of independent random variables under Lindeberg's condition, CLT for iid random variables. Problems based on CLT.

REFERENCES

1. Ash, Robert.(1972): Real Analysis and Probability. Academic Press.
2. Billingsley, P.(1986): Probability and Measure. Wiley.
3. Dudley, R. M. (1989): Real Analysis and Probability, Wadsworth and Brooks/Cole.
4. Kingman, J F C and Taylor, S.J. (1966). Introduction to Measure and Probability. Cambridge University Press.
5. B.R. Bhat: Probability Theory.

Paper –IV

APPLIED STATISTICS

(i) Course learning outcome:

The course gives following idea:

(A) Change in prices of commodities, demand and supply theory

(B) An estimate of values of commodities and their prices due to individual effect of trend, seasonal, cyclical and irregular components.

(C) Various components like fertility, mortality and migration which are responsible for population size, its growth or decay in a defined territory.

Knowing all these facts, a student can understand the reality of socio-economic changes in the society.

(ii)**The detail content of this course and references and suggested books:**

Demography: Sources of demographic data– census, register, adhoc survey, hospital records, measurement of mortality ,crude death rate, age specific death rates, standardized death rate infant mortality rates, Complete and abridged life table-Kings method, Greville's method and method of Reed and Merrel, Construction of life table.

Laws of mortality-Fitting of Makeham's law, Measurement of fertility-crude birth rate, general fertility rate ,age-specific birth rate, total fertility rate ,gross reproduction rate. The Stable and Stationary populations, Logistic curve for population growth, Population Projection.

Economic Analysis: Different Component of time series, Measurement of secular trend: Fitting of mathematical curves, method of moving average, variate difference method, effect of elimination of trend ,merits and demerits of different methods of trend estimation. seasonal components, Determination of cyclical component., Periodogram analysis, Yule-Slutsky effect, Correlogram Analysis.

Index number :meaning and construction of index number, different formulae for constructing index numbers, tests of consistency of index number formulae, Chain base index numbers, Cost of living index numbers, Whole sale price index numbers. Demand Analysis: Demand and supply curves, Price elasticity of demand and supply, determination of demand curves from market data, Engel' Law and Engle's Curve.

REFERENCES
1. O. S. Srivastava (1983) – A text book of demography ,Vikas Publishing House.
2. Parimal Mukhopadhaya (1999) – Applied Statistics, Books and Allied (P) Ltd.
3. V. K. Kapoor and S. C. Gupta: Applied Statistics, Sultan Chand and Sons.

Paper V : Lab Course I – Practical Based on Paper I & II

Course learning outcome: This Practical paper develops an skill among students to have an idea about the values of population parameters like various measures of central tendencies, measures of dispersion, correlation and regression, use of Statistical Tables for testing of hypothesis relating to parameters, the difference between theoretical and actual frequencies through the technique of curve fitting using data of case studies.

Paper VI : Lab Course II – Practical Based on Paper III & IV

Course learning outcome: Students become aware about the calculation of various methods of Index Numbers, the different components of Time series; and various measures of fertility and mortality.

SEMESTER-II

Paper -I

Linear Algebra

(i) Course learning outcome:

The students become fluent to learn the mathematical discussion of the statistical theory.

(ii) The detail content of this course and references and suggested books:

Fields, vector spaces, subspaces, linear dependence and independence, basis and dimension of a vector space, finite dimensional vector spaces, completion theorem, examples of vector spaces over real and complex fields, linear equations. Determinants.

Vector spaces with an inner product, Gram-Schmidt orthogonalization process, orthonormal basis and orthogonal projection of a vector. Linear transformations, algebra of matrices, row and column spaces of a matrix, elementary matrices, rank and inverse of a matrix, null space and nullity, partitioned matrices, Kronecker product.

Hermit canonical form, generalized inverse, Moore-Penrose generalized inverse, Idempotent matrices, Solutions of matrix equations. Real quadratic forms, reduction and classification of quadratic forms, index and signature, triangular reduction of a positive definite matrix.

Characteristic roots and vectors, Cayley-Hamilton theorem, minimal polynomial, similar matrices, algebraic and geometric multiplicity of a characteristic root, spectral decomposition of a real symmetric matrix, reduction of a pair of real symmetric matrices, Hermitian matrices. Singular values and singular value decomposition, Jordan decomposition, extrema of quadratic forms, vector and matrix differentiation.

REFERENCES
1. Graybill, F.A.(1983). Matrices with applications in statistics, 2nd Ed. Wadsworth.
2. Rao, C.R.(1973). Linear statistical inference and its applications, 2nd ed. John Wiley and Sons, Inc.
3. Searle, S.R. (1982). Matrix Algebra useful for Statistics. John Wiley and Sons. Inc.

4. Shanti Narayan: Matrices
5. Vashishtha, A. R.: Matrices

Paper – II

Statistical Computing

(i) Course learning outcome:

Various techniques of finding out intermediate as well as extreme values out of a given series of values are discussed. Students become familiar of the use of 'SPSS' Statistical package as well as 'R' Programming for data analysis.

(ii) The detail content of this course and references and suggested books:

Numerical Analysis : Finite differences & interpolation, Interpolation with unequal intervals, Central differences Interpolation-Gauss's, Stirling's and Bessel's Formulae.

Numerical differentiation and integration, Trapezoidal rule, Simpson's one third, 3/8 rule, Weddle's rule, Euler-Maclaurin Summation Formula, Newton-Cotes Formula, Gauss formula for approximation to factorials, Difference equation of first and second order.

R Software: introduction Programming, Data Analysis, Calculations of various statistic & Inference drawing, Non Parametric Statistic.

Use of Excel, SPSS for data analysis (To calculate mean, median, mode, standard deviation, coefficient of correlation, chi square, t and F tests).

REFERENCES

1. Balagurusamy,E.: Programming in ANSI C .Tata McGraw Hill.
2. John R. Hubbard and Kahate Atul (2017): Programming with C^{++}, Schaum's outline Publication.
3. B.W. Kernighan and D.M. Ritchie (1988). The C Programming Language, Second Edition. Prentice Hall.
4. W.H. Press, S.A. Teukolsky, W.T. Vellering, and B.P. Flannery (1993). Numerical Recipes in C, Second Edition. Cambridge University Press.
5. R.A. Thisted (1988). Elements of Statistical Computing. Champman and Hall.
6. Rajaraman,V.: Computer Oriented Numerical Methods.
7. Grewal, B. S.: Numerical methods.
8. Saxena, H. C.: Finite differences.
9. Sandeep Rakshit(2017): R Programming for beginners, Mc Graw Hill Publication.
10. Michael J. Crawley (2017): The R Book, Willey Publication.

Paper - III

Stochastic Processes

(i) Course learning outcome:

Student becomes able to appraise the probability of occurring of an event occurring according to the time and longevity of its existence.

(ii) The detail content of this course and references and suggested books:

Introduction to stochastic processes (sp's).; classification of sp's according to state space and time domain. Countable state Markov chains (MC's), Chapman-Kolmogorov equations; calculation of n-step transition probability and its limit. Stationary distribution, Classification of states; transient MC; Probability generating function. Properties of probability generating function .Laplace transform & its properties.

Random walk and Gambler's ruin problem ; Applications from social, biological and physical sciences. Renewal theory: Elementary renewal theorem and applications. Statement and uses of key renewal theorem; study of residual life time process. Martingle in discrete time, inequality, convergence and smoothing properties.

Discrete state space continuous time MC ; Kolmogorov- Feller differential equations ; Poisson process, birth and death process ; Applications to queues and storage problems. Wiener process as a limit of random walk; first - passage time and other problems.

Stationary process: weakly stationary and strongly stationary processes; Moving average and auto regressive processes. Branching process : Galton-Watson branching process, probability of ultimate extinction, distribution of population size. Statistical inference in MC and Markov processes.

REFERENCES

1. Adke, S.R. and Manjunath, S.M. (1984): An Introduction to Finite Markov Processes, Wiley Eastern.
2. Bhat, B.R. (2000): Stochastic Models: Analysis and Applications, New Age International, India.
3. Cinlar, E. (1975): Introduction to Stochastic Processes, Prentice Hall.
4. Feller, W. (1968): Introduction to Probability and its Applications, Vol.1, Wiley Eastern.
5. Harris, T.E. (1963): The Theory of Branching Processes, Springur-Verlag.
6. Hoel, P.G., Port, S.C. and Stone, C.J. (1972): Introduction to Stochastic Processes, Houghton Miffin & Co.
7. Jagers, P. (1974): Branching Processes with Biological Applications, Wiley.
8. Karlin, S. and Taylor, H. M. (1975): A first Course in Stochastic Processes, Vol.1, Academic Press.
9. Medhi, J. (1982): Stochastic Processes, Wiley Eastern10. Parzen, E.(1962): Stochastic Processes, Holden-Day.

Paper - IV

Sampling Theory

(i) Course learning outcome:

This paper delivers various techniques of drawing samples from a finite populations with their advantages and disadvantages with smaller cost. It also provides estimating techniques of population values.

(ii) The detail content of this course and references and suggested books:

Sample Surveys : concept of population sample and properties of estimator for finite populations, need for sampling, census and sample survey, sample selection and sample size, Basic finite population sampling techniques ,simple random sampling with and without replacement, Estimation of population proportion, Non-sampling errors, estimation of population mean in presence of non-response. Randomised response technique: Warner's method.

Stratified sampling, systematic sampling and related results on estimation of population mean/total. Allocation problem in stratified sampling. Optimum allocation, Neyman allocation and Proportional allocation, Estimation of gain in precision due to stratification, Post Stratification, Construction of strata, Effect of increasing number of strata. Systematic sampling. Comparison of stratified, systematic and simple random sampling, Systematic sampling under a linear model.

Ratio regression estimators based on srswor and stratified methods of sampling. Bias of ratio estimate and optimum property of ratio estimate, Ratio estimate in stratified sampling, Regression estimate with pre-assigned and with estimated regression coefficient, comparison of ratio and regression estimate with sample mean. Unequal probability sampling: pps wr/wor methods [including Lahiri's scheme] and related estimators of a finite population mean [Desraj estimator and Murthy's estimator].

Cluster sampling. One stage cluster sampling, variance and cost functions, sampling with probability proportional to cluster size, Hurwitz-Thompson estimator , two stage cluster sampling ,Allocation of sample to two stages :equal first stage unit comparison of two stage with one stage sampling. Double sampling ratio and regression estimate with cost aspect .

REFERENCES

1. Cochran, W.G. : Sampling Techniques [3rd Edition, 1977). Wiley
2. Des Raj and Chandak (1998) : Sampling Theory. Narosa
3. Murthy, M.N. (1977). Sampling Theory & Methods. Statistical Publishing Society, Calcutta.
4. Sukhatme et al (1992). Sampling Theory of Surveys with Applications. lowa State University Press & IARS.
5. Singh, D. and Chaudhary, F.S. (1986). Theory and Analysis of Sample Survey Designs. New Age International Publishers.

Paper V : Lab Course I – Practical Based on Paper I and III

(i) Course learning outcome:

The students become familiar of applying the techniques of getting intermediate values and data analysis by the use of Statistical packages.

Paper VI : Lab Course II – Practical Based on Paper IV

(i) Course learning outcome:

This practical paper strengthens students to apply theoretical techniques of drawing samples from a real population and estimation methods with their relative efficiencies.

Paper VII : Choice Based Credit System (Minor Elective from other Subject)

(i) Course learning outcome:

(ii) The detail content of this course and references and suggested books:

THIRD SEMESTER

Paper I

Multivariate Analysis

(i) Course learning outcome:

This course strengthens the student to deal with the data analysis in the situation of avaibility of multi-variates.

(ii) The detail content of this course and references and suggested books:

Multivariate Normal Distribution and its properties, Reproductive property, transformation by a vector, singular /non-singular matrix, conditional distribution of a sub-set of multivariate normal variable/ Random sampling from a multivariate normal distribution. Maximum likelihood estimators of parameters. Distribution of sample mean vector.

Null and non-null distribution of simple correlation coefficient. Null distribution of partial and multiple correlation coefficient. Distribution of sample regression coefficients. Distribution of

Hotelling's T^2 statistic. Application in tests on mean vector for one and more multivariate normal populations and also on equality of the components of a mean vector in a multivariate normal population, Fisher-Behran statistic, Mahalanobis D^2 Statistic.

Distribution of sample generalized variance. Wishart matrix - its distribution and properties, Characteristic function of Wishart distribution ,chi-square distribution as a particular case of Wishart distribution. Multivariate linear regression model-estimation of parameters, tests of linear hypotheses about regression coefficients.

Classification and discrimination procedures for discrimination between two multivariate normal populations - sample discriminant function, probabilities of misclassification and their estimation, classification into more than two multivariate normal populations. Principal components, Dimension reduction, Canonical variables and canonical correlation - definition, use, estimation and computation. Factor Analysis. Cluster Analysis.

REFERENCES

1. Cook, R.D. and Weisberg, S. (1982). Residual and Influence in Regression. Chapman and Hall.
2. Draper, N.R. and Smith, H.(1998). Applied Regression Analysis. 3rd Ed. Wiley.
3. Gunst, R.F. and Mason, R.L.(1980). Regression Analysis and its Applications – A Data Oriented Aproach. Marcel and Dekker.
4. Rao, C.R.(1973). Linear Statistical Inference and Its Applications. Wiley Eastern.
5. Weisberg, S. (1985). Applied Linear Regression. Wiley.
6. Andrson, T.W.(1983) : An Introduction to multivariate statistical analysis. 2nd Ed. Wiley. Giri, N.C.(1977) : Multivariate Statistical inference. Academic Press.
7. Kshirsagar, A.M. (1972) : Multivariate Analysis. Marcel Dekker.
8. Morrison, D.F. (1976) : Multivariate statistical methods. 2nd Ed. McGraw Hill.
9. Muirhead, R.J.(1982) : Aspects of multivariate statistical theory, J. Wiley.
10. Seber, G.A. F.(1984) : Multivariate observations. Wiley.
11. Sharma, S.(1996) : Applied multivariate techniques. Wiley.
12. Srivastava, M.S. and Khatri, C.G. (1979).: An introduction to multivariate statistics. North Holland.
13. Johnson, R. and Wychern (1992): Applied multivariate Statistical analysis, Prentice Hall, 3rd Ed.

PAPER - II

INFERENCE- I

(i) Course learning outcome:

This a very important paper for statisticians. In this paper, a student learns techniques of getting an efficient estimator of population parameter.

(ii) The detail content of this course and references and suggested books:

Unbiasedness , Consistency, efficiency and sufficiency of point estimator, Fisher –Neyman factorization theorem, Cramer -Rao inequality, Bhattacharya bounds, Minimum Variance unbiased estimators, Minimal sufficient statistics,

Likelihood function, examples from standard discrete and continuous distributions. such as Bernoulli, Binomial, Poisson, normal, exponential gamma etc) Methods of estimation – Method of maximum likelihood estimators, properties of maximum likelihood estimators. Method of scoring, method of moments, method of minimum chi-square, method of minimum variance, B.A.N. estimators. CAN estimators.

Rao-Blackwell theorem. Completeness of sufficient statistics. Completeness and Bounded Completeness, Koopman's theorem (Distributions admitting sufficient statistics),.Lehmann-Scheffe theorem, UMVUES, Invariant estimators. Confidence interval and confidence coefficients, Theory of confidence set, Relationship with the theory of hypothesis testing, Confidence interval for large samples.

Loss function, Risk function, Admissibility, Minimax rule, Bays rule, Structure of Bay's rule, Construction of a Minimax rule, point and interval estimation as decision problem. State of nature, payoff opportunity loss or regret, expected monitory value(EMV) criterion for decision making, maximum, maximax and minimax regret strategy, expected value of perfect information (EVPI).

REFERENCES:

1. Kendall M.G. and Stuart A.(1972) : Advanced Theory of Statistics, Vol. 2, Charles Griffin and Co., New York.
2. Rohatgi V.K. (1988): An Introduction to Probability and Mathematical Statistics. Wiley Eastern Ltd. New.Delhi (Student Edition)
3. Lehmann, E.L.(1986): Testing Statistical hypotheses (Student Edition).
5. Rao, C. R. (1973): Linear Statistical Inference.
6. Zacks, S. (1971): Theory of Statistical Inference, John Wiley and Sons, New York.
7. Dudewicz, E.J. and Mishra, S.N. (1988). Modern Mathematical Statistics. Wiley Series in Prob. Math. Stat., John Wiley and Sons, New York (International Student Edition)
8. Ferguson, T.S. (1996). A course on Large Sample Theory. Chapman and Hall, London.

Paper - III

Operations Research –I

(i) Course learning outcome: This paper provides the answer of the question that how we will maximize profit as well as minimizes losses. This will give idea about saving cost as time by using transportation and assignment problems. Inventory problems deal will shortage of materials. Queuing theory gives us idea about service time as well waiting time time.

(ii) The detail content of this course and references and suggested books:

Definition and scope of Operational research ; phases in Operations Research ; models and their solutions ; decision-making under uncertainty and risk, use of different criteria ; The structure and formation of a linear programming problem,Graphical and simplex procedure,Two phase methods, and charne's-M method with artificial variables ; duality theorem .

Transportation and Assignment problems, Routing and traveling salesman problem .

Inventory problems – Deterministic models of inventory , Economic Lot size formula ,instantaneous production case ,finite production rates situation ,cases when shortages are allowed /not allowed. Stochastic inventory models – a single period model with no set up cost.

Basic characterics of queuing systems, Steady-state solutions of M/M/1 and M/M/c models with associated distributions of queue-length and waiting time. M/G/1 queue and Pollazcek Khinchine result. Steady-state solutions of M/Ek/1 and E_k/M/1 queues, Machine interference problem. Transient solution of M/M/1 queue.

Decision-making in the face of competition, two-person games, pure and mixed strategies, existence of solution and uniqueness of value in zero-sum games, finding solutions in 2x2, 2xm and mxn games. Non-zero sum games, co-operative and competitive games, equilibrium solutions and their existence in bi-matrix games. Nash equilibrium solution. ;

REFERENCES

1. Taha H.A. (1982) Operational Research : An Introduction ; Macmillan.
2. Hillier F.S. and Leiberman G.J. (1962) Introduction to Operations Research ; Holden Day.
3. Kanti Swarup, Gupta, P.K. and Singh M.M. (1985) Operations Research ; Sultan Chand& Sons.
4. Philips D.T., Ravindran A. and Solberg J. Operations Research, Principles and Practice.
5. Churchman C.W., Ackoff R.L. and Arnoff E.L.(1957) Introduction to Operations Research ; John Wiley.
6. Kleinrock L. (1975) Queueing Systems, vol. 1, Theory ; John Wiley
7. Saaty T. L. (1961) Elements of Queueing Theory with Applications ; McGraw Hill
10. Hadley G.and Whiting T.M. (1963) Analysis of Inventory Systems ; Prentice Hall
11. Starr M.K. and Miller D.W. (1962) Inventory Control-Theory and Practice ; Prentice Hall
12 . Mckinsey J.C.C. (1952) Introduction to the Theory of Games ; McGraw Hill
13. Wagner H.M. (1973) Principles of O.R. with Applications to Managerial Decisions ; Prentice Hall
14. Gross, D. and Harris, C. M. (1974) Fundamentals of Queueing Theory ; John Wiley

PAPER - IV
Statistical Quality Control

(i) Course learning outcome: This paper gives various procedures to control of quality of products. Quality itself has some standards, to maintain high level of quality we need Statistical Quality Control. It has been widely used in industry.

(ii) The detail content of this course and references and suggested books:

Basic concept of process monitoring and control, process capability and process optimization. General theory and review of control charts for attribute and variable data ; O.C. and A.R.L. of control charts, control by gauging.

Moving average and exponentially weighted moving average charts ; Cu-sum charts using V-masks and decision intervals ; Economic design of X-bar chart. Capability indices Cp, Cpk and Cpm ; estimation, confidence intervals and tests of hypotheses relating to capability indices for Normally distributed characteristics.

Acceptance sampling plans for attribute inspection; single, double and sequential sampling plans and their properties ; Bayesian sampling plan.

Plans for inspection by variables for one-sided and two-sided specifications ; Continuous sampling plans of Dodge type and Wald-Wolfiwitz type and their properties. Use of Design of Experiments in SPC; factorial experiments, fractional factorial designs, construction of such designs and analysis of data. Multivariate quality control; use of control ellipsoid and of utility.

REFERENCES

1. Montgomery, D.C. (1985) Introduction to Statistical Quality Control ; Wiley.

2. Ott, E.R. (1975) Process Quality Control ; McGraw Hill.
3. Wetherill, G.B. (1977) Sampling Inspection and Quality Control ; Halsted Press.
4. Wetherill, G.B. and Brown, D.W. (1991) Statistical Process Control, Theory and Practice ; Chapman and Hall.
5. Duncan, A. J.(1986): Quality Control and Industrial Statistics. 5th ed., Richard D. Ervin, Homewood, Illiions.
6. Ekambaram, S.K. (1963): The Statistical basis of quality control charts. Asia Publishing House, London.
7. Grant, E.L. & Leavenworth, R.S. (1988): Statistical Quality Control. 6th ed., McGraw-Hill Book Co., New York.
8. Bowker, A.H. & Goode, H.P. (1952): Sampling inspection by variables. McGraw-Hill Book Co., New York.
9. Schilling, E.G. (1982): Acceptance sampling in quality control. Marcel Dekker, Inc., New York.

Paper V: Lab Course I – Practical Based on Papers I and II

(i) Course learning outcome:

The student becomes able to apply theoretical methods of finding a good estimate of population parameters in practice.

Paper VI: Lab Course II – Practical Based on Papers III and IV

(i) Course learning outcome:

Paper- VII : Choice Based Credit System (Minor Elective from other Subject)

(ii) Course learning outcome:

(iii)The detail content of this course and references and suggested books:

FOURTH SEMESTER

Paper – I

Design of Experiments

(i) Course learning outcome:

This paper describes various methods of performing statistical experiments so that population parameters may be tested efficiently at lesser cost.

(ii) The detail content of this course and references and suggested books:

Gauss- Markov set-up, Estimability condition, best point estimates/interval estimates of estimable linear parametric functions ,Normal equations and Least squares estimates, Gauss-Markov Theorem, Introduction to fixed, mixed and random effects linear models. Analysis of variance for one way and two way classified data with equal and unequal number of observations per cells, Analysis of covariance model.

Introduction to design of experiments, Principle of design of experiments, completely randomized design, Randomized block design, Latin square design. Missing plot technique - general theory and applications, efficiency of a design.

Graeco Latin Square design, Cross-over designs, Analysis of covariance: Applications to standard designs with one concomitant variable, Split plot and split block experiments, efficiency of whole plot and sub plot treatments, merits and demerits of split plot experiments.

General factorial experiments, factorial effects; best estimates and testing the significance of factorial effects ; study of 2 and 3 factorial experiments in randomized blocks ; Complete and partial confounding. Fractional replication for symmetric factorials, 2^n experiment with 2^k blocks per replicate, 3^2 experiment.

General block design and its information matrix. criteria for connectedness, balance and orthogonality, BIBD- Analysis with intrablock information and recovery of interlock information ; PBIBD, Youden design - intrablock analysis.
Application areas: Response surface experiments; first order designs and orthogonal designs.

REFERENCES

1. Aloke Dey (1986) :Theory of Block Designs, Wiley Eastern.
2. Angela Dean and Daniel Voss (1999) : Design and Analysis of Experiments, Springer.
3. Das, M.N. and Giri, N.(1979) : Design and Analysis of Experiments, Wiley Eastern
4. Giri, N. (1986) : Analysis of Variance, South Asian Publishers
5. John, P.W.M. (1971) : Statistical Design and Analysis of Experiments, Macmillan.
6. Joshi, D.D. (1987) : Linear Estimation and Design of Experiments, Wiley eastern.
7. Montgromery, C.D.(1976): Design and Analysis of Experiments, Wiley, New York.
8. Pearce, S.C. (1984): Design of Experiments, Wiley, New York.

Paper-II
Inference II

(i) Course learning outcome:

Here the student becomes able to test the significance of population parameters with more accuracy. The methods of taking decision with drawing samples are also intimated.

(ii) The detail content of this course and references and suggested books:

Test of Hypothesis: Concepts of critical regions, Test functions, two kinds of errors. Size function, power function, level, M. P. and U,M.P. Test, Neymann Pearson Lemma, M.P. test for simple null against simple alternative hypothesis ,UMP test for simple null hypothesis against one sided alternatives in one parameter exponential family .Unbiased test, UNIFORMELY most powerful unbiased test ,Type “A” critical region or locally most powerful unbiased test. Generalized form of Neyman Pearson lemma.

Composite Hypothesis and similar regions, similar regions and complete sufficient statistics, Construction of most powerful similar regions, Unbiased critical regions, optimum regions and Sufficient Statistics. Likelihood ratio test, properties of likelihood ratio test, Likelihood ratio test for the mean of normal population, LR test for equality of means and variances of two and several normal populations.

Sequential analysis: Wald’s sequential probability ratio test (SPRT) with prescribed errors of two types, OC and ASN function of SPRT.

Non parametric test, Rank test, Wilcoxon test, Median test, Sign test, Mann-Whitney U test, Wald-Wolfowitz run test, Kolomogorov-Smirnov test, One sample location problem, chi square test of goodness of fit.

REFERENCES

1. Kale, B.K. (1999): A first Course on Parametric Inference, Narosa Publishing House.
2. Rohatgi V. (1988): An Introduction to Probability and Mathematical Statistics. Wiley Eastern Ltd. NewDelhi (Student Edition)

3. Lehmann, E.L.(1986)-(Latest): Theory of point Estimation (Student Edition).
4. Lehmann, E.L.(1986): Testing Statistical hypotheses (Student Edition).
5. Rao, C. R. (1973): Linear Statistical Inference.
6. Zacks, S. (1971): Theory of Statistical Inference, John Wiley and Sons, New York.
7. Gibbons,J.D.(1985) : Nonparametric statistical inference 2nd Ed.,Marcel dekker,Inc.
8. Dudewicz, E.J. and Mishra, S.N. (1988). Modern Mathematical Statistics. Wiley Series in Prob. Math. Stat., John Wiley and Sons, New York (International Student Edition)
9. Ferguson, T.S. (1996). A course on Large Sample Theory. Chapman and Hall, London.
10. Ferguson, T.S. (1967) : Mathematical Statistics, Academic Press.

Paper –III

Operations Research –II

(i) Course learning outcome: This paper gives idea about replacement policies of any product, to search shortest path and project planning. Some other programming problems are also discussed to achieve the goal of profit.

(ii) The detail content of this course and references and suggested books:

Replacement problems : Replacement of items that fails and those that deteriorate ,group and individual replacement policies

Network analysis,-Shortest Path Problem, Project planning and control with PERT and CPM

Integer programming-Branch and Bound technique. Dynamic programming , Deterministic and Probabilistic Dynamic programming: decision tree and Bellman's Principle of optimality, models of dynamic programming,

Quadratic programming, Kuhn-Tucker conditions for quadratic programming problem, Wolf's modified simplex method, Beale's method Goal Programming simulation :Monte Carlo method.

REFERENCES

1. Taha H.A. (1982) Operational Research : An Introduction ; Macmillan.
2. Hillier F.S. and Leiberman G.J. (1962) Introduction to Operations Research ; Holden Day.
3. Kanti Swarup, Gupta, P.K. and Singh M.M. (1985) Operations Research ; Sultan Chand& Sons.
4. Philips D.T., Ravindran A. and Solberg J. Operations Research, Principles and Practice.
5. Churchman C.W., Ackoff R.L. and Arnoff E.L.(1957) Introduction to Operations Research ; John Wiley.

Paper – IV

Any one of the following (Major Elective)

(a) Reliability and Life Testing
(b) Demography
(c) Econometrics

Paper – IV (a)

RELIABILITY AND LIFE TESTING (Major Elective)

(i) **Course learning outcome:** This paper provides knowledge about concepts of reliability, components of reliability. Life testing will be carried out by means of exponential distribution, Wiebull and Gamma distributions. Life testing provides the average life time of products to be survived.

(ii)The detail content of this course and references and suggested books:

Reliability concepts and measures ; reliability function ; hazard rate ; components and systems ; coherent systems ; reliability of coherent systems ; cuts and paths ; modular decomposition ; bounds on system reliability ; structural and reliability importance of components.

Life distributions ; common life distributions-exponential, Weibull, gamma etc. Estimation of parameters and tests in these models. Notions of ageing ; IFR, IFRA, NBU, DMRL, and NBUE Classes and their duals ; loss of memory property of the exponential distribution ; closures or these classes under formation of coherent systems, convolutions and mixtures.

Univariate shock models and life distributions arising out of them ; bivariate shock models ; common bivariate exponential distributions and their properties. Reliability estimation based on failure times in variously censored life tests and in tests with replacement of failed items .

Stress-strength reliability and its estimation. Maintainability and availability, Maintenance and replacement policies ; availability of repairable systems ; modeling of a repairable system by a non-homogeneous Poisson process. Reliability growth models; Hollander-Proschan and Deshpande tests for exponentiality; tests for HPP vs NHPP with repairable systems. Basic ideas of accelerated life testing.

REFERENCES:

1. Barlow R.E. and Prochan F.(1985) ,Statistical theory of reliability and life testing ,Rinehart and Winston
2. Lawless J.F. (1982) ,Statistical Models and Methods of Life time data ; John Wiley .
3. Bain L.J. and Engelhardt (1991) ;statistical Analysis of Reliability and Life testing Models ,Marcel Dekker.
4. Nelson ,W (1982) ;Applied Life data analysis ; john Wiley .
5. Zacks S.;Reliability Theory ,Springer.

Paper – IV(b)
DEMOGRAPHY (Major Elective)

(i) Course learning outcome: This paper describes fertility and mortality trends in various segments of a population, and hence population growth. It also discusses the forces of migration, and population projection.

(ii) The detail content of this course and references and suggested books:

Coverage and content errors in demographic data, Chandrasekharan-Deming formula to check completeness of registration data, adjustment of age data-use of Whipple, Myer and UN indices, Population transition theory.

Measures of fertility; Stochastic models for reproduction, distributions of time of birth, inter-live birth intervals and of number of births (for both homogeneous and homogeneous group of women), estimation of parameters; estimation of parity progression from open birth interval data.

Measures of Mortality; construction of abridged life tables, infant mortality rate and its adjustuemts, model life table. Stable and quasi-stable populations, intrinsic growth rate. Models of population growth and their filling to population data.

Internal migration and its measurement, migration models, concept of international migration. Methods for population projection, component method of population projection, Nuptiality and its measurements.

REFERNCES:

1. Kumar, R.(1986): Technical Demography, Wiley Eastern Lts.
2. Benjamin, B.(1969): Demographic Analysis, George, Allen and Unwin.
3. Chiang, C.L.(1968): Introduction to Stochastic Progression.
4. Cox, P.R. (1970): Demography, Cambridge University Press.
5. Keyfitz, N. (1977): Introduction to the Mathematics of Population-with Revision, Addison-Wesley, London.
6. Spiegelman, M.(1969): Introduction to Demographic Analysis, Harvard University Press.
7. Wolfenden, H.H.(1954): Population Statistics and Their Compilation, Am Actuarial Society.

Paper – IV(c)
ECONOMETRICS (Major Elective)

(i) Course learning outcome:

Students become able to understand statistical analysis of economic events and their prediction through their mathematical modeling under different situations.

(ii) The detail content of this course and references and suggested books:

Nature of econometrics, the general linear model (GLM) and its extensions, ordinary least squares (OLS) estimation and prediction, generalized least squares (GLS) estimation and prediction, heteroscedastic disturbances, pure and mixed estimation.

Auto correlation, its consequences and tests. Theil BLUS procedure, estimation and prediction, multicollinearity problem, its implications and tools for handling the problem, ridge regression. Linear regression and stochastic regression, Instrumental variable estimation. Errors in variables.

Autoregressive linear regression, lagged variables, distributed lag models, estimation of lags by OLS method, Koyck's geometric lag model, Simultaneous linear equations model and its generalization, identification problem, restrictions on structural parameters, rank and order conditions.

Estimation in simultaneous equations model, recursive systems, 2 SLS estimators, limited information estimators, k-class estimators. 3 SLS estimator, full information maximum likelihood method, prediction and simultaneous confidence intervals.

REFERENCES:

1 Apte, P.G.(1990): Text books of Econometrics, Tata Mcgraw Hill.
2 Cramer, J.S.(1971): Empirical Econometrics, North Holland.
3 Gujarathi, D.(1979): Basic Econometrics, McGraw Hill.
4 Intrulligator, M.D.(1980): Econometric models-Techniques and applications, Prentice Hall of India.
5 Johnston, J.(1984): Econometric methods. Third edition, McGraw Hill.
6 Klein, L.R. (1962): An introduction to Econometrics, Prentice Hall of India.
7 Koutsoyiannis, A. (1979): Theory of Econometrics, Macmillan Press.
8 Malinvaud, E. (1966): Statistical methods of Econometrics, North Holland.

9 Srivastava, V.K. and Gelies D.A.E.(1987): Seemingly unrelated regression equations models, Maicel Dekker.
10 Theil, H. (1982): Intruduction to the theory and practice of Econometrics, John Wiley.
11 Walters, A. (1970): An introduction to Econometrics, Macmillan & Co.
12 Wetherill, G.B.(1986): Regression analysis with application, Chapman Hall.

Paper V : Lab Course I : Practical based on Papers I, II and III

(i) **Course learning outcome:** This practical paper develops skill among students to design statistical experiments, testing of statistical hypothesis more powerfully and profit making decisions in industry through their modified replacement policies.

Paper VI : Project Work

(i) **Course learning outcome:**

Students are given more practical knowledge by defining project title, forming questionnaire, conducting survey, data compilation and its analysis; and interpretation.

PT. RAVISHANKAR SHUKLA UNIVERSITY: RAIPUR
SCHOOL OF STUDIES IN STATISTICS

Outcome of Syllabus
M.A./M.Sc.- Choice Based Credit System, 2021-22
Subject: Statistics

M.A./M.Sc. II Semester(CBCS)
Subject: Statistics
Paper- I
BASIC STATISTICS-I

(i) Course learning outcome:

The course is multi-disciplinary, which deals with a brief account of data analysis. The student becomes familiar of the use of the statistical package 'SPSS' for data analysis.

(ii) The detail content of this course and references and suggested books:

Methods of data collection, types of data, construction of questionnaire, Processing and analysis of data. Presentation of data. Measure of central tendency and dispersion. Karl Pearson's coefficient of correlation, Rank correlation, Lines of Regression.

Mathematical and statistical definitions of probability. Idea of Probability distribution. Normal distribution. Test of Hypothesis, level of significance, p –value, Applications of chi square, t and F distribution. Chi square test for goodness of fit.

Sampling techniques: Simple random sampling, Stratified random sampling, Cluster Sampling, Systematic sampling, non sampling error.

One way and two way analysis of variance, Use of Statistical Software packages for data analysis – SPSS and Excel.

References:

1. Goon A.M., Gupta M.K., Dass Gupta B. (1991): Fundamentals of statistics, Vol.I & II, World Press, Calcutta.
2. Gupta V. K. and Kapoor S. C.(2005): Fundamentals of Mathematical Statistics S. Chand and Sons.
3. Mood A. M. Graybill F.A. and Boes D.C. (1974): Introduction to the Theory of Statistics, MegrawHill.
4. Bhatt B. R., Srivenkatramana T and Rao Madhava K.S. (1977): Statistics : A Beginner's text, Vol.II, New Age International (P) Ltd.
5. C.R.Kothari,"Research Methodology", Second Edition, Wishwa Publication, New Delhi.
6. Shukla S. M. & Sahay S. P. (): Business Statistics, Sahitya Bhawan Publications, Agra.

M.A./M.Sc. III Semester(CBCS)

Subject: Statistics

Paper- I

BASIC STATISTICS-II

(i) Course learning outcome:

This is also a multi-disciplinary subject, where students of various subjects can offer this paper to enhance their knowledge regarding fertility and mortality trends in the society.

He also becomes aware to know about measuring the values changing according to its increasing or decreasing trend in the society as well as the seasonal effect.

Further this course enables to aware the student regarding change in price according to change in places or time.

(ii) The detail content of this course and references and suggested books:

Sources of demographic data –census, register, adhoc survey, hospital records, measurement of mortality, crude death rate, age specific death rates, standardized death rate infant mortality rates, Complete life table and its applications. Laws of mortality and Makeham's law.

Measurement of fertility-crude birth rate, general fertility rate ,age-specific birth rate, total fertility rate, gross reproduction rate. The Stable and Stationary populations, Logistic curve for population growth, Population Projection.

Different Component of time series, Measurement of secular trend: Fitting of trend, method of moving average, effect of elimination of trend, Yule-Slustky effect, merits and demerits of different methods of trend estimation. seasonal components and its estimation.

Index number :meaning and construction of index number, different formulae for constructing index numbers, Laysperes and Paasche's index number, tests of a good index number, Fisher's Ideal index number. Chain base index numbers, Cost of living index numbers, Whole sale price index numbers. Demand Analysis: Demand and supply curves, Price elasticity of demand and supply, Engel' Law.

References:

1. O. S. Srivastava (1983) – A text book of demography ,Vikas Publishing House.
2. Parimal Mukhopadhaya (1999) – Applied Statistics, Books and Allied (P) Ltd.
3. V. K. Kapoor and S. C. Gupta: Applied Statistics, Sultan Chand and Sons.

LEARNING OBJECTIVE & OUTCOMES

SEMESTER-I

S.NO.	SUBJECT NAME	SUBJECT CODE	COURSE OBJECTIVE	COURSE OUTCOME
1	FUNDAMENTALS OF ELECTRONICS	RETM. 101	To familiar students to the basic electronics devices and their fundamentals	To study basics of semiconductor & devices and their applications in different areas.
			To enable students to use different electronics devices for different applications	Recognizes conductor, semiconductor, and insulator and explains characteristics of these materials.
			To encourage students to get their hands in the field of semiconductor, as this technology will play a vital role in understanding the concept for generation of various types of energy.	Explains ideal diode, equivalent circuit and dc characteristic of a diode.
2	BUSINESS COMMUNICATION	RETM 102	To introduce students to the theory, fundamentals and tools of communication	The course is specifically focused on laying a firm foundation for English language proficiency by helping students build a strong base in Grammar and vocabulary.
			To develop in them vital communication skills this should be integral to personal, social and professional interactions	Develop effective letter writing skills & effective interpersonal communications
			To enable students to have firm grounding in English to be able to use it effectively in professional as well as social contexts	Research approaches and information collection.
			To work towards strengthening the learning process of English language so that our graduates can find their feet in the fiercely competitive job market.	Developing and delivering effective presentations.

3	ENERGY SOURCES AND ENERGY SCENARIO	RETM 103	To understand the social, economic impacts of various energy sources	Understand the various forms of energy along with energy demand and efficiency of different energy conversion technology.
			To discuss the financial aspects like pricing and reforms of energy sources	Know about the schemes of renewable energy in India.
			To make the students aware about conservation act, security of energy and environment	Know about the current energy scenario; energy installed capacity of renewable energy in India
			To understand the vision and policies of government	
4	APPLIED PHYSICS	RETM 104	To familiar students to the basic concepts of physics, its laws	Analyze and interpret quantitative results.
			To get student squinted with principles of electronic and electrical devices	Strengthen the skills in basic measurements by exposing the students to well-equipped labs and enhance the problem solving ability.
			To introduce the application of physics in the energy systems and to encourage them to use these concepts to develop ideas for renewable energy field	Familiarity with laws, principles & current developments in physics.
5	ROOFTOP SOLAR PV POWER PLANT INSTATLATION-I	RETM 105	To understand the solar radiation on earth surface.	Conceptual knowledge of the technology, economics and regulation related issues associated with solar power development and management
			To understand the various solar cell parameters.	Ability to analyse the viability of solar power projects
			The principle of photovoltaic technologies and there characteristics	Capability to integrate various options and assess the business and policy environment regarding solar power projects
			Estimation of cost of PV Systems	
6	ROOFTOP SOLAR PV POWER PLANT	RETM 106	To understand the solar radiation on earth surface.	Conceptual knowledge of the technology, economics and regulation related issues associated with solar power development and management

	INSTALLATION-II		To understand the various solar cell parameters.	Ability to analyse the viability of solar power projects
			The principle of photovoltaic technologies and there characteristics	Capability to integrate various options and assess the business and policy environment regarding solar power projects
			Estimation of cost of PV Systems	
7	WIND ENERGY	RETM 107	Awareness about Wind Energy	Understand wind resource, principles of conversion and technologies
			Understanding the design considerations of wind projects.	Develop wind regimes and assessment of wind resource
			Awareness about global scenario & current status	
			Get acquainted to various types of Wind power stations	
8	WIND TURBINE GENERATOR	RETM 108	Awareness about various wind turbines.	Understand the operation and constraints of wind turbine generators
			Understanding the design considerations of wind projects.	Illustrate the operation of the grid connected and off grid applications of wind energy
			Awareness about global scenario & current status	Analyze the performance of WECS
			Get acquainted to various types of Wind power stations	Develop hardware related to system components and software tools for the design, analysis and assessment of wind energy resources
9	LABORATORY -I (ELECTRONICS LAB)	RETM 109	Hands on experience on PV Technology Basic Electronics based equipments	Understand the diode and transistor characteristics. Verify the rectifier circuits using diodes and implement them using hardware Operate and understand standard electronic equipment such as breadboard, pulse generator, digital multi-meters, power supplies and digital ICs to analyze, test and implement the digital circuits.

10	LABORATORY -II (PHOTOVOLTAIC LABORATORY)	RETM 110	Hands on experience on PV Technology	Determine the maximum power point and fill factor of a solar photovoltaic Module and Demonstrate the effect of shading and effect of variation in tilt angle on PV module output power.

SEMESTER-II

S.NO.	SUBJECT NAME	SUBJECT CODE	COURSE OBJECTIVE	COURSE OUTCOME
1	ENVIRONMENTAL STUDIES	RETM 201	To familiarize students to the basic concepts of environmental studies.	Understand and evaluate the global scale of environmental problems
			To help students develop their own perspectives around environmental issues.	Capability to identify relevant environmental issues, analyse the various underlying causes, evaluate the practices and policies, and develop framework to make informed decisions.
			To enable students to take practical steps to conserve the environment.	Develop empathy for various life forms and appreciate the various ecological linkages within the web of life.
2	INDUSTRIAL ELECTRONICS & INSTRUMENTATION	RETM 202	To familiarize with the characteristics of instruments.	Understand the knowledge of basic fundamentals, terms, and units of pressure, temperature, level and flow rate.
			To familiarize with the properties of transducer	Illustrate the construction and working principle of various type of transducers/sensor to measure physical quantities.
			To understand the fundamentals of amplifiers & OPAMP's	Demonstrate a working knowledge of safety practices used in the measurement and control of industrial processes.

3	BIOMASS POWER GENERATION SYSTEMS	RETM 203	The course develops necessary understanding on the biomass of enefgy rnaterials. It is specifically designed to enlpower non-biology background students ltrith necessary knowledge and very important concepts of biomass. Student will acquire understanding at the molecule level as well as at the bulk material level.	Understand the fundamental of conversion processes of any carbonaceous fuel
				Learn how to characterization of any carbonaceous fuel and analyze technology application
				Apply the concepts of thermo-chemical conversion process of any dry solid fuel
				Apply the concepts of physical and bio-chemical process conversion of any wet solid fuel.
4	REPORT WRITING	RETM 204	Understand the research preparation and planning.	Understand typical conventions of technical and lab reports
			Understand various data collection methods	Understand the purpose of different sections of a report.
			Study various sampling methods	
			Perform various sampling tests.	
5	WASTE TO ENERGY CONVERSION SYSTEMS	RETM 205	To understand the various waste generatiol.r sources and their management.	Understand the fundamental of conversion processes of any waste

			To know the various waste to energy conversion technologies.	Learn how to characterization of any characterization of wastes and analyze technology application
			To understand various impacts like health and environment issues and significance of different technologies	Apply the concepts of thermo-chemical conversion process of any energy production from waste plastics
			To get acquainted with commercial aspects of waste to energy.	Apply the concepts of physical and bio-chemical process conversion of any wet waste solid fuel.
6	DESIGN OF SOLAR PV POWER PLANT-I	RETM 206	To understand the various solar cell parameters	Develop understanding on the PV plant design and select suitable technologies.
			The principle of photovoltaic technologies and there characteristics.	Plan project implementation, operation and maintenance.
			Estimation of cost of PV Systems	Carry out techno-economic-environmental performance evaluation of a solar PV power plant.
7	DESIGN OF SOLAR PV POWER PLANT-II	RETM 207	To understand the various solar cell parameters	Develop understanding on the PV plant design and select suitable technologies.
			The principle of photovoltaic technologies and there characteristics.	Plan project implementation, operation and maintenance.
			Estimation of cost of PV Systems	Carry out techno-economic-environmental performance evaluation of a solar PV power plant.
8	INSTALLATION AND COMMISSIONING OF SOLAR PV POWER PLANT	RETM 208	To understand the various solar cell parameters	Develop understanding on the PV plant design and select suitable technologies.
			The principle of photovoltaic technologies and there characteristics.	Plan project implementation, operation and maintenance.

			Estimation of cost of PV Systems	Carry out techno-economic-environmental performance evaluation of a solar PV power plant.
9	LABORATORY -III (COMPUTER LAB)	RETM 209	Knowledge of hardware that goes in the making of a computer: Assembling of PC.	Implement the basic elements of a C program including arithmetic and logical operators, functions, control structures, and arrays
			Installation of OS, setting up of dual boot, installation of hardware and software.	Design a program related to challenging questions
			Hands on experience on the basic utilities in computers.	
			Execution of File handling commands in DOS Prompt.	
10	LABORATORY -IV (RENEWABLE ENERGY LABORATORY)	RETM 210	Hands on experience on RE based Energy Generation Equipments	To make the students understand the basic concept of renewable energy sources like as Solar PV, Solar Thermal, Wind, concentrating and relevant technologies towards their effective utilization for meeting energy demand. After undergoing this course the student will have the knowledge of construction, working, principal operation and energy conversion system studies etc.

SEMESTER-III

S.NO.	SUBJECT NAME	SUBJECT CODE	COURSE OBJECTIVE	COURSE OUTCOME
1	INNOVATIONS IN SCIENCE	RETM 301	To develop an understanding of the world of science and its relevance to the 21'st century	Contribution of science and technology to everyday life and to the quality of life.
			To develop critical thinking ability using scientific methods through the study of the milestone innovations of the 20th century	Appreciate the contribution science and technology have made in the past and how it will help create solutions for the future.
			To analyze these innovations for their relevance to society	Discuss relevant scientific and technological issues in appropriate ways with others.
2	APPLIED MATHEMATICS	RETM 302	Apply mathematical concepts and principles to perform computations	Students will demonstrate basic knowledge of Laplace Transform., Vector differentiation and differentiation Integration.
			Apply mathematics to solve problems	Students will be able to apply the application of Mathematics in Telecommunication Engineering
			Create, use and analyze graphical representations of mathematical relationships	Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
			Communicate mathematical knowledge and understanding.	
3	MECHANICS & THERMODYNAMICS FOR ENERGY	RETM 303	To familiar students to the basics of mechanics & thermodynamics and their fundamentals	To apply the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon.

	APPLICATION		To enable & encourage students to apply the subject skill in different applications, as this portion will play a vital role in understanding the concept for structural based analysis & technological information of various system used in energy	To identify and formulate power production based on the fundamentals laws of thermal engineering.
4	ELECTRICAL SYSTEMS	RETM 304	To familiar students to the basic concepts of electrical & its laws.	Recall basic concepts of Electrical Engineering
			To get student squinted with principles of electrical devices.	Illustrate basics of AC circuits
			Concepts of electrical system will play major role in designing the power plants & their operation.	Explain operative principle of transformer with background of magnetic circuits
				Classify and compare different types of Electrical machines
5	SOLAR PV POWER PLANT & COMPONENTS	RETM 305	This subject will enable students to understand the designing, Installation, and Operation and maintenance of solar based power plants	To develop a comprehensive technological understanding in solar PV system components
				To provide in-depth understanding of design parameters to help design and simulate the performance of a solar PV power plant
				To pertain knowledge about planning, project implementation and operation of solar PV power generation.
6	PROGRAMMING C++/JAVA	RETM 306	Understand object-oriented programming features in C++'	Describe the object-oriented programming approach in connection with C++
			Apply these features to program design and implementation.	Apply the concepts of object-oriented programming
			Make them learn about Java programming concepts, graphical user interfaces, and basic data structures.	Illustrate the process of data file manipulations using C++

7	SOLAR WATER PUMPING SYSTEM	RETM 307	To understand solar pumping systems	The students will be able to experiment with solar panels (angle, direction) to power a small fan/LED light/circuit board. Students will be able to identify the best position/angle for maximum power.
			The principle of photovoltaic technologies and pumping.	Students will apply scientific ideas to design and test a solar powered water pump that moves water at the fastest rate.
			Estimation of cost, installation and commission of pumping system	Students will experiment and build understanding of parallel and series wiring and how energy moves in these circuits.
8	EVALUATION AND MONITORING FOR WIND POWER PLANT	RETM 308	Awareness about various types of Wind Energy System.	Understand wind resource, principles of conversion and technologies
			Understanding the design considerations of Wind projects.	Develop wind regimes and assessment of wind resource
			Awareness about global scenario & current status.	Understand the operation and constraints of wind turbine generators
			Get acquainted to various types of Wind power stations.	Illustrate the operation of the grid connected and off grid applications of wind energy
				Analyze the performance of WECS
9	LABORATORY-V (DIGITAL ELECTRONICS)	RETM 309	To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits	Operate and understand Multiplexers, Encoders, Decoders, Flip flops & other digital circuits.
			To prepare students to perform the analysis and design of various digital electronic circuits.	Illustrate the basic of logic gates and their realization using universal gates.

10	LABORATORY-VI (RENEWABLE ENERGY LABORATORY)	RETM 310	Hands on experience on RE based Energy Generation Equipments	To make the students understand the basic concept of renewable energy sources like as Solar PV, Solar Thermal, Wind, concentrating and relevant technologies towards their effective utilization for meeting energy demand. After undergoing this course the student will have the knowledge of construction, working, principal operation and energy conversion system studies etc

SEMESTER-IV

S.NO.	SUBJECT NAME	SUBJECT CODE	COURSE OBJECTIVE	COURSE OUTCOME
1	ENERGY MANAGEMENT, AUDITING & UTILIZATION	RETM 401	To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of energy conservation and energy auditing	Evaluate the performance analysis and optimization of utilities.
			To enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding energy conservation and energy auditing	Formulate energy action planning for various types of industry.
			Better energy conservation, Cost reduction & efficiency	Describe and categorize the global environmental concerns for effective energy conservation and compare with international standards.
			Awareness about Energy Management Principles & energy audit procedure as adopted by the Bureau of Energy Efficiency, Ministry of Power, GoI.	Ability to analyse the viability of energy conservation projects. Advocacy of strategic and policy recommendations on energy conservation and energy auditing
2	POWER ELECTRONICS	RETM 402	To understand and acquire knowledge about various power semiconductor devices.	Learning of operation of Rectifiers and their performance parameters

			To prepare the students to analyze and design different power converter circuits.	Learning of types and operation of dc choppers
			Analyze basic operation of switching power converters.	
3	CONTROL & EMBEDDED SYSTEMS	RETM 403	The basic concepts of process control and controllers.	Model different Physical systems.
			Electronic realization of controllers.	Understand Transient response of first and second order systems to standard inputs.
			Embedded system and automation	Draw the root loci, Nyquist criterion, bode plots to obtain Frequency Response.
			Advanced controls in solar plants'	To study various Control System Components.
4	MATERIAL SCIENCE FOR ENERGY APPLICATIONS	RETM 404	Basics of materials science and engineering.	Explain importance of materials in materials science and engineering field.
			Properties of various materials and special coatings and applications	Give information about atomic structure, atomic bonds, crystal structure, crystal geometry and crystal defects.
			Testing of materials behaviour suitable for application in solar energy systems.	Interpret mechanical properties of materials.
5	SOLAR THERMAL TECHNOLOGIES	RETM 405	The fundamentals of design calculations and analysis of polar thermal systems.	Understand availability of solar radiation, solar geometry, instrument used for measuring solar radiation

			The functioning and design of solar thermal cooling systems	Describe and analyse of various thermal energy storage systems
			The fundamentals of design calculations and economics of solar power generation.	Analyse and design solar thermal systems for appropriate application
				Have appropriate knowledge on solar energy based thermal power plant.
6	CONCENTRATING SOLAR THERMAL SYSTEMS	RETM 406	To gain knowledge on solar passive heating and cooling	Understand availability of solar radiation, solar geometry, instrument used for measuring solar radiation
			The fundamentals of design calculations and analysis of solar thermal systems	Describe and analyse of various thermal energy storage systems
			The basics of solar thermal technology for process heating applications	Analyse and design solar thermal systems for appropriate application
			The fundamentals of design calculations and economics of solar power generation	Have appropriate knowledge on solar energy based thermal power plant.
7	ENGINEERING DRAWING	RETM 407	Use of common drafting tools to construct engineering drawings	Visualize and draw intersections of various solids.
			Apply dimensions on engineering drawings	Understand and draw various types of joints and power transmitting joints.
			Create 2D drawings, construct and Interpret views and sectional views	Draw assembly and part drawings of various mechanical components.

			Utilize various line types to give best descriptive drawings	
8	SOLAR THERMAL SYSTEM	RETM 408	Understand the fundamentals of solar flat plate collectors.	Understand availability of solar radiation, solar geometry, instrument used for measuring solar radiation
			Analyze the performance of solar flat plate collectors	Describe and analyse of various thermal energy storage systems
			Analyze the performance of concentrating solar collectors	Analyse and design solar thermal systems for appropriate application
			Familiar with the solar low, medium and high temperature applications.	Have appropriate knowledge on solar energy based thermal power plant.
9	WORKSHOP PRACTICES - I/ MINOR PROJECT	RETM 409	Overview of state-of-the-art solar technology, development and research in the project area	Students will be able to practice acquired knowledge within the chosen area of technology for project development.
			Pre-design of innovative solar thermal, PV and hybrid systems and their components with realistic constraints	Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach
			Analysis of system performance, economics, and assessment of environmental impact.	Reproduce, improve and refine technical aspects for RE based projects.

SEMESTER-V

S.NO.	SUBJECT NAME	SUBJECT CODE	COURSE OBJECTIVE	COURSE OUTCOME
1	SOLAR BUSINESS SOLUTIONS	RETM 501	Understand the research preparation and planning	Design the solar PV system for rural households.
			Understand various data collection methods	Interpret from field experience for solar PV market analysis including government schemes & policies.
			Study various sampling methods.	AD Benefits and other attractive schemes for encouraging implementation of Solar based equipments
2	HEALTH AND SAFETY PRACTICES AT PROJECT SITE	RETM 502	To make students aware about best practices to be followed at Project site	Get acquainted about how to follow good practices so that accidents & other unfavourable conditions could be avoided/ minimized
			To make students understand the usage of Safety kits, First aid and other essential safety measures	Get acquainted about various safety measurement kits, helmets, gloves etc.
3	ENERGY IN BUILDINGS	RETM 503	Concepts and techniques of energy efficient buildings design features	Identify the critical sustainability issues that should be addressed in planning a building or new development.
			Concepts and techniques of solar passive heating and cooling systems	Estimate the green star rating of a new building.
			Concepts and techniques of day lighting and electrical lighting, heat control of	Identify the issues effecting indoor environmental quality.

			buildings.	
4	ENERGY MODELING AND PROJECT MANAGEMENT	RETM 504	To familiarize the students with the methods of modeling and analysis of solar thermal and PV systems	Identify and select the effective energy modelling with interpreting the economics and investment planning.
			To understand the Mathematical modeling development methods, quantitative techniques, various numerical methods to solve equations, Software tools to solve problems.	Calculate the energy demand and customize the best suited methods/ option.
				Interpret the data and compare the various renewable energy options along with energy conservation technologies.
5	ENERGY EFFICIENCY IN ELECTRICAL UTILITIES	RETM 505	To enable the students to understand the concept of generation, transmission and distribution of energy & to enlighten them on the power factor improvement and transformer distribution.	Define and identify the concept of generation, transmission and distribution of energy
			To enrich students with the knowledge regarding energy efficient technologies in electrical systems.	Explain the importance of electrical equipment, electrical symbols and SLD
6	HYDROGEN ENERGY AND FUEL CELLS	RETM 506	Methods of hydrogen production, storage and utilization.	To understand the fundamentals of fuel cell and to recognize the future scope of fuel cell in various application.

			Basics of fuel cell technology.	Have a basic knowledge of Hydrogen Energy, Properties of Hydrogen, Production methods and purification, Storage methods, Environmental benefits and its Applications in the Hydrogen Economy.
			Major types of fuel cells and their modes of operation.	
7	SMART AND MICRO GRID	RETM 507	To know, list and classify the basic terms of a power System Grid; Explain the importance and objectives of the various dispersed generation units.	Understand Smart & Micro grid and essential pillars of the technology
			To describe by drawing a block diagram and explain the operation of the basic part of a smart grid (namely the Microgrid) & to quantify its operation	Apply the key elements of SMG with their functions and operation
			To know, understand and explain the concept of a smart grid.	Understand the advances in SMG as Energy Storage, eVs etc.CO5. Impact of SMG in socioeconomic development
8	ENERGY EFFICIENCY IN THERMAL UTILITIES	RETM 508	To understand the main constituents of boiler feed water, classification of boiler in to various types	Recall storage and handling technique for each type of fuel
			To study different water treatment methods, to examine types of refractories	Identify different types of boiler
			To understand the mechanism of heat transfer, determination of economic thickness of insulation	Recognise factors to be considered for steam trap installation

9	WORKSHOP PRACTICES - II	RETM 509	Overview of state-of-the-art solar technology, development and research in the project area.	Students will be able to practice acquired knowledge within the chosen area of technology for project development.
			Pre-design of innovative solar thermal, PV and hybrid systems and their components with realistic constraints.	Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach
			Analysis of system performance, economics, and assessment of environmental impact	Reproduce, improve and refine technical aspects for RE based projects. Communicate and report effectively project related activities and findings.

SEMESTER-VI

S.NO.	SUBJECT NAME	SUBJECT CODE	COURSE OBJECTIVE	COURSE OUTCOME
1	INDUSTRIAL TRAINING	RETM-601	To provide students the opportunity to test their interest in a particular career before permanent commitments are made.	Participate in the projects in industries during his or her industrial training.
			To develop skills in the application of theory to practical work situations.	Describe use of advanced tools and techniques encountered during industrial training and visit.
			To expose students to real work environment experience gain knowledge in writing report in technical works/projects.	Interact with industrial personnel and follow engineering practices and discipline prescribed in industry.
			To enhance the ability to improve students creativity skills and sharing ideas.	Develop awareness about general workplace behavior and build interpersonal and team skills.
			The student will be able instilled with good moral values such as responsibility , commitment and trustworthy during their training.	Prepare professional work reports and presentations.

2	MAJOR PROJECT	RETM-602	to develop employment abilities in students and to provide industrial experience and insights	the students take on new and challenging tasks that enables them to develop a multiple set of new skills
			Demonstrate the personal abilities and skills required to produce and present an extended piece of work.	Live projects will require student to develop awareness of your social responsibility and your role as an Solar Engineer
			To be able to apply some of the techniques/principles you have been taught	Get acquainted about entire work flow that includes Site Survey, Documentation, Tender Drafting, Specification Definition in Solar & Renewable based Industry
			To develop effective communication skill by delivering a seminar based on major project	Operation & Maintenance during Live Projects

PT. RAVISHANKAR SHUKLA UNIVERSITY

Centre for Basic Sciences

Outcome Based Curriculum

Integrated M. Sc.: Chemistry Stream

[Choice and Credit Based System]

(Semester- I to X)

Semester Examination

SESSION 2015-2020

INDEX

Vision & Mission

- Establish scientific institutions of the highest caliber where teaching and education are totally integrated with state-of the- art research. Make learning of basic sciences exciting through excellent integrative teaching driven by curiosity and creativity.
- Entry into research at an early age through a flexible borderless curriculum and research projects and to develop the researcher and scientist in chemical sciences through Integrated M.Sc. program.
- To develop the competent manpower with technology based experimentation, methodologies and value based practices for business and industries.

Objectives

The CBS model of education is concept-based and inquiry-driven, as opposed to the more traditional content-based models. There is a strong emphasis on the interdisciplinary nature of today's science, and recognition of the importance of research experience in undergraduate education.

Courses offered in the Int. M. Sc. program at CBS form part of a comprehensive program that will enable the students-

- To understand the basic laws of nature and develop necessary skills to apply them to any desired area or discipline.
- To undertake projects to solve field base problems.
- To provide student centric learning facilities for the development of overall personality of learner. The program is planned as student-centric collaborative learning.
- Students get trained for a career in basic sciences or any related applied science or technology.

Title of the Program: Integrated Master of Science in Chemistry

:Program Educational Objectives:

PEO1: To have advance knowledge of chemistry domain.

PEO2: To opt for higher education, disciplinary & multi-disciplinary research and to be a life-long learner.

PEO3: To provide the professional consultancy and research support and professional services from industry, research organization and recognized institutes to provide the super specialization of their domain.

PEO4: To provide, value based and ethical leadership in professional as well as social life.

:Program Learning Outcomes:

- Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Physical Chemistries.
- Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.
- Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.
- Students will be able to clearly communicate the results of scientific work in oral, written and electronic formats to both scientists and the public at large.
- Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
- Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.
- Students will be able to explain why chemistry is an integral activity for addressing social, economic, and environmental problems.

Students will be able to function as a member of an interdisciplinary problem solving team.

:General Pattern of the Program:

Courses offered during the first year (Semesters I to II) are meant as basic and introductory courses in Biology, Chemistry, Mathematics, Physics and Environmental Science. These are common and mandatory for all students. These courses are intended to give a flavor of the various approaches and analyses and to prepare the students for advanced courses in later years of study. In addition, there will be Interdisciplinary Courses for computational skills and mathematical methods. Students are also given training to develop skills in Communication, Creative & Technical Writing and History of Science through courses in Humanities and Social Sciences.

In the second year (Semester - III), students have the freedom to choose their stream for masters program on the bases of their interest. Courses offered in the first two years would help them make an informed judgment to determine their real interest and aptitude for a given subject.

One of the important features that the CBS has adopted is semester-long projects called Lab Training / Theory projects, which are given the same weightage as a regular course. By availing this, a student can work in an experimental lab or take up a theory project every semester. This is meant to help the student get trained in research methodology, which will form a good basis for the 9^{th} semester project work in the fifth year. The subjects/courses are described further with their credit points. Few courses are common to different streams.

Center for Basic Sciences
Pt. Ravishankar Shukla University, Raipur

Course structure for the M. Sc. (Integrated) Chemistry stream

1st July, 2015

(B: **B**iology, C: **C**hemistry, M: **M**athematics, P: **P**hysics, G: **G**eneral, H: **H**umanities, BL: **B**iology **L**aboratory, CL: **C**hemistry **L**aboratory, PL: **P**hysics **L**aboratory, GL: **G**eneral **L**aboratory, PE: **P**hysics **E**lective, PPr: **P**hysics **Pr**oject)

FIRST YEAR
SEMESTER –I

Subject Code	Subject	Contact Hours / Week Theory +Tutorials	Credits
B101	Biology – I	[2 + 1]	3
C101	Chemistry – I	[2 + 1]	3
M100/101	Mathematics – I	[2 + 1]	3
P101	Physics – I	[2 + 1]	3
G101	Computer Basics	[2 + 1]	3
H101	Communication Skills	[2 + 0]	2
		Contact Hours / Week Laboratory	
PL101	Physics Laboratory – I	[4]	2
CL101	Chemistry Laboratory – I	[4]	2
BL101	Biology Laboratory – I	[4]	2
GL101	Computer Laboratory	[4]	2

25
(25 of 240 credits)

SEMESTER –II

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
B201	Biology – II	[2 + 1]	3
C201	Chemistry – II	[2 + 1]	3
M200/201	Mathematics – II	[2 + 1]	3
P201	Physics – II	[2 + 1]	3
G201	Electronics and Instrumentation	[2 + 1]	3

G202	Glimpses of Contemporary Science	[2 + 0]	2
		Contact Hours / Week Laboratory	
PL201	Physics Laboratory – II	[4]	2
CL201	Chemistry Laboratory – II	[4]	2
BL201	Physics Laboratory – II	[4]	2
GL201	Electronics Laboratory	[4]	2

25
(50 of 240 credits)

SECOND YEAR

SEMESTER –III

Subject Code	**Subject**	**Contact Hours / Week Theory+Tutorials**	**Credits**
CB301	Essential mathematics for Chemistry and Biology	[3 + 1]	4
CB302	Biochemistry-I	[3+ 1]	4
CB303	Organic Chemistry-I	[3 + 1]	4
C301	Inorganic Chemistry-I	[3 + 1]	4
H301	World Literature	[2 + 0]	2
H302	History and Philosophy of Science	[2 + 0]	2
		Contact Hours / Week Laboratory	
CL301	Chemistry Laboratory	[6]	3
GL301	Applied Electronics Laboratory	[4]	2

25
(75 of 240 credits)

SEMESTER –IV

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
PCB401	Physical and Chemical kinetics	[3 + 1]	4
CB401	Introductory Spectroscopy (UV-vis, fluorescence, IR, Raman, NMR)	[3+ 1]	4
C401	Properties of Matter	[3 + 1]	4
C402	Group theory	[3 + 1]	4
G401	Statistical Techniques and Applications	[2 + 0]	2
		Lab hrs	**Credits**
CL401	Chemistry Laboratory	[6]	3
GL401	Computational Laboratory and Numerical Methods	[4]	2
			25

(100 of 240 credits)

3rd Year
SEMESTER –V

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
CB501	Analytical Chemistry	[3 + 1]	4
C501	Quantum Chemistry	[3+ 1]	4
C502	Inorganic Chemistry II	[3 + 1]	4
C503	Organic Chemistry II	[3 + 1]	4
G501	Earth Science and Energy & Environmental Sciences	[3 + 1]	4
		Lab contact hrs	**Credits**
CL501	Chemistry Laboratory	[8]	4
			24

(124 of 240 credits)

SEMESTER –VI

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
CB601	Biophysical Chemistry	[3 + 1]	4
C601	Atomic and molecular spectroscopy	[3+ 1]	4
C602	Inorganic Chemistry III	[3 + 1]	4
C603	Organic Chemistry III	[3 + 1]	4
C604	Nuclear Chemistry	[3 + 1]	4
H601	Ethics in Science and IPR	[2 + 0]	2
		Lab contact hrs	**Credits**
CL601	Chemistry Laboratory	[8]	4

26

(150 of 240 credits)

<u>FOURTH YEAR</u>

SEMESTER –VII

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
C701	Photochemistry	[3 + 1]	4
C702	Chemical biology	[3+ 1]	4
C703	Organometallics & Bio-inorganic Chemistry	[3 + 1]	4
C704	Physical Organic Chemistry	[3 + 1]	4
CPr701	Reading project	-	4
		Lab contact hrs	**Credits**
CL701	Advanced Chemistry Laboratory-I	[5+5]	5

25

(175 of 240 credits)

SEMESTER –VIII

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
C801	Chemistry of Materials	[3 + 1]	4
C802	Macro and Supra-molecular chemistry	[3+ 1]	4
C803	Reaction Dynamics	[3 + 1]	4
C804	Computational Chemistry	[3 + 1]	4
		Lab contact hrs	**Credits**
CL801	Advanced Chemistry Laboratory-II	[10]	5
CPr801	Project	-	4

25

(200 of 240 credits)

FIFTH YEAR

SEMESTER –IX

Subject Code	Subject	Contact Hours / Week	Credits
CPr901	Project	-	20

20

(220 of 240 Credits)

SEMESTER –X

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
CE1001	Elective I	[3 + 2]	5
CE1002	Elective II	[3 + 2]	5
CE1003	Elective III	[3 + 2]	5
CE1004	Elective IV	[3 + 2]	5

20

(240 of 240 credits)

Note- Any four papers out of the available seven papers (mentioned in the syllabus) shall be in operation on availability of the instructors with more than 50% of students opting for them.

SEMESTERWISE SYLLABUS

C 101: Chemistry-I
UNIT-I **(30 + 15 = 45 hrs.)**

Structure and Properties of atoms: Revisited **(4 + 2 = 6 hrs.)**
(i) Atomic spectra, Bohr's theory of atomic structure, Sommerfield's theory for complex electron spin and magnetic quantum number, Pauli exclusion principle, Hund's rule, electron configuration of elements, Sequence of energy levels and Periodic Table.
(ii) Size of atoms and ions, ionization energy, electron affinity, electronegativity – values by Pauling, Mulliken and Allred-Rochow, Metallic character, variable valency and oxidation states, horizontal, vertical and diagonal relationships in the periodic table.
(iii) Atomic Nucleus: Fundamental particles, classification of nuclides, nuclear stability, the neutron to proton ratio N/Z, nuclear potential, binding energy, exchange force. Radioactivity and radioactive elements, radioactive decay and decay kinetics.

UNIT-II
Types of Chemical Bonds **(14+ 7 = 18 hrs.)**
(i) The covalent bond - the Lewis theory, Octet rule and its limitations. Shapes of the molecules – Sidgwick – powel theory. Valence shell electron pair (VSEPR) theory, effect of lone pair and electronegativity, isoelectronic principle, examples to apply VSEPR theory. Valence bond theory. Hybridization. Bond length, bond angle & dihedral angle, d-orbital participation in molecular bonding, sigma and pi bonding. Molecular orbital method – Linear combination of atomic orbitals (LCAO), MO treatment for di- and tri-atomic molecules and involving delocalized pi-bonding. Conjugation & aromaticity.

UNIT-III
(ii) Metallic and organometallic bonds – general properties.
(iii) Coordinate bond- coordination complexes.
(iv) Physical properties and molecular structures – polaizability and dipole moments, melting point, solubility and acid-base properties, Intermolecular forces (dipole-dipole interaction) Hydrogen bonding and vander Waals's forces.

UNIT-IV
Reactivity & Mechanism: **(12 + 6= 18 hrs)**
(i) Inductive and field effects and bond dissociation energy. p□-d□ bonding. Delocalization – cross conjugation, resonance. Aromaticity and Huckel's rule – systems of 4n and 4n+2 electrons, antiaromaticity . Resonance and Hyperconjugation.
(ii) Reaction mechanism: Types of mechanisms, Arhenius theory, collision theory, types of reactions, redox reactions, displacement and addition reactions, thermodynamic and kinetic requirements.

UNIT-V
Hammond postulate, Curtin-Hammett principle, transition states and intermediates, carbocations, carbanions, free radicals, methods of determining mechanisms, isotopic effects.

(iii) General concepts: Oxidation number and oxidation states, Oxidation – reduction reactions and the use of reduction potential, Bronsted acids and bases, gas phase vs. solution acidity, solvent levelling effects, hardness and softness, surface acidity.

Suggested texts and References:

(1) J.D.Lee, Concise Inorganic Chemistry, 4th Edition, ELBS, 1991.
(2) P.W.Atkins, Physical Chemistry, Oxford University Press, 7th Edition, 2006.
(3) G.M.Barrow, Physical Chemistry, 5th Edition, Tata McGraw-Hill, New Delhi, 1992.
(4)R. T. Morrison and R. N. Boyd, Organic Chemistry, Prentice Hall of India.
(5)G.W. Castellan, Physical Chemistry, 3rd Ed. Addison - Wesley/Narosa Publishing House, 1993.

C 201: Chemistry II **(30 + 15 = 45 hrs.)**

UNIT-I

(1) Thermochemistry: Enthalpy, heat of fusion and heat of vapourisation, enthalpy of a chemical reaction (heat of combustion, heat of solution, heat of neutralization), enthalpy of formation, standard reaction enthalpy, Hess's law, Kirchhoff's law, bond energy, dissociation energy. Entropy formulation of Second law, entropy change in a phase transition, Trouton's Rule, calculation of absolute (Third law) entropy, entropy change in a chemical reaction.

UNIT-II

(2) Free energy functions, criteria for spontaneity and equilibrium of closed systems, variation of Gibbs free energy with pressure and temperature, Gibbs Helmholtz equation, the concept of chemical potential, partial molar quantity, Gibbs Duhem relation.

UNIT-III

(3) Phase equilibrium in simple systems: Solid – liquid, liquid – vapour, vapour – solid, phase diagrams – water, carbon dioxide, sulphur, phase equilibrium condition, Gibbs phase rule, Clapeyron equations, Clausius – Clapeyron equation.

UNIT-IV

(4) Ideal Solutions, chemical potential of a solute in a binary ideal solution, Raoult's Law, entropy and Gibbs energy of mixing, Colligative properties – freezing point depression, boiling point elevation, osmotic pressure, van't Hoff equation.

UNIT-V

(5) Chemical equilibrium: Gibbs energy change of a reaction, standard reaction Gibbs energy, the condition for chemical equilibrium, equilibrium constant, reactions involving gases and pure substances, the Principle of Le Chatelier and applications.
(6) Chemical potential of a charged species, electrochemical cell (galvanic and electrolytic), examples of electrochemical cells, half cell potential (electrode potential), Nernst equation.

Suggested texts and References:

(1) P.W.Atkins, Physical Chemistry, Oxford University Press, 7th Edition, 2006.
(2) G.W. Castellan, Physical Chemistry, 3rd Ed.Wesley/Narosa Publishing House, 1993.

(3) G.N.Lewis and Randall, Thermodynamics, (Revised by K.S.Pitzer and L.Brewer), International Students Edition, McGraw Hill, 1961.
(4) K. Denbigh, The principles of Chemical Equilibrium.
(5) B. G. Kyle , Chemical & Process Thermodynamics.

CB 303: Organic Chemistry –I **(45 +15 = 60 hrs.)**

UNIT-I
A. Basic concepts - Recapitulation
Hybridisation, formal charge, inductive and resonance effects and their effect on reactivity and acidity and basicity of organic compounds; polar & non polar covalent bonds; homolytic and heterolytic fission, types of reagents- electrophiles and nucleophiles; curly arrow notation; classification of organic reactions.

UNIT-II
B. Chemistry of Aliphatic compounds
IUPAC nomenclature of aliphatic and substituted aliphatic compounds and alicyclic compounds
Preparation, structure, properties and reactions of the following classes of compounds.
i) Hydrocarbons: a) alkanes, Methods of formation Kolbe reaction, Wurtz reaction, Corey House reaction, decarboxylation of carboxylic acids; Mechanism of halogenation of alkanes, orientation, selectivity & reactivity, product ratio. b) **Cycloalkanes** : Methods of formation and reactivity ; Baeyer's strain theory and its limitation; theory of strainless rings c**) Alkenes:** Elimination reactions ; Saytzeff & Hoffman elimination; Reactions – halogenation reactions-free radical and polar mechanisms. Markownikoff's rule, the peroxide effect, allylic halogenations using NBS; Ozonides/Ozonolysis. epoxidation; hydroboration-oxidation; oxymercuration-demercuration; Oxidation using $KMnO4$ & $OsO4$.; polymerization. d**) Dienes:** Structure of butadiene and allene ; 1,2 vs 1,4 addition ; Diels Alder reaction.

UNIT-III
e) Alkynes: Methods of formation; acidity of alkynes; electrophilic addition to alkynes; hydroboration oxidation ; metal ammonia reductions; hydrogenation using Lindlar's catalyst.
ii) Alkyl halides Preparation, properties and synthetic applications of alkyl halides; SN1 & SN2 reactions (mechanism), E1 and E2 reactions(mechanism); Grignard reagent and its applications.
iii) Alcohols: Methods of formation; acidity; H-Bonding; reactions of mono; di & trihydric alcohols; Diols as protecting groups.

UNIT-IV
iv) Ethers and epoxides: Formation & reactions of ethers and epoxides ; ring opening reactions of epoxides under acidic and basic consitions; reaction epoxides with Grignard & organolithium reagents
v) Aldehdyes & ketones: Methods of formation of aldehdyes and ketones; Nucleophilic addition reactions with cyanide, ammonia and derivatives of ammonia; acetal formation; oxidation reduction reactions. Meerwin-Pondroff-Verley reduction, Clemmensen reduction, Wolf-Kishner reduction, Aldol condensation reaction, Cannizzaro reaction, Tischenko reaction, haloform reaction, Baeyer-Villiger oxidation, Wittig reaction; Mannich reaction

vi) Carboxylic acids : Methods of formation of mono and di carboxylic acids; acidity and factors affecting acidity; reactions of carboxylic acids :
vii) Carboxylic acid derivatives: Methods of formation of acid chlorides, amides, anhydrides and esters and their interconversions; relative stabilities of acid derivatives; Rosenmund reaction; Hoffmann rearrangement; saponification.
viii) Nitrogen and sulphur compounds. a) Nitro alkanes: methods of formation and reactions of aliphatic and aromatic nitro compounds b) Amines: methods of formation; basicity and factors affecting basicity ; reactions of aliphatic amines. c) Sulfonic acids : Methods of formation & reactions of aliphatic sulfonic acids.
ix) Applications of phosphorous and boron in organic synthesis :
Wittig reaction (with mechanism) ; hydroboration-oxidation (with mechanism); reduction using 9-BBN.

UNIT-V

C. Chemistry of aromatic compounds

IUPAC Nomenclature of benzene, naphthalene and anthracene derivatives
i) Aromaticity: Structure and stability of benzene, Huckel's rule, MO picture, polycyclic aromatic hydrocarbons.
ii) Aromatic electrophilic substitution: General mechanism. Effect of substituents on rate and orientation to aromatic electrophilic substitution in substituted benzenes, ortho-para ratio.
iii) Hydrocarbons: Alkylarenes, preparation via Friedel Crafts reaction. Reactions- oxidation, nuclear and side chain halogenation.
iv) Haloarenes: Preparation, aromatic nucleophilic substitution, elimination-addition and addition-elimination mechanisms, hydrolysis and amination of nitrohaloarenes.
v) Phenols: Preparation from sulfonic acids, haloarenes, alkylbenzenes, Acidity, O-alkylation, O-acylation, Fries rearrangement, Claisen rearrangement, Reimer- Tiemann reaction, Hauben Hoesch reaction, Lederer Manasse reaction.
vi) Aromatic aldehydes and ketones: Preparation via Gattermann, Gattermann-Koch, Vilsmeyer-Haack, Rosenmund and Friedel Crafts acylation reactions, Reactions: Claisen-Schmidt, Knovenagel, Perkin, Benzoin condensation and Cannizaro reactions,
vii) Aromatic carboxylic acids: Preparation, acidity, preparation and interconversion of acid derivatives.
viii) Aromatic sulfonic acids: Preparation, acidity, preparation and interconversion of sulfonic acid derivatives.
ix) Aromatic nitrogen compounds: Nitro and nitroso compounds - preparation and reduction, Amino compounds – preparation, basicity, Aromatic electrophilic substitution, N-alkylation, N-acylation, Diazotisation, Synthetic uses of diazonium salts, azo coupling

Suggested texts and References:

(1) I. L. Finar, Organic Chemistry, Vol. 1 & 2, ELBS.
(2) R. T. Morrison and R. N. Boyd, Organic Chemistry, Prentice Hall of India.
(3) J. McMurry, Organic Chemistry, Asian Books Pvt. Ptd.
(4) L. G. Wade, Organic Chemistry, Pearson Education
(5) G. Solomons and C. Fryhle, Organic Chemistry, John Wiley & Sons (Asia) Pte Ltd.
(6) J. March, Advanced Organic Chemistry, 3rd Edn. McGraw Hill,1991.
(7) S.H.Pine, Organic Chemistry, 5th Edn., McGraw Hill, 1987.

C 301: Inorganic Chemistry I

UNIT-I **(45 + 15 = 60 hrs.)**

(i) Hydrogen: Preparation of hydrogen, Isotopes, ortho and para hydrogen, hydrides.

(ii) Rare gases: Occurrence and recovery of the elements, physical and chemical properties, Clathrate compounds, chemistry of Xenon and xenon fluoride complexes.

UNIT-II

(iii) Chemistry of s-block elements: a) alkali and alkaline earth metals: Extraction, general physical properties, flame colours ans spectra, Reaction with water, air and nitrogen, oxides, hydroxides, peroxides and superoxides, sulphides, oxysalts, halides and hydrides, oraganic and organometallic compounds. b) Group IIB elements: Zn, Cd, Hg.

UNIT-III

(iv) Chemistry of p-block elements: a) Group IIIA elements: Boron, aluminium, gallium indium and thalium – physical properties, oxidation states and type of bonds, Reactions with other elements, compounds of boron with oxygen and hydrogen. b) Group IVA elements: carbon, silicon, germanium, tin and lead – physical properties, allotropes of carbon, graphite compounds, carbaides, carbonates, carbon cycle, silicates, organosilicons, hydrides, halides and cyanides, cluster compounds.

UNIT-IV

c) Group VA elements: Nitrogen, phosphorous, Arsenic, antimony and bismuth – general properties, hydrides, azides, oxides and oxyacids, sulphides and organometallics, fertilizers. d) Group VIA elements: oxygen, sulphur, selenium, tellurium and polonium – general properties, structure and allotropy of the elements, chemistry of ozone, oxides, oxyacids, oxohalides, hydrides and halides, organo derivatives.

UNIT-V

e) Group VIIA elements: Fluorine, chlorine, bromine, iodine and Astatine- general properties, oxidizing power, hydrogen halides, ionic and molecular halides, bridging halides, halogen oxides, oxoacids, interhalogen compounds, polyhalides, pseudohalogens and pseudohalides.

Suggested texts and References:

(1) J. E. Huheey, ‘Inorganic Chemistry - Principles of Structure and Reactivity’ Harper & Row, 1988.
(2) F. A. Cotton and G. Wilkinson, ‘Advanced Inorganic Chemistry’, John Wiley, 1995.
(3) D. F. Shriver, P.W. Atkins and C.H. Langford, ‘Inorganic Chemistry’, OxfordUniversity Press, 1991.
(4) F. A.Cotton and G. Wilkinson, Basic Inorganic Chemistry, Wiley Easter, 1978.
(5) J. D. Lee, Concise Inorganic Chemistry, Van Nostrand Reinhold, 1977.

PCB 401: Physical and Chemical Kinetics: **(45 + 15 = 60 hrs.)**

UNIT-I

(i) Basic Concepts: Rate, order and molecularity of a reaction, First, second and third order reactions – effect of concentration on reaction rate, rate expressions and integrated form, pseudo-unimolecular and second order autocatalytic reactions, nth order reaction of a single component, effect of temperature on reaction rate – Arrhenius equation and activation energy.

UNIT-II

(ii) Complex Reactions: parallel first order reactions, series first order reactions – determination of rate constants by graphical method and the time ratio method. The stationary state, radioactive decay, general first order series and parallel reactions. Competitive, consecutive second order reactions, reversible reactions, equilibrium from the kinetic view point, complex mechanisms involving equilibria.

UNIT-III

(iii) Kinetic Measurements: Experimental determination of reaction rates and order of reactions – correlation of physical properties with concentrations, reactions in the phase, reactions at constant pressure, fractional-life period method, initial rate as a function of initial concentrations.

UNIT-IV

(iv) Reactions in Solutions: General Properties, Phenomenological theory of reaction rates, Diffusion limited rate constant, Slow reactions, Effect of ionic strength on reactions between ions, Linear free energy relationships, Relaxation methods for fast reactions.

UNIT-V

(v) Catalysis: Homogeneous catalysis in gas phase, in solution, basis of catalytic action, catalysis and the equilibrium constant, acid base catalysis, The Bronsted catalysis law, linear free energy changes, general and specific catalysis. Heterogeneous catalysis. Negative catalysis and inhibition, Surface reactions – effect of temperature and nature of surface. Industrial catalysis.

Suggested texts and References:

(i) K.A. Connors, Chemical Kinetics : A Study of Reaction Rates in Solution, V.C.H. Publications 1990. **(ii)**J.I. Steinfeld, J.S. Francisco and W.L. Hase, Chemical Kinetics and Dynamics, Prentice Hall 1989. **(iii)** Paul L. Houston, Chemical Kinetics and reaction dynamics.
(iv) K.J.Laidler, Chemical Kinetics, 3rd ed. Harper and Row, 1987.
(v) J.W. Moore and R.G. Pearson, Kinetics and Mechanisms, John Wiley and Sons, 1981.
(vi) A. A. Forst and R. G. Pearson, Kinetics and Mechanism, Wiley International Edition.
(vii) Sanjay K. Upadhay, Chemical kinetics and Reaction Dynamics, Springer, 2006

CB401: Introductory Spectroscopy **(45 + 15 = 60 hrs)**

UNIT-I

(i) The electromagnetic spectrum: Nature of electromagnetic radiation. The electromagnetic spectrum and its regions. Frequency, waveno and wavelength: units and conversions. Absorption of electromagnetic radiation. Molecular energy states and quantisation of internal energy. Boltzmann distribution.

(ii) Spectroscopic Processes: Absorption, emission, and scattering of light. Beer-Lambert Law - Quantitative absorption measurements, Jablonski diagram
(iii) Fourier transformation: A mathematical tool to our advantage, basic principle and its relevance in spectroscopy.

UNIT-II

(iv) UV-VIS Absorption Spectroscopy: Principles and instrumentation of spectrophotometers. UV-vis spectroscopy to determine conjugation. UV-visible spectroscopy and electronic transitions. Electronic ground states and excited states in organic molecules: n to pi-star and pi to pi-star transitions. band position and band intensities.
(v) Fluorescence Spectroscopy: Principles and instrumentation of fluorimeters. Advantage of fluorimetry compared to absorption spectrophotometry. Luminescence and the fate of excited states: timescale of fluorescence and phosphorescence.Qualitative and Quantitative Fluorimetry.
UNIT-III

(vi) IR - Principles and instrumentation of Infrared spectroscopy. nfrared spectroscopy and molecular vibrational transitions. Simple dispersive IR spectrometer and ovewrview of modern instrumentation. Transmittance and absorbance. Vibrational modes and selection rules. Factors governing the position and intensity of IR bands: effects of variation in reduced mass and force constant. Group frequency and fingerprint regions: use of IR for identification by presence/absence of absorptions characteristic of specific bonds/bond groupings. Interpretation of IR spectra.
(vii) Raman Spectroscopy: Raman Effect and molecular polarizability. Technique and instrumentation. Pure rotational Raman spectra, vibrational Rama spectra. Structure determination from Raman and IR.

UNIT-IV
(viii) Nuclear Magnetic Resonance (NMR): Introduction to Nuclear Magnetic Resonance (NMR) spectroscopy. 1H and 13C NMR, number of signals, integration, chemical shift, splitting of signals. Principles and instrumentation of NMR spectroscopy. Nuclear spin and nuclear magnetism. Energies of nuclear spin states in a magnetic field. Boltzmann population of nuclear spin states and the origin of NMR signals. Applications: Interpretation of simple 1H NMR spectra. Information from: chemical shifts and delta values, peak areas and integration, splitting patterns and spin-spin coupling constants. (n+1) rule and Pascal's triangle. 13C NMR spectra and sensitivity issues. Interpretation of NMR spectra using examples of organic compounds. Short introduction about application of NMR for proteins.

UNIT-V

(ix) Mass spectrometry: Introduction to mass spectroscopy (molecular mass, accurate mass and isotopes) Principles, ionisation methods (including EI, MALDI, ESI). Molecular ions and fragmentation processes under EI. Mass spectrometry for determining the molecular weight/formula of organic compounds and identify the presence of isotopes. Introduction of MS application in protein analysis.

C 401: Properties of Matter **(45 + 15 = 60 hrs.)**

UNIT-I

(i) Gaseous State a). Perfect gases and gas laws, law of partial pressures and partial volumes, Graham's law of effusion, critical state and determination of the critical constants, continuity of state, coefficient of expansion and compressibility. b). The kinetic theory of gases, pressure and temperature of a gas, derivation of the gas laws from the kinetic theory, The Boltzmann constant, Maxwell's law of distribution of molecular velocities, experimental verification of Maxwell's law. c). Ideal and real gases, deviations of the real gases from the ideal gas laws, collision diameter, van der Waals equation, reduced equation of state, The Dieterici equation, The Berthelot's equation, The equation of Kammerling-Onnes, Virial Theorem and equation of state, compressibility factors, The heat capacity of gases, The principle of equipartition of energy, gas density and vapour density. d). Collision number and mean free path, transport properties: viscosity, thermal conductivity and diffusivity of gases.

UNIT-II

(ii) The Liquid State: a) Intermolecular forces – dipole-dipole London forces, hydrogen bonding. b) Vapour pressure, determination of vapour pressure, external and internal pressure, boiling point and vapour pressure. c) Surface tension, angle of contact and wetting of surface pressure on a curved surface, rise of liquid in a capillary tube, measurement of surface tension. Surface tension and vapour pressure, surface tension and temperature – Eootvos-Ramsay-Shields relation, Macleod's equation, parachor. d) Viscosity, measurement of relative and absolute viscosity, viscosity and temperature, molecular weight from viscosity. e) refractive index, specific rotation, molar refraction and chemical constitution, optical activity and specific rotation.

UNIT-III

(iii) The Solid State: Crystalline and amorphous solids, Crystals – Steno's law, Hauy's law, Laws of symmetry. Crystals systems and lattices, Crystals and X-rays, Bragg's method of crystal analysis. Different kinds of crystal structures, methods of crystal analysis, electron diffraction, Isomorphism, Heat capacity of solids, Debye's equation. Liquid crystals, magnetic properties - diamagnetic and paramagnetic materials. Ionic, covalent, metallic and coordinate bonds. (ii) Ionic Bond - characteristics of ionic compounds and crystal structures, radius ratio rules and coordination number, close packing. Classification of ionic structures – AX, AX2 and AX3 groups. Lattice Energy, Stoichiometric defects – Schottky and Frenkel. Non-stoichiometric defects – metal excess and metal deficiency. Semiconductors and transistors.

UNIT-IV

(iv) Colloids: The colloidal system, preparation of colloidal systems, classification. Lyophobic sols - optical and electrical properties, effect of addition of electrolytes and applied electric field. Determination of zeta potential by electrophoresis and electroosmotic methods. Origin of charge and the mechanism of flocculation – stability of sols. Properties of Lyophilic sols – viscosity and protective action.

UNIT-V

Kinetic properties of sols and Brownian motion. Determination of Avogadro's number from vertical distribution of sol particles and by diffusion method. Macromolecules – viscosity and molecular weight of polymers, osmotic pressure, The Donnan equilibrium. Sedimentation and ultracentrifuge, scattering of light. Protein sols, association colloids and emulsions, Ideal solution and colligative properties.

Suggested texts and References:

(1) P.W.Atkins, Physical Chemistry, Oxford University Press, 7th Edition, 2006.
(2) G.M.Barrow, Physical Chemistry, 5th Edition, Tata McGraw-Hill, New Delhi, 1992.
(3) D.A.McQuarrie and J.D. Simon, Physical Chemistry - a molecular approach, Viva Books Pvt. Ltd. (1998).
(4) D.K.Chakrabarty, Adsorption and catalysis by solids, Wiley Eastern, 1990.
(5) F.P.Kane and G.B.Larrabee (Eds.),Characterisation of solid surfaces, Plenum, 1978.
(6) A.W.Adamson, Physical Chemistry of Surfaces, 3rd Edn.,Wiley Interscience, 1976.

C 402: Group theory (45 + 15 = 60 hrs)

UNIT-I
(i) Symmetry Elements and Operations, Pure Rotations (C_nRotations), Improper Rotations, Rotation-Reflection (S_n) & Rotation-Inversion (n-bar) Axes.

UNIT-II

(ii) Point Groups: Low Symmetry Point Groups (C1 ,Ci , Cs), Simple Axial Point groups (c., S4n, Cnv' Cnh), Dihedral Groups (Dn, , Dnd, Dnh)

UNIT-III
Platonic Solids & the "Cubic" Groups (Td, 0h , Ih), Derived High Symmetry Groups (T, Th , 0, I), The "Infinite Groups" (C∞v and D∞h), Points Groups & Chirality, Point Groups & Dipole Moment.

UNIT-IV
(iii) Multiplication Tables (i.e., operation 1 followed by operation 2) for point groups. Similarity Transforms, Classes of Symmetry Elements. Naming Representations (Mulliken Symbols), Subgroups and Supergroups., Non Commutative Operations.

UNIT-V
(iv) Representations of Groups., Irreducible Representations., Character Tables. Their derivations and use of their contents. Matrix Representation of Symmetry Operations. The "Full Form" of the Character Table.

Suggested texts and References:
1. F. A. Cotton, "Chemical Applications of Group Theory", 3rd Edition, John Wiley (1990).
G 401: statistical techniques and its applications

CB 501: Analytical Chemistry **(45 + 15 = 60 hrs.)**

UNIT-I

(i) Error analysis: Methods of sampling and associated errors, Classification of errors, Propagation of errors, treatment of errors, Normal distribution, Tests of Significance and Confidence Limits.

UNIT-II

(ii) Separation techniques: Solvent Extraction Technique: Conventional, Liquid Membranes – Bulk, Supported and Emulsified, Solid Phase Extraction (SPE). Ion Exchange: Conventional, Membranes. Chromatography: Gas chromatography (GC), High Performance Liquid Chromatography (HPLC), Ion chromatography (IC).

UNIT-III

(iii) Mass Spectrometry: Mass Analysers – Magnetic, Quadrupole, Time of Flight (TOF), Features – Resolution, Dispersion, Abundance, Sensitivity, Detectors, Ion Sources –Thermal Ionisation (TI), Electron Impact, ICP, GD, Laser Ablation (LA-ICP), Secondary Ionisation (SI), Matrix Assisted Laser Desorption and Ionisation (MALDI), Hyphenated Technique – IC-MS, HPLC-MS, GC-MS.

UNIT-IV

(iv) Thermal Methods: Thermogravimetric Analysis (TGA), Derivative Thermogravimetric Analysis (DTG), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC), Evolved Gas Analysis (EGA).

(v)Electrochemical Methods: Introduction, Potentiometry , Ion Selective Electrodes (ISE), Voltammetry & Polarography , Cyclic, Pulse and Stripping Voltammetry, Coulometry and Amperometry, AC Electrochemical Techniques, Scanning Electrochemical Microscopy.

(vi) Detectors- Photomultiplier Tube (PMT), Charge Coupled Device (CCD), Charge Injection Device (CID), Spectrometers – Czerny Turner, Echelle, Sample Introduction Devices – Flame, Electrothermal, Laser Ablation, Direct Sample Insertion Devices, Interferences, detection limits, sensitivity.

UNIT-V

(vii) Conductance of solutions and electrochemistry: Faraday's laws of electrolysis, Electrolytic conduction- Arrhenius theory of electrolytic dissociation, strong and weak electrolytes. Migration of ions – transference numbers, Determination of transference number using Hittrof's rule and moving boundary method. Conductance of solutions – electrolytic conductance, determination of conductance, equivalent conductance and concentration, Kohlrausch's law of independent migration of ions, ionic mobilities, temperature dependence. Hydration of ions, the interionic attraction theory. Applications of conductance measurements– degree of dissociation of weak electrolytes, dissociation constants of weak acids, degree of dissociation of water, basicity of organic acids, determination of solubilities of sparingly soluble salts, conductometric titrations, activities of electrolytic solutions, ionic strength. The Debye-Huckel theory of dilute ionic solutions.

Suggested texts and References:

(1) D.A. Skoog, D. M. West, F. J. Holler, S.R. Crouch, Fundamentals of Analytical Chemistry, 8th Edition, Thomson (2004).
(2) A.I. Vogel, A text book of Quantitative Analysis, 5th Edition Revised by G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney, ELBS (1989).
(3) A. K. De, S. M. Khopkar and R. A. Chalmers, Solvent Extraction of Metals, Van Nostrand, Reinhold (1970).
(4) L. R. Snyder and J. J. Kirkland, Introduction to Modern Liquid Chromatography, 2nd Edition, Wiley (1979).
(5)Jose A. C. Broekaert, Analytical Atomic Spectrometry with flames and Plasmas, Wiley-VCH (2002).
(6) John Roboz, Introduction to Mass Spectrometry: Instrumentation and Techniques, Interscience (1968).

C 501: Quantum Chemistry **(45 + 15 = 60 hrs.)**

UNIT-I

(i) Foundations of quantum mechanics.
(ii) Wave function for a free particle, the Schrodinger equation, physical interpretation of the Scrodinger equation wave function, expectation of a dynamical quantity, Wavepackets and the uncertainty principle, WKB approximation.

UNIT-II

(iii) Operator concept in quantum chemistry.
(iv) Solution of Schrodinger's equation in some simple systems: one and three dimensional boxes, electron in a ring, rigid rotator, concept of tunnelling, one dimensional harmonic oscillator, hydrogen-like atoms, shapes of atomic orbitals.

UNIT-III

(v) Approximate methods of quantum chemistry: variational principle; Time-independent perturbation theory: Many electron sysytems: Orbital approximation, Slater determinant; Hartree-Fock self-consistent field theory; Slater type orbitals.

UNIT-IV

Concept of LCAO and introduction to ab-initio and semi-empirical molecular orbital calculations of molecules. Huckel Theory: Extended systems: From bonds to bands. Angular momentum of many-particle systems. Born-Oppenheimer approximation, MO and VB theories illustrated with H2-molecule, An elementary treatment of scattering theory.

UNIT-V

(vi)Spin orbital interaction; LS and JJ coupling. Spectroscopic term symbols for atoms. Molecules and Chemical bonding, Spectroscopic term symbols for diatomics; Directed valence & hybridization in simple polyatomic molecules.

Suggested texts and References:

(1) Ira N. Levine, Quantum ChemistryPrentice Hall India.
(2) John L. Powell and Bernd Crasemann, Quantum Mechanics, Oxford & IBH Publishing.
(3) A. K. Chandra, Introductory Quantum Chemistry, Tata McGraw-Hill Publishing Comp. Ltd.
(4) David B. Beard, Quantum Mechanics, Allyn & Bacon, Inc, Boston.

C 502: Inorganic Chemistry II: **(45 + 15 = 60 hrs.)**

UNIT-I

(i) Coordination compounds, Werners's theory, effective atomic number, coordination number, shapes of d-orbitals and bonding in transition metal complexes, stability of complexes, the chelates and macrocyclic effects, types of classification of ligands, second sphere of coordination, π-complexes, π-acid ligands, multiple bonds from ligands to metals.

UNIT-II

(ii) Crystal Field theory – crystal filed splitting and elementary treatment of the electronic spectra, Jahn-Teller distortion of octahedral complexes, square planar complexes, tetrahedral complexes, magnetic properties of 3*d* compounds.

UNIT-III

(iii) MO theory – Nomenclature of coordination compounds, d-orbital splitting in various fields - Spectroscopic states - Tanabe-Sugano and Orgel diagrams - Derivation of Ligand field parameters (Dq. B) from electronic spectra - Magnetic moments - Orbital contribution, spin-orbit coupling and covalency.

UNIT-IV

Molecular orbitals and energy level diagrams for common symmetries.

(iv) Bonding involving-donor ligands - Back-bonding - f-orbital splitting - Spectral and magnetic properties of f-block elements.

UNIT-V

(v) Reaction mechanisms: Substitution reactions - Dissociative and associative interchange - trans-effect - Linear free energy relations. Rearrangements - Berry pseudo rotation, Electron transfer reactions. Photo-dissociation, substitution and redox reactions, Fluxional molecules.

Suggested texts and References:

(1) F.A. Cotton, G. Wilkinson, C.A. Murillo and M. Bochmann, Advanced Inorganic Chemistry, Wiley Eastern, John Wiley, 6th Ed., 1999.

(2) J.E. Huheey, E. Keiter and R. Keiter, Inorganic Chemistry, 4th Ed., Harper Collins College Publisher, 1993.

(3) D.Banerjea, Inorganic Chemistry Principles, Books Syndicate Pvt. Ltd., 2000.

(4) N.N. Greenwood and E.A. Earnshaw, Chemistry of Elements, Pergamon Press, 1989.

(5) J.J. Kratz, G.T. Seaborg and L.R. Morss; *The Chemistry of Actinide Elements,* 2nd Edition, Vol. 1&2, Chapman & Hall, New York (1986).

(6) J.C. Bailar, H.J. Emelius, R. Nyholm and A.F. Trotman-Dickenson; *Comprehensive*

C 503: Organic Chemistry – II **(45 + 15 = 60 Hrs.)**

UNIT-I

(A) Stereochemistry of Organic Compounds 25h **(i)** Isomerism – Concept and types **(ii)** Chirality: Configuration, stereogenic/chiral center, chirality and enantiomerism. Representation of configuration by flying wedge formulae and Fischer, Newman and Sawhorse projection formulae. **(iii)** Stereochemistry of carbon compounds with upto three similar and dissimilar asymmetric carbon atoms; enantiomers, diastereomers, and racemic mixtures and their properties, resolution (chemical and chromatographic). **(iv)** Diastereomerism: Threo, erythro, meso diastereomers. Geometrical isomerism in olefins, cycloalkanes and oximes. Absolute configuration: Assigning of stereochemical descriptors - R/S to Fischer projection and flying wedge formulae of chiral molecules and E/Z to olefins.

UNIT-II

(v) Molecular chirality and elements of symmetry: Stereochemistry and stereochemical nomenclature of biphenyls, spirans, cummulenes, and alkylidene cycloalkanes **(vi)** Conformational concepts, conformations of acyclic molecules (ethane and butane), cyclohexane and mono, di-substituted cyclohexanes. Conformationally rigid and mobile diastereomers. **(vii)** Stereoselectivity and stereospecificity of organic reactions: Enantiomeric and diastereomeric selectivities.

UNIT-III

The mechanism and stereochemical outcome of the following reactions: (a) S_N1, S_N2 and S_Ni reactions (b) Catalytic hydrogenation of alkenes (c) Ionic trans addition of bromine to alkenes (d) Epoxidation of alkenes, acid catalysed ring opening of epoxides. (e) Reactions of OsO_4 and $KMnO_4$ with olefins (f) E2 reactions. (g)Topicity and prostereoisomerism - Enantiotopic and diastereotopic atoms, groups and faces.

UNIT-IV

(B) Chemistry of heterocyclic compounds **25h**

Heterocycles containing one heteroatom (furan, thiophene, pyrrole, pyridine) and more than one heteroatom (pyrazole, imidazole, oxazole, thiazole, pyrimidine and pyrazines) their derivatives – preparation, properties and reactions. **(C) Chemistry of Alicyclic compounds:** Cycloalkanes and cycloalkenes. Factors affecting stability of conformations, conformation of cycloalkanes. Reaction mechanism in alicyclic compound.

UNIT-V

(i) Conformation of Cyclic System: Monocyclic compounds and Fused ring and Bridged ring Compound. Topicity and Prostereoisomerism & Racemisation and Methods of Resolution.

(ii) Dynamic stereochemistry: Conformationally rigid and mobile diastereomers, seteroselectivity.

(iii) Chemistry of Carbon radical (Single electron transfer mechanism): neighboring group participation; non-classical carbocataion; S_Ni mechanism. Rearrangements of Carbocataion, Free-radical: Allylic, Pinacol/ Pinacolone, 1,2 rearrangements etc and rearrangement to heteroatoms. Pericyclic reaction and FMO approach.

Suggested texts and References:

(1) I. L. Finar, Organic Chemistry, Vol. 1 & 2, ELBS.

(2) R. K. Bansal, Heterocyclic Chemistry, Synthesis, Reactions and Mechanisms, Wiley Eastern Ltd., 1990.

(3) J.A.J. Joule and G.F. Smith, Heterocyclic Chemistry, ELBS, 2nd Ed., 1982.F.G. Riddell, The Conformational Analyis of Heterocyclic Compounds, Academic Press, 1980.

(4) L.A. Paquette, Principles of Modern Heterocyclic Chemistry, W.B. Benjamin, Inc., 1978.

(5) B.M. Acheson, An Introduction to the Chemistry of Heterocyclic Compounds, Interscience, 2nd Ed., 1975.

CB 601: Biophysical Chemistry

UNIT-I
(i) The Chemistry of Life: An introduction: Physical properties of water: Structure, water as solvent, The hydrophobic effect, osmosis and diffusion. Introduction to Biomolecules: Nucleic Acid, Protein - Polymer Description of Macromolecular Structure, Intermolecular and Intramolecular forces, Non Covalent Interaction
.

UNIT-II
(ii) General principles of Biophysical chemistry I: Hydrodynamic properties: Diffusion and sedimentation, determination of molecular weight from sedimentation and diffusion; Introduction of Ultra Centrifugation, Dynamic Light Scattering and Electrophoresis. Spectroscopic properties of proteins and nucleic acid: UV/Vis, Intrinsic fluorescence, Circular dichroism.

UNIT-III
(iii) General principles of Biophysical chemistry II: The concept and application of Chemical and Physical equilibria in Biological system, The equilibrium constant and Standard Gibbs Free energies of reactants and products, Temperature dependence of the equilibrium constant, Double Strand formation in nucleic acid, Ligand-protein binding, Protein denaturation and stability, Introduction of DSC and ITC.

UNIT-IV
(iv) Molecular self-assembly and Molecular medicine: Protein folding kinetics and Biophysical methods, Misfolding and aggregation; Physical basis of conformation diseases, Therapeutic approaches to protein misfolding diseases**.**

UNIT-V
(v) Introduction to structure biology: Introduction to basic principles of protein X-ray crystallography, protein NMR, Small Angle X-ray scattering (SAXS), and Electron microscopy (EM).

Suggested texts and References:
(1) Tinoco, Sauer, Wang, and Puglisi. (2003) Physical Chemistry: Principles and Applications in the Biological Sciences. Prentice Hall, Inc.
(2) Physical Chemistry for the Life Sciences: Peter Atkins and Julio de Paula
(3) General review papers Dobson CM. Principles of protein folding, misfolding and aggregation. Semin Cell Dev Biol. 2004 Feb;15(1):3-16.

C 601: Atomic and molecular Spectroscopy **(45 + 15 = 60 hrs.)**

UNIT-I
(i) Born-Oppenheimer approximation - rotational, vibrational and electronic energy levels of homonuclear and heteronuclear diatomic and polyatomic molecules.

UNIT-II

(ii) Microwave Spectroscopy: Rotational of molecules and rotational spectroscopy of rigid diatomic molecules, Effect of isotopic substitution, The non-rigid rotator and rotational spectra. Rotational spectra of polyatomic molecules – linear, symmetruic top and asymmetric top. Techniques and instrumentation.

UNIT-III

(iii) Infrared spectroscopy: energy levels of vibrating diatomic molecule, simple harmonic oscillator and anharmonic oscillator, diatomic vibrating rotator, vibration-rotation spectra of CO. Breakdown of B-O approximation – interaction of rotations and vibrations. Vibrations of polyatomic molecules – Fundamental vibrations and their symmetry, overtone and combination frequencies, influence of rotation on the spectra of polyatomic molecules – linear and symmetric top molecules. Influence of nuclear spin. Group frequencies and analysis of spectra, Techniques and instrumentation, FTIR spectroscopy.

UNIT-IV

(iv) Raman Spectroscopy: Classical and quantum theories of Raman effect and molecular polarizability. Pure rotational Raman spectra, Vibrational Raman spectra, Polarization of light and the Raman effect, Structure determination from Raman and infrared spectroscopy, Techniques and Instrumentation, Near IR FT Raman spectroscopy. Resonance Raman and electronic Raman transition and applications.

UNIT-V

(v) Electronic spectroscopy – Electronic structure and spectra of diatomic and polyatomic molecules. Techniques and instrumentation. Molecular photoelectron spectroscopy.

(vi) Electron spin resonance spectroscopy - spin and spectra - relaxation processes - origin of g-shifts and hyperfine coupling - Tensor quantities - Experimental determination of g, A and D tensors - their interpretation - several examples.

Suggested texts and References:

(1) G. M. Barrow, Molecular spectroscopy

(2) C.N. Banwell and E. M. McCash, Fundamentals of Molecular spectroscopy, Tata McGraw HillPub. Co.New delhi

(3) J. D. Graybeal, Molecular Spectroscopy, McGraw Hill International Book Co. N.Y.

C 602: Inorganic Chemistry III **(45+15 = 60 hrs)**

UNIT-I

Chemistry of d-block elements

(i) General introduction to transition elements – Electronic structure, Metallic character, variable oxidation state, complexes, magnetic and catalytic properties.

UNIT-II

(ii) Elements of the first transition series: Occurance, separation, extraction and chemistry of the scandium group (IIIB), titanium Group (IVB), vanadium group (VB), chromium group (VIB), Manganeese group (VIIB).

UNIT-III

Iron group (VIIIB(8)), Nickel group (VIII(9)) and Copper group (VIIIB(10)).

(iii) Chemistry of the elements of the second and third transition elements: fnium group (Group IVB), Niobium and Tantalum (Group VB), Molybdenum and tungsten (Group VIB); Technitium and Rhenium (Group VIIB),

UNIT-IV

The Platinum group Metals, Ruthenium and Osmium (Group VIII(8)); Rhodium and Irridium (Group VIII(9)), Palladium and Platinum (Group VIII(10), Silver and gold Group (1B(11)).

UNIT-V

(iv)Chemistry of f-block elements-The lanthanide and actinide elements.

Suggested texts and References:

(1) Advanced Inorganic Chemistry, F. Albert Cotton and G. Wilkinson@1988, John Wiley & Sons.

C 603: Organic chemistry III (45 + 15 = 60 Hrs.)

UNIT-I

Chemistry of Natural Products:

(i) Terpenoids: Classification, structure, chemistry and biogenesis of some important mono; sesqui,di, and triter penes.

UNIT-II

(ii) Steroids: Sterols and bile acids, estrogens, androgens, gestogens and adrenocortical hormones. Hormone production. Cardiac glycosides. Steroidal triterpenes; biogenesis of steroids and correlation with terpenoids.

UNIT-III

(iii) Alkaloids: Characteristic reactions, general methods of degradation, structure and chemistry of some well-known alkaloids.

UNIT-IV

(iv) Natural Pigments: anthocyanines, Flavones, flavanones, isoflavones, xanthones, quinones, pterins, chlorophyll and haemin.

UNIT-V

(v) Carbohydrates: Stereochemistry, reaction and conformation of monosaccharides, deoxy and aminosugars, hexonic acid and vitamin C, disaccharides, polysaccharides, inositol; gangliosides and other glycosides. Chemistry of vitamins A, B, C and E.

Suggested texts and References:

(1) I. L. Finar, Organic Chemistry, Vol. 1 & 2, ELBS.

C 604: Nuclear Chemistry (45 + 15 = 60 hrs.)

UNIT-I

(i) Nuclear Stability: Concept of nucleus and properties, nuclear mass and binding energy, elemental abundance, radioactive decay laws and equilibria. Nuclear Models: Liquid drop model, Shell model, Fermi gas model, collective model, optical model, concept of spin, parity electric and magnetic moments, isomerism.

UNIT-II

(ii) Modes of Decay: □ decay, □ decay, electron captures, □ de-excitation, internal conversion, artificial radioactivity.

(iii) Nuclear reactions: Energetics, cross-section, centre of mass system, angular momentum, compound nucleus, statistical model, nuclear fission and fusion, nuclear reactors, Heavy ion induced reactions, Accelerators.

UNIT-III

(iv) Applications of radioactivity: Probing by isotopes, preparation of radioisotopes, Szilard-Chamers' reaction, Concept of tracers, chemical yield, radiochemical purity, Application of radiotracers in Chemical Sciences, uses of nuclear radiations, radioisotopes as a source of electricity.

UNIT-IV

(v) Elements of Radiation Chemistry: Interaction of radiation with matter, radiation dosimetry, radiolysis of water and some aqueous solutions, other radiolytic events.

(vi) Nuclear Methods: Activation Analysis – Neutron Activation Analysis (NAA),

UNIT-V

Charged Particle Activation Analysis (CPAA), X-ray fluorescence (XRF) spectrometry, Ion Beam Analysis – Backscattering Spectrometry (BS), Particle Induced □-ray Emission (PIGE), Nuclear Reaction Analysis (NRA), Elastic Recoil Detection Analysis (ERDA), Particle Induced X-ray Emission (PIXE).

Suggested texts and References:

(1) G. Friedlander, J. Kennedy, Nuclear and Radiochemistry (1981) –J. M. Miller and J. W. Macias
(2) R. D. Evans, Atomic Nucleus (1955)
(3) S. Glasstone, Source book of Atomic Energy (1969)
(4) G. T. Seaborg, Man made elements (1963).
(5) H. J. Arnikar, Essentials of Nuclear Chemistry (1982).
(6) C. Keller, The Chemistry of Transuranium Elements (1971).
(7) J.C. Bailar, H.J. Emelius, R. Nyholm and A.F. Trotman-Dickenson; Comprehensive Inorganic Chemistry, Vol. 5, Pergamon Press, Oxford (1973).

C701: Photochemistry **(45 + 15 = 60 hrs.)**

UNIT-I

Basic Principles of photochemistry:

(i) Photophysical processes: Deexcitation processes for the excited molecules (fluorescence, phosphorescence, delayed emission, nonradiative relaxation, excimer and exciplex formation, heavy atom effect, etc.). Kinetics of excited state processes and quantum yields of different processes.

(ii) Properties of the excited state: Acid-base properties, redox potential, geometry, dipole moment, dynamic properties of the excited states.

UNIT-II

(iii) Photoinduced processes: Photo-dissociation, photo-ionization, intramolecular charge and proton transfer processes, intermolecular electron and proton transfer reactions, conformational relaxations, intra and intermolecular energy transfer processes and other important photochemical reactions. Kinetics and mechanism of photochemical reactions.

(iv) Applications of photochemistry: Photosynthesis, vision, solar energy conversion, atmospheric photochemistry, etc.

UNIT-III

(v) Studies on ultrafast processes: Nanosecond, picoseconds and femtosecond laser flash photolysis, fluorescence time domain spectroscopy with special emphasis on energy transfer and electron transfer reactions and studies on excited state properties.

UNIT-IV

(vi) Organic Photochemistry Distintive features of photochemical reactions, methods of preparative photochemistry, Photochemistry of alkenes, alkynes and related compounds – geometrical isomerism, electrocyclic processes, sigmatropic shifts, di-π methane reactions, addition, cycloaddition and oxidative reactions. Photochemistry of aromatic compounds – bond cleavage and hydrogen abstraction reactions, cycloaddition reactions, rearrangements of cyclo-hexenones and cyclo-hexadienones, thiocarbonyl compounds. Photochemistry of other organic compounds – imines, imminium salts, nitriles and nitro compounds, azo and diazo compounds, diazonium salts, sulphur and halogenated compounds, photohalogenation and photonitrosation reactions. Photooxidation of alkanes.

UNIT-V

(vii) Inorganic Photochemistry Introduction to inorganic photochemistry. Photophysical processes. The electronic absorption spectra of inorganic compounds. Characteristics of the electronically excited states of inorganic compounds. Photoelectochemistry of excicted state redox reactions. Photosensitization. Photochemical reactions; substitution, decomposition and fragmentation, rearrangement, and redox reactions. Selective inorganic photochemistry using laser beams. Inorganic photochemistry in biological processes and their model studies. Ligand field photochemistry of dn complexes, photochemistry of carbonyl compounds, energy conversion (solar) and photodecomposition of water.

Suggested texts and References:

(1) K.K.Rohatagi-Mukherjee, Fundamentals of Photochemistry, Wiley Eastern, 1978.

(2) M.S.Wrighton, Inorganic and Organometallic photochemistry, ACS Pub., 1978.
(3) V. Balzani and V. Carasiti, Photochemistry of Co-ordination compounds, Academic Press, 1970.
(4) J. D. Coyle, Introduction to Organic Photochemistry, ISBN

C703: Organometalics and Bioinorganic Chemistry (45 + 15 = 60 hrs.)

UNIT-I

Organometallics: Overview, 18-electron rule, square planar complex. Carbonyl ligand – bonding, binary carbonyl complexes, oxygen-bonded carbonyls, other ligands similar to CO, IR spectrum, main group parallels with binary carbonyl. Pi-ligands – linear and cyclic pi systems, NMR spectra of organometallic complexes.

UNIT-II

Comparative survey of structure and bonding of metal alkyls and aryls, complexes with □ acids, CO and related ligands, complexes with olefins, acetylenes and related unsaturated molecules, catalytic properties of mononuclear compounds, stereochemical non-rigidity in organometallic compounds, boranes, carboranes and metallocarboranes, bimetallic and cluster complexes, structure and applications in catalysis, applications of organometallic compounds in organic synthesis, enantioselective synthesis via organometallic compounds.

UNIT-III

importance of organometallic compounds in certain biological systems. Other important ligands – complexes containing M – C, M= C, M ≡ C bonds, hydride and dihydrogen complexes, phosphines and related ligands.
(ii) Organometallic reactions occurring in metal – ligand substitution, oxidative, addition, reductive, elimination. Organometallic reactions involving modification of ligands – insertion and deinsertion, nucleophilic addition to ligands, nucleophilic abstraction, electrophilic reactions.

UNIT-IV

Homogeneous catalysis and heterogeneous catalysis – use of transition metal complexes, hydroformylation reaction, Walker-Smidt synthesis of acetaldehyde, hydrogenation, Monsanto acetic acid process. Transition metal carbine complexes – structure, preparation and chemistry, metathesis and polymerization reactions. Applications of organometallics to organic sysnthesis and other applications. Metal cluster compounds - metal-metal bond, carbonyl and non-carbonyl clusters, structure and bonding low dimensional solids, clusters in catalysis.

UNIT-V

(iii) Bio-inorganic chemistry - biochemistry of iron - its storage, transport and function, copper and zinc proteins, biological activation of oxygen, bioinorganic chemistry of alkali and alkaline earth metal cations, photosynthesis, nitrogen fixation, toxicity of metals. Chemical make up and essential inorganic elements of organisms. Chemistry aspects of metal complexes. Spectral, biochemical and biological methods used in bioinorganic chemistry. Bioinorganic chemistry of Na^{+}, K^{+}, Mg^{2+} and Ca^{2+}. Role of metal ions in biology : Proteins and enzymes of V, Mn, Fe, Co, Ni, Cu, Zn and Mo. Structural and functional models. Transport and storage of metal ions. Carcinogenicity of chromium. Selenium in biology.

Suggested texts and References:
(1) G.O.Spessard, G.L.Miessler, Organometallic Chemistry, Prentice Hall, 1997.
(2) C.Elsehenbroich and A. Salzer, Organometallic Chemistry, 2nd Ed., Wiley VCH, 1992.
(3) F.A.Cotton, G. Wilkinson, C.A. Murillo and M. Bochmann, Advanced Inorganic Chemistry, 6th Edn., Wiley, 1999.
(4) N.N.Greenwood and A. Earnshaw, Chemistry of the Elements, lst Edn., Pergamon, 1985.
(5) S.J.Lippard & J.M.Berg, Principles of bioinorganic chemistry, University Science Books, Mill Valley, 1994.
(6) I. Bertini, H.B.Gray, S.J.Lippard and J.S.Valentime, Bioinorganic Chemistry, Univ. Sci. Books, Mill Valley, 1994.
(7) James A.Cowan, Inorganic Biochemistry, VCH Publishers, 1993.

C 704: Physical organic chemistry (45 + 15 = 60 hrs)

UNIT-I

Structure and Models of Bonding: Basic Bonding Concepts, Bonding and Structure of Reactive Intermediates, Molecular Orbital Theory, electron in a box problem, energies and coefficients of linear pi-systems, Secular Determinant, Huckel MOT, HMOT in cyclic and acyclic pi-systems, Aromatic and antiaromatic systems.

UNIT-II

(ii) Strain and Stability: Thermochemistry of Stable Molecules, Thermochemistry of Reactive Intermediates, Relation Between Structure and Energetics-Basic Conformational Analysis, Conformations of Acyclic and Cyclic Systems, Electronic Effects.
Acid-Base Chemistry: Bronsted Acid-Base Chemistry, Aqueous and Non-Aqueous Systems, Predicting Acid Strength in Solution, Lewis Acids/Bases and Electrophiles/Nucleophiles.

UNIT-III

(iv) Thermal Pericyclic Reactions: Cycloadditions, Orbital correlation diagram, Frontier Molecular Orbital, Comments on forbidden and allowed reactions, Photochemical pericyclic reactions, D-A cycloadditions, regio- and stereoselectivity, endo-effect, [2+2] cycloaddition, ketene cycloaddition, 1,3-dipolar cycloaddition, ene-reaction, retrocycloaddition, electrocyclic reactions, torquoselectivity, sigmatropic rearrangements, Claisen and Cope rearrangements, Cheletropic reactions.

UNIT-IV

(v) Reactivity, Kinetics and Mechanisms: Energy Surfaces and Related Concepts, Postulates and Principles Related to Kinetic Analysis, Kinetic Experiments and Deciphering Mechanisms.
(iv)Experiments Related to Thermodynamics and Kinetics: Isoptope Effects, Substituent Effects, Hammett Plots and Linear Free Energy Relationships, Other Linear Free Energy Relationship, Acid-Base Related Effects, Experiments for Studying Mechanism.

UNIT-V

(vii) Application of physical methods: Deciphering mechanisms of electrophilic and nucleophilic substitution/additions, eliminations, cyclizations, radical reactions and reactions involving reactive intermediates.

Suggested texts and References:

(1) E. V. Anslyn and D. A. Dougherty, Modern Organic Chemistry, University Science, 2005.
(2) I. Fleming, Molecular Orbitals and Organic Chemical Reactions, John Wiley, 2009.
(3) J. Clayden, S. Warren, N. Greeves, P. Wothers, Organic Chemistry, 1st Edition, Oxford University Press, 2000
(4) F. J. Carey and R. J. Sundburg, Advanced Organic Chemistry, Part A and Part B, 5th Ed., Springer, 2007
(5) J. March, Advanced Organic Chemistry, 3rd edition, McGraw Hill, 1991.
(6) S. H. Pine, Organic Chemistry, 5th edition, McGraw Hill, 1987.

C801: Chemistry of Materials **(45 + 15 = 60 hrs.)**

UNIT-I

Basic Aspects of the Solid State

(i) Solid State Structure: Primitive lattice vectors - reciprocal lattice - crystal systems and desymmetrization schemes. Bravais lattices; closed packed structures, octahedral and tetrahedral holes, crystallographic point groups and space groups - organic and in organic crystal structure motifs - polytypes and polymorphs. pervskites and related structures, normal and inverse spinels.
(ii) Defects and Non-stoichiometry: Intrinsic and extrinsic defects - point, line and plane defects; vacancies, Schottky defects, Frenkal defects - Charge compensation in defective solids - non-stoichiometry, thermodynamic aspects and structural aspects.

UNIT-II

(iii) Thermal Properties: Free electron theory, electrical conductivity, Hall effect - band theory, band gap, metals and semiconductors - intrinsic and extrinsic semiconductors, hopping semiconductors - semi-conductor/metal transition - p-n junctions - superconduction, Meissner effects, type I and II superconductors, isotope effect, basic concepts of BCS theory, manifestations of the energy gap, Josephson devices.
(iv) Ionic Conductors: Types of ionic conductors - Mechanism of ionic conduction; interstitial jumps (Frenkel), vacancy mechanism, diffusion - superionic conductors, phase transitions and mechanism of conduction in superionic conductors - examples and applications of ionic conductors.

UNIT-III

(v) High Tc Materials: Defect pervskites - high Tc superconductivity in cuprates – preparation and characterization of 1-2-3 and 2-1-4 materials - normal state properties, anisotropy, temperature dependence of electrical resistance, optical phonon modes – superconducting state, heat capacity, coherence length, elastic constants, positron lifetimes, microwave absorption - pairing and multigap structure in high Tc materials - applications of high Tc materials.
(vi) Magnetic Properties: Classification of magnetic materials - Langevin diamagnetism - Quantum theory of paramagnetism - cooperative phenomena - magnetic domains and hysteresis - magnetism and dimensionality.
(vii) Optical Properties: Optical reflectance - excitons - Raman scattering in crystals - photoconduction - color centers - lasers - photovoltaic effect.

UNIT-IV

(viii) Synthesis of Materials: Phase diagrams - preparation of pure materials, mass transport, nucleation and crystal growth - preparative techniques, zone refining, chemical transport, etc. **(ix)** Multiphase materials: Ferrous alloys, Fe-C phase transformations in ferrous alloys, stainless steels - non-ferrous alloys - properties of ferrous and non-ferrous alloys and their applications. **(x)** Nanocrystalline phase - preparation procedures – special properties - applications
(xi) Thin Films, Langmuir-Blodgett Films: Preparation techniques, evaporation/sputtering, chemical processes, MOCVD, sol-gel etc. - LB film growth techniques - photolithography - properties and applications of thin films, LB films.

UNIT-V

(xii) Liquids Crystals: Mesmorphic behavior - thermotropic and lyotropic phases – description of ordering in liquid crystals, the director field and order parameters - nematic and semectic mesophases, smectic -nematic transition and clearing temperature - homeotropic, planar and twisted nematics - chiral nematics - smectic A and smectic C phases - cholesteric-nematic transition - optical properties of liquid crystals - effect of external field.
(xiii) Materials for Solid State Devices: Rectifiers, transistors, capacitors - IV-V compounds - low-dimensional quantum structures, optical properties.
(xiv) Organic Solids, Fullerenes, Molecular Devices: Conducting organics – organic superconductors - magnetism in organic materials.
(xv) Fullerenes - doped fullerenes as superconductors
(xvi) Nonlinear Optical Materials: Nonlinear optical effects, second and third order – molecular hyperpolarisability and second order electric susceptibility - materials for second and third harmonic generation.

Suggested texts and References:

(1) H.V. Keer, Principles of the Solid State, Wiley Eastern (1993).
(2) N.W. Ashcroft, N.W. Mermin, Solid State Physics, Saunders College, Philadelphia (1976).
(3) W.D. Callister, Material Science and Engineering. An Introduction, Wiley, New York (1985).
(4) Charles Kittle, Introduction to solid state physics, John Wiley & Sons, New York (1968). Anthony R.West, Solid State Chemistry and its Applications, John Wiley & Sons, New York (2005).
(5) Lesley E. Smart, Elaine A. Moore, Solid State Chemistry (3rd Ed), Taylor & Francis (2005).
(6) N.N. Greenwood, Ionic crystals, lattice defects and non-stoichiometry,

C 802: Macro and Supramolecular Chemistry (45 + 15 = 60 hrs.)

UNIT-I

A. Polymer Chemistry

(i) Polymerization reactions, mechanism and kinetics – cationic, anionic and radical polymerization. Template, emulsion and electrochemical polymerization, Condensation, ring opening, step growth and radiation polymerization reactions. Coordination complex polymerization, Naturally occurring polymers, Biological polymers, inorganic polymers. Polymerization of cyclic organic compounds. Copolymerization and multicomponent polymerization,

(ii) Thermodynamics and kinetics. Polymerization and depolymerization equilibria - Kinetics of condensation (Step-Growth), Free radical and ionic polymerizations.

UNIT-II

(iii) Physical Characterization: Fabrication and Testing, Relationship between structure and properties - Thermal, flame and chemical resistance - Additives - Electroactive polymers - Biomedical applications. Molecular wieght (Mn, Mw) determination - Morphology -Glass transitions and crystallinity - Conformational analysis. Dynamics of dilute polymer solutions and effect of increasing concentration, NMR and neutron scattering studies.
(iv) Reactions and degradation of polymers, biodegradable polymers. Thermal and oxidative degradation, catalysis by macromolecules, computer applications.

UNIT-III

Supramolecular Chemistry

(i) Introduction to Supramolecular Chemistry.
(ii) Molecular and Chiral Recognition - Self-Organization, Self-Assembly and Preorganization, molecular and chiral recognition, self-Assembly and self-organization, role of preorganization in the synthesis of topological molecules, template reactions, one-pot' reactions.
(iii) Covalent self-assembly based on preorganization - inclusion complexes, host-guest chemistry, early development of host-guest chemistry. pedersen's works onc crown ethers, nomenclature, the structure of inclusion complexes, dynamic character of inclusion complexes, the complexes involving induced fit and without it, endo-hedral fullerene, hemicarcerand and soft rebek's tennis ball-like hosts.
(iv) Mesoscopic Structures as an Intermediate Stage Between Molecules (Micro Scale) on the One Hand and Biological Cells (Macro Scale) on the Other – introduction, medium sized molecular aggregates.

UNIT-IV

(v) Between Classical Organic Chemistry and Biology Understanding and Mimicking Nature-Introduction, the role of self-organization and self-association in the living nature, modeling processes in living organisms.
(vi) On the Border Between Chemistry and Technology - Nanotechnology and Other Industrial Applications of Supramolecular Systems – introduction, between chemistry and solid state physics - crystal engineering, obtaining crystals with desired properties, nanotechnology and other industrial applications of supramolecular systems, supramolecular catalysis.
(vii) The Most Interesting Macrocyclic Ligands which Are Hosts for Inclusion Complexes- . Crown ethers and coronands, cryptates and cryptands, calixarenes, hemispherands, and spherands, carcerands, hemicarcerands and novel `molecular flasks' enabling preparation and stabilization of short-lived species, cyclodextrins, and their Complexes, endohedral fullerene complexes, nanotubes and other fullerene-based supramolecular systems, dendrimers, cyclophanes and steroids forming inclusion complexes, anion binding receptors and receptors with multiple binding Sites.

UNIT-V

(viii) Other Exciting Supramolecular Systems- Making Use of the preorganization phenomenon, topological molecules, multiple hydrogen-bonded Ssstems, organic zeolite, metal directed self-assembly of comple, supramolecular architecture, chains, racks, ladders, grids, macrocycles, cages, nanotubes and self-Intertwining strans (helicates).

(ix) The Prospects of Future Development of Supramolecular Chemistry.

Suggested texts and References:

1. H.R. Allcock, F.W. Lampe and James Mark, Contemporary Polymer Chemistry, Prentice Hall, Inc. (1990).
2. M.P. Stevens, Polymer Chemistry: An Introduction (2nd Edition) Oxford University Press 91990).
3. F.W. Billmeyer, Jr., Textbook of Polymer Science (3rd Edition) Wiley-Inter Science (1984) paperback.
4. A. Ravve, Principles of Polymer Chemistry.
5. Recommended Review Articles in the field of supramolecular chemistry.
6. "Supramolecular Chemistry" by F. Vogtle, John Wiley, 1991.
7. "Crystal Engineering. The Design of Organic Solids" by G.R. Desiraju, Elsevier, 1989.
8. Introduction to Supramolecular Chemistry, Dodzuick Helena.

C 803: Reaction dynamics (45 + 15 = 60 hrs.)

UNIT-I

Chain reactions: general treatment, activation energy, chain length, chain transfer reactions, inhibition, bond dissociation energies, branching chain reactions.

UNIT-II

The collision theory: Dynamics of bimolecular collisions and rate and rate constant of bimolecular reaction, factors determining effectiveness of collisions, Termolecular reactions, unimolecular reactions. Relation between cross section and rate coefficients.

UNIT-III

Potential Energy Surfaces:: Long range, empirical intermolecular and molecular binding potentials, Internal coordinates and normal modes of vibration, Potential energy surfaces, ab-initio calculation of potential energy surface, experimental determination of potential energy surfaces.

UNIT-IV

Details of the reaction path, potential energy surface for electronically excited molecule. Molecular beam scattering, State resolved spectroscopic technique, molecular dynamics of H_2 + H reaction, state-to-state kinetics of F + H_2 reaction.

UNIT-V

(iv) ***Transition State Theory (TST):*** Motion on the potential energy surface, Basic postulates and derivation of TST, dynamical derivation of TST, Quantum mechanical effects on TST, Thermodynamic formulation of TST, Application of TST, Micro-cannonical TST, Variational TST, Experimental observation of TST.

Suggested texts and References:

(1) J.I. Steinfeld, J.S. Francisco and W.L. Hase, Chemical Kinetics and Dynamics, Prentice Hall 1989.
(2) Paul L. Houston, Chemical Kinetics and reaction dynamics.

(3) R.D.Levine and R.B.Bernstein, Molecular Reaction Dynamics and Chemical Reactivity, Oxford University Press, 1987.
(4) Sanjay K. Upadhay, Chemical kinetics and Reaction Dynamics, Springer, 2006

C 804 Computational chemistry **(45 + 15 = 60 hrs.)**

A brief outline of molecular mechanics, semi-empirical approximations, ab initio methods, basis sets and Z-matrix; Application of these computational methods for prediction of structural and electronic properties of molecules by using standard programs; FMOs in organic chemistry, crystal and ligand field calculations, computation of potential energy surfaces. Conformational analysis by molecular mechanics; Dynamical and structural studies of molecules using molecular dynamics simulations; Monte Carlo simulations of molecules.

Suggested texts and References:
(1) C. J. Cramer, Essentials of Computational Chemistry: Theories and Models, John Wiley & Sons, 2002.
(2) David Young, Computational Chemistry: A practical Guide for applying Techniques to Real World Problems, Wiley Interscience, 2001.
(3) A.R. Leach, Molecular Modelling: Principles and Applications, Pearson Education, 2001.
(4) J. B. Foresman, A. Frisch, Exploring Chemistry with Electronic Structure Methods. Gaussian Inc., 1996.
(5) M.P. Allen and D.J. Tildesley, Computer Simulations of Liquids, Oxford, 1987.

X- SEMESTER ELECTIVES

CE1- Environmental Chemistry

Unit-I
Scope: Environmental pollution, structure of atmosphere, biogeological cycles – oxygen, nitrogen, carbon, phosphorous, sulphur ; biodistribution of elements, air pollutions - reactions in atmosphere, primary pollutants, air quality standards, analysis of CO, nitrogen oxides, sulphur oxides, hydrocarbons and particulate matter, particulate pollution - control methods, vechicular pollution, green house effect and global warming, climatic changes, ozone, photochemical smog, acid rain, sampling, monitoring & control.
Unit-II
Hydrosphere: Water pollution, hydrological cycle, chemical composition, sea water composition, water quality criteria for domestic and industrial uses, BIS and WHO standards, ground water pollution, surface water pollution - lake and river water, eutrophication, marine pollution, water pollutants - biodgradeability of detergents – pestisides - endosulfan and related case studies.
Unit-III
Classification of industrial waste waters: 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, electrodialysis, reverse osmosis, other purification methods, chemical speciation of elements.

Unit-IV

Water analysis: Color, odor, conductivity, TDS, pH, acidity, alkalinity, chloride, residual chlorine, hardness, trace metal analysis, elemental analysis, ammonia, nitrite, nitrate, fluoride, sulphide, phosphate, phenols, surfactants, BOD, COD, DO, TOC, nondispersive IR spectroscopy, anode stripping, ICP, AES, Chromatography, ion selective electrodes, neutron activation analysis.

Unit-V

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.

References:

1. H. Kaur, Environmental Chemistry, 6th Edn, Pragathi Prakashan, Meerut, 2011.
2. K.H.Mancy and W,.J.Weber Jr. Wiley, Analysis of Industrial Waste Water, Interescience New York, 1971.
3. L.W. Moore and E. A. Moore, Environmental Chemistry, McGraw Hill Publication, New York, 2002.
4. S. M. Khopkar, Environmental Pollution Analysis, New Age International (P) Ltd, 1993.
5. Colid Baird. Environmental Chemistry, W. H. Freemand and Company, 1995.

CE2- Inorganic Rings, Cages and Clusters

Unit-I

Main group clusters: Geometric and electronic structure, three - four and higher connect clusters, the closo-, nido-, arachno- borane structural paradigm, Wade-Mingos and Jemmis electron counting rules, clusters with nuclearity 4-12 and beyond 12. Structure, synthesis and reactivity.

Unit-II

Transition metal clusters: Low nuclearity metal carbonyl clusters and 14n+2 rule, high nuclearity metal carbonyl clusters with internal atoms, structure, synthesis and reactivity - capping rules.

Unit-III

Isobal analogy: Heteronuclear clusters - carboranes and heteroboranes, metal clusters - structural prediction of organometallic clusters, main group transition metal clusters: Isolobal analogs of p-block and d-block clusters - interstitial systems - cubanes and zintl clusters.

Unit-IV

Inorganic homo- & heterocycles: Synthesis, structure and reactivity - structural variety & properties of borazins and phosphazenes, borides, carbides, silicides, nitrides, phosphides, oxides and sulphides of transition elements, multiple bonds and cluster variety of transition metals.

Unit-V

Inorganic rings and polymers: Definition, variety and merits, P, Si, S, N, & O based polymers, poly-phosphazenes, poly-thiazenes, poly-siloxanes and poly-silanes.

References:

1. D. M. P. Mingos and D. J. Wales, Introduction to Cluster Chemistry, Prentice Hall, 1990.
2. N. N. Greenwood and E. A. Earnshaw, Chemistry of Elements, Pergaman Press, 1984.
3. I. Haiduc & D. B. Sowerby (Eds.), Inorganic Homo-and Heterocycles Vols. 1 & 2, Academic Press, 1987. 4. J. E. Mark, R. West & H. R. Allcock, Inorganic Polymers, Academic Press, 1992.
5. T. P. Fehlner, J. F. Halet and J-Y. Saillard, Molecular Clusters: A Bridge to Solid-State Chemistry, Cambridge University Press, 2007.
6. P. Braunstein, L. A. Oro, P. R. Raithby, Ed. Metal Clusters in Chemistry, John Wiley and sons, 1999.
7. T. Chivers, I. Manners, Inorganic Rings and Polymers of the p-Block Elements, from Fundamentals to Applications, RSC Publishing, 2009.

CE3- Medicinal Chemistry

Unit-I

Introduction: History of medicinal chemistry, general mechanism of drug action on lipids, carbohydrates, proteins and nucleic acids, drug metabolism and inactivation, receptor structure and sites, drug discovery development, design and delivery systems, gene therapy and drug resistance.

Unit-II

Classification: Drugs based on structure or pharmacological basis with examples, synthesis of important drugs such as α - methyl dopa, chloramphenicol griseofulvin, cephelosphorins and nystatin. Molecular modeling, conformational analysis, qualitative and quantitative structure activity relationships.

Unit-III

General introduction to antibiotics: Mechanism of action of lactam antibiotics and non lactam anti biotics, antiviral agents, chemistry, stereochemistry, biosynthesis and degradation of penicillins - An account of semisynthetic penicillins, acid resistant, penicillinase resistant and broad spectrum semisynthetic penicillins.

Unit-IV

Elucidation of enzyme structure: Mechanism, kinetic, spectroscopic, isotopic and stereochemical studies. Chemical models and mimics for enzymes, design, synthesis and evaluation of enzyme inhibitors.

Unit-V

Interactions: DNA-protein interaction and DNA-drug interaction. Introduction to rational approach to drug design, physical and chemical factors associated with biological activities, mechanism of drug action.

Recommended books:

1. I. Wilson, Giswald and F. Doerge, Text Book of Organic Medicinal and Pharmaceutical Chemistry, J.B. Lippincott Company, Philadelphia, 1971.
2. A. Burger, Medicinal Chemistry, Wiley Interscience, New York, Vol. I and II, 1970.
3. Bentley and Driver's Text Book of Pharmaceutical Chemistry revised by L.M. Artherden, Oxford University Press, London, 1977.
4. A. Gringauz, Introduction to Medicinal Chemistry, How Drugs Act and Why?, John Wiley and Sons, 1997.
5. G. L. Patrick, Introduction to Medicinal Chemistry, Oxford Univeristy Press, 2001.

CE4- Nanochemistry and Nanoscience

Unit-I

Introduction to nanoscience and nanotechnology: Underlying physical principles of nanotechnology, Nanostructured Materials, Size is Everything: Fundamental physicochemical principles, size dependence of the properties of nanostructured matter, quantum confinement, single electron charging, the central importance of nanoscale morphology, Societal aspects of nanotechnology: Health, environment, hype and reality.

Unit-II

The advent of the nanomaterial: Top down and bottom up approaches to building materials, Properties of nanomaterials such as nanoparticles, carbon nanotubes, Overview of selfassembly, Inert gas condensation, arc discharge, RF plasma, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, ball milling, molecular beam epitaxy, chemical vapour deposition method and electro deposition.

Unit-III

The basic tools of nanotechnology: Scanning electron microscopy (SEM), TEM and EDAX analysis and X-ray diffraction, A brief historical overview of atomic force microscopy (AFM) and an introduction to its basic principles & applications, Optical microscope and their description, operational principle and application for analysis of nanomaterials, UV-VIS-IR spectrophotometers, Principle of operation and application for band gap measurement.

Unit-IV

Metal nanoparticles: Size control of metal nanoparticles and their characterization, study of their properties, optical, electronic, magnetic. Surface plasmon band and its applications, role in catalysis, alloy nanoparticles, stabilization in sol, glass, and other media, change of band gap, blue shift, colour change in sol, glass, and composites, plasmon resonance.

Unit-V

Carbon nano structures: Introduction, Fullerenes, C60, C80 and C240 nanostructures, Properties & applications (mechanical, optical and electrical), Functionalization of carbon nanotubes, reactivity of carbon nanotubes, Nanosensors: Temperature sensors, smoke sensors, sensors for aerospace and defense. Accelerometer, pressure sensor, night vision system, nano tweezers, nano-cutting tools, integration of sensor with actuators and electronic circuitry biosensors.

Recommended books:

1. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill, New Delhi, 2007.

2. G. Cao, Nanostructures and Nanomaterials – Synthesis, Properties and Applications, Imperial College Press, London, 2004, chapters 3, 4 and 5.

3. C. N. R.Rao, A. Muller and A. K. Cheetham, The Chemistry of Nanomaterials, Volume 1, Wiley –VCH Verlag GmbH & Co. KgaA, Weinheim, 2004, Chapter 4

CE5- Surface Chemistry

Unit-I

Surface and Interface Chemistry: Classifications, micellization, CMC and its determination. Shape and structure of micelles, effect of additives on micellization, thermodynamics of micellization, solubilization and applications, effect of electrolytes on solubilization. Macro and micro emlusions, dispersion and aggregation of solids by surfactants.

Unit-II

Membranes and their applications: Artificial and natural membranes, Donnan membrane equilibrium, transport of electrolytes, membrane potential and ion selective electrodes.

Unit-III

Adsorption on solids and porous materials: Model for multilayer adsorption, BET isotherm and application to different types of adsorbents, adsorption by porous, non-porous and microporous solids, Estimation of specific surface area and pore size distribution.

Unit-IV

Colloid systems and their properties: Origin of the charges, electro-kinetic phenomena, electrophoresis, electroosmosis, sedimentation and streaming potential. The concept of electrical double layer and various models to explain its structure and properties, DLVO theory and stability of colloids. Smoluchowski theory of kinetics of coagulation and distribution of colloids aggregates. Organic and inorganic gels and clay colloids.

Unit-V

Methods to detect interfacial phenomena: Principle and instrumentation of ATR-FTIR spectroscopy, SFG Spectroscopy.

Recommended books:

1. Hunter, R.J., *"Foundation of colloid Science"*, Oxford University,Press,2009
2. Lyklema,J., *"Fundamentals of Interface and Colloid Science"*,Academic press San Diego,2000
3. Adamson, A.W., *"Physical Chemistry of Surface"*,5th Ed.,Jhon Wiley and Sons, NewYork, 1990
3. Kruyt, H.R., *"Colloid Chemistry"* Vol. I and II. Elsevier Press,1991
4. Gerg, S.J. and Singh, K.S.W., *"Adsorption, Surface Area and Porosity",* 2nd Ed., Academic Press.,U.K. 1982.

CE6- Heterocyclic Chemistry

Unit-I

Introduction to Heterocycles: Nomenclature (Hantzsch Widman System), spectral characteristics, reactivity and aromaticity of monocyclic, fused and bridged heterocycles.

Unit-II

Nonaromatic heterocycles: Different types of strains, interactions and conformational aspects on nonaromatic heterocycles. Synthesis, reactivity, and importance of the following ring systems. Azirines, Oxaranes, Thiiranes, Diazirenes, Diaziridines, Azetidines.

Unit-III

Five and six-membered heterocycles with two hetero atoms: Synthesis, reactivity, aromatic character and importance of the following heterocycles: Pyrazole, Imidazole, Oxazole, Thiazole, Pyrimidine, Pyrazine, Oxazine, and Thiazine.

Heterocycles with more than two hetero atoms: Synthesis, reactivity, aromatic character and importance of the following heterocycles: Triazoles, Oxadiazoles, Thiadiazoles, Triazines.

Unit-IV

Larger ring and other heterocycles: Synthesis and reactivity of Azepines, Oxepines and Thiepines. Synthesis and rearrangement of Diazepines. Synthesis of Benzoazepines, Benzodiazepines, Benzooxepines, Benzothiepines, Azocines, and Azonines.

Unit-V

Banzanellated azoles and dipolar structures: Banzanellated azoles: Synthesis and reactivity of Benzimidazoles, Benzoxazoles and Benzothiazoles. Heterocyles with Ring-Junction nitrogen:

Synthesis and reactivity of Quinolizines, Indolizines and Imidazopyridines. Heterocycles with Dipolar structures: Betaines. Formation, aromaticity and reactivity of pyridine-N-oxides and pyridinium imides. Mesoionic heterocycles: Synthesis and aromaticity of sydnones and 1,3-dipolar addition reaction of mesoionic heterocycles.

Recommended books:

1. Heterocyclic Chemistry, T. L. Gilchrist.
2. An Introduction to the Chemistry of Heterocyclic compounds, R. M. Acheson.
3. Heterocylic chemistry, J. A. Joule & K. Mills.
4. Principals of Modern Heterocyclic Chemistry, A. Paquette.
5. Heterocyclic Chemistry, J. A. Joule & Smith.
6. Handbook of Heterocyclic Chemistry, A. R. Katritzky

CE7- Advanced Polymer Chemistry

Unit-I

Properties of commercial polymers Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers – Fire retarding polymers and electrically conducting polymers, Bio-medical polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells

Unit-II

Polymer Additives: Role of additives in polymers, Fillers, plasticizers, anti-oxidants and stabilizers, Flame-retardants, colourants.

Unit-III

Natural polymers: Cellulose: Cellulose nitrate, cellulose acetate. viscose rayon, starch, silk, Rubber and modified rubber.

Unit-IV

Polymer supported reagents in organic chemistry: Preparation and application of polymer supported catalysts, acids, bases, phase transfer catalysts, transition metal complexes etc. Polymer supported reagents and polymer supported protecting groups including “Solid Phase” peptide synthesis.

Unit-V

Polymer Degradation and Stabilization: Types of degradation – Physical and chemical degradation.

Types of Physical degradation: a)Thermal degradation b) Photodegradation and stabilization c) Mechanical degradation.

Types of Chemical degradation: a) Solvolytic degradation b) hydrolytical degradation c) Oxidative degradation and stabilization d) biodegradation.

Recommended books:

1. Text book of Polymer science ; F.w.Billmeyer J.Willey
2. Polymer science, V.R.Gowarikar, N.V.Vishwanathan and J.Sreedhar, Wiley Eastern
3. Principles of Polymerization, George Odian III.Ed.
4. Organic Polymer Chemistry, K.J.Saunders
5. Polymer Chemistry, Golding
6. Principles of Polymer Chemistry, Flory
7. Physical Chemistry of Macromolecules, D.D.Deshpande, Vishal Publications,1985
8. Functional monomers and polymers, K.Takemoto, V.Inaki and R.M.Ottanbrite
9. Contemporary polymer chemistry, H.R.alkock and F.W.Lambe, Prentice Hall
10. Physics and Chemistry of polymers, J.M.G.Cowie, Blackie Academic and Professional.

: SEMESTER WISE COURSE OUTCOMES:

Int. M. Sc. Chemistry program

C 101: Chemistry-I

Student will gain understanding of-

- Chemistry at the level of atoms and molecules, and to make connections between the rules governing such microscopic particles to what we observe in the macroscopic world.
- Structure and properties of atoms and molecules and gives a brief introduction of physical organic chemistry.
- In addition, a part of this course also deals with bonding, hybridization.

CL 101: Chemistry Laboratory

1. To calibrate given glasswares (i) 100 ml beaker & (ii) 50 ml volumetric flask.
2. To calibrate given glasswares (i) Burette, (ii) Pipette & (iii) Measuring cylinder.
3. To calibrate given glasswares (i) Micripipette.
4. To determine the strength of unknown solution of NaOH with N/10 oxalic acid by volumetric.
5. To determine the strength of unknown solution of NaOH with N/10 hydrochloric acid by volumetric.
6. To determine the strength of unknown solution of NaOH with potassium hydrogen phthalate by volumetric.
7. To determine hardness of given water sample complexometrically using EDTA & EBT.
8. To determine the strength of unknown solution of magnesium salt solution using standard magnesium solution and EDTA complexometrically.
9. To identify functional group:
   (i) Glucose
   (ii) Starch
   (iii) Carboxalic acid
   (iv) Oxalic acid
   (v) Benzoic acid
   (vi) Phthalic acid
   (vii) Acetone

(viii) Acetophenone
(ix) Methanol
(x) Ethanol
(xi) β- napthol
(xii) α- napthol
(xiii) Ethyl acetate
(xiv) Benzamide
(xv) Urea
(xvi) Thiourea

10. To separate Ni (II) & Co (II) by paper chromatography.

C 201: Chemistry-II

Student will gain understanding of-

- Concepts in chemical principles and focuses on the changes that molecules undergo through temperature change.
- Thermo-chemistry, thermodynamics, laws, types and its application to various areas in detail with emphasis on practical applications.

CL 201: Chemistry Laboratory

1. To determine endpoint of neutralization by the conductometric titration using strong acid & strong base.
2. To determine end point of neutralization by the conductometric titration using weak acid & weak base.
3. To determine pK_a of monobasic acid using pH meter.
4. To identify two acidic-, basic- and interfering radicals in given inorganic mixture (various combinations).
5. To determine molar volume of isopropyl alcohol & its partial molar volume.
6. To determine molar volume of ethanol & its partial molar volume.
7. To study the variation of viscosity with ethanol & water.
8. To study the variation of viscosity with methanol & water.
9. To determine % composition of mixture of ethanol & water by surface tension method.
10. To determine % composition of mixture of methanol & water by surface tension method.
11. Short project of 2 weeks based on the experiments available in Journal of Chemical

Education.

CB303: Organic Chemistry-I

Student will gain understanding of-

- Structural chemistry of organic compounds with an emphasis on electronic structure, reactivity, conformation and stereochemistry.
- Various strategies involved in logical organic synthesis by incorporating basic organic transformations, reactions, and reactivity. Various functional group transformations, reagents, and reaction mechanisms, will be discussed to provide students a clear understanding and importance of organic synthesis.

This course should serve as a stepping stone for students looking to progress to more advanced synthetic concepts and methodologies. These concepts will prepare students for a mechanistic-based approach to learning organic reactivity. Emphasis will be given towards developing problem-solving skills unique to organic chemistry.

C301: Inorganic Chemistry-I

Student will gain understanding of-

- Chemistry of main group elements such as hydrogen, alkali metals and P-block elements from group 13 – 18 of the periodic table. The central theme of this course is to give a detailed account on the fundamental concepts relevant to structure and bonding, acids and bases, redox behavior, reactions and applications of the main group elements and their compounds.
- In addition to providing a necessary foundation for inorganic chemistry, this course will also emphasize the role of main group compounds in multi disciplinary areas of chemistry such as supramolecular, organometallic, materials science and catalysis.

CL301: Chemistry Laboratory

1. Preparation of Tetraamine Cupric Sulphate
2. Preparation of Potash alum
3. Preparation of Mohr's salt
4. Preparation of Epsom salt from Magnesium chloride
5. Preparation of Potassium trioxalate chromate (III)
6. Preparation of Nickel Ammonium Sulphate using Nickel Sulphate and Ammonium Sulphate
7. Preparation of Sodium trioxalato ferrate from ferric chloride, oxalic acid and sodium hydroxide

8. Preparation of Ammonium Ferric Sulphate using Ferrous Sulphate and Ammonium Sulphate
9. Preparation of Hexammine nickel (II) chloride
10. Preparation of Potassium Chlorochromate
11. Preparation of Cis-Potassiumdioxalatodiaquachromate
12. Preparation of Lead chromate
13. Preparation of Chrome alum
14. Preparation of Hexamine Cobalt (III) Chloride
15. Estimation of barium as barium sulphate in the given solution of barium chloride gravimetrically
16. Estimation of barium as barium sulphate gravimetrically and estimation of zinc volumetrical from the mixture of barium chloride and zinc oxide

PCB401: Physical and Chemical kinetics

Student will gain understanding of-

- Basic concepts of chemical kinetics, theories, fundamental terms, complex reactions and derivations.
- Reactions in solutions and their kinetics too.
- Various techniques for kinetic measurements (for fast reactions) are also described (like temperature and pressure jump methods, flash photolysis).
- Catalysis and surface reactions are also discussed.

CB401: Introductory Spectroscopy (UV-vis, fluorescence, IR, Raman, NMR)

This is a very essential module for both chemistry and biology students. Student will gain understanding of-

- Basics of spectroscopy, interaction of electromagnetic waves with matter, types of spectroscopic techniques like UV-Vis, Fluorescence spectroscopy,
- IR, Raman, Mass spectroscopy.
- Nuclear magnetic resonance spectroscopy Proton chemical shift, spinspin coupling, coupling constants and applications to organic structures 13C resonance spectroscopy is also covered etc.

C401: Properties of Matter

Student will gain understanding of-

- Introduction of states of matter (Gas, solid, liquid etc).

- Gaseous state covers Perfect gases and gas laws, law of partial pressures and partial volumes, Graham's law of effusion, The kinetic theory of gases.
- Intermolecular forces, Vapour pressure, Surface tension, Viscosity etc are described in liquid state section.
- Solid state and colloidal state are described.

C402: Group theory

The objective of this course is to recognize symmetry in molecules and understand its role in chemistry. The course will explore the role of symmetry in -

- Determining molecular properties like optical activity and dipole moment
- Classifying and assigning nomenclature to molecules, molecular states and molecular motions,
- Bringing about simplifications in the application of quantum mechanics to molecules and
- Determining spectroscopic selection rules based on molecular symmetry. Group theory applied to the study of molecular symmetry has far reaching consequences in chemistry and the course will provide an in-depth appreciation of this.

CL401: Chemistry Laboratory

1. Study on hydrolysis of ethyl acetate catalysed by 1M of HCl at room temperature and also stu on effect of anionic surfactant SDS (sodium dodecyl sulphate)
2. Study on the rate of reaction of ethyl acetate at two different concentration of acid.
3. Study on the decomposition of H_2O_2 by Fe^{3+} and Cu^{2+} at 35°C.

Other experiments related to kinetics will be performed.

CB501: Analytical Chemistry

Separation plays a crucial role in Chemistry and Biology, where sample purity is of utmost importance e.g. Pharmaceuticals, Biopharmaceuticals and Fragrances etc. In this course, Student will gain understanding of-

- Theory and practice of separation.
- Various separation techniques like HPLC, GC, GC MS, Centrifugation, Electrophoresis and few other Chromatographic techniques.
- Principle, instrumentation and applications.

C501: Quantum Chemistry

The objective of this course is to-

- Understand the rules governing the behavior of molecules and atoms – the theory of quantum mechanics – and thereby get a feeling for how to explain and predict chemical properties.

- The course starts by discussing the fundamental principles of quantum mechanics with an emphasis on the physical implications of this elegant, yet non-intuitive theory. It then applies quantum mechanics to simple model systems and eventually to atoms and molecules.
- It explores one of the most pervasive concepts in chemistry: the chemical bond. The ideas discussed in this course will be useful to those who wish to pursue further study in the areas of theoretical and computational chemistry, spectroscopy, molecular biology and materials science.

C502: Inorganic Chemistry II

The objective of this course is to-

- Provide a detailed account to the chemistry of transition metals and emphasize their relationship to other multidisciplinary topics such as organometallic chemistry.
- The central theme of this course is to focus on the fundamental concepts needed to understand the transition metal chemistry relevant to their structure, bonding, properties such as spectral characteristics, reactivity, stereochemistry etc.
- At the end of this course, students will also learn about the role of transitionmetals in several other fields like materials science, biology and catalysis.

C503: Organic Chemistry II

The module is the extension of Organic Chemistry–I and student will gain understanding of-

- Stereochemistry of organic compounds, molecular chirality and elements of symmetry.
- Mechanism and stereochemical outcome of various reactions.
- Chemistry of heterocyclic compounds and chemistry of alicyclic compounds.

CL501: Chemistry Laboratory

1. Determination of concentration of K^+ ion in given water sample by using flame photometer.

2. Conductometric study of Saponification of ethyl acetate by sodium hydroxide at equal concentration of ester and alkali at room temperature.

3. Determine of concentration of Na^+ ion in given water sample by using flame photometer.

4. Conductometric study of Saponification of ethyl acetate by potassium hydroxide at equal concentration of ester and alkali at room tempreture.

5. Determination of the concentration of Fe in a sample of water using ammonium thiocyanate by spectrophotometer.

6. Determination of the concentration of Fe in a sample of water using 1,10_phenanthroline by spectrophotometer.

7. Determination of strength of given HCl solution by titrating it potentiometrically against a solution of sodium hydroxide.

8. Isolation of lycopene from tomatoes.

9. Isolation of caffeine from tea leaves.

10. Isolation of casein and lactose from milk.

CB601: Biophysical Chemistry

This course is for both chemistry and biology students and will gain understanding of-

- Different interactions those are important for the formation of structures in biological systems and
- How thermodynamic parameters can be measured and explains the basic concepts within statistical thermodynamics.
- Protein denaturation and stability, Introduction of DSC and ITC. It also includes spectroscopic methods to study of structures, functions and interactions of biomolecules.

C601: Atomic and molecular spectroscopy

The objective of this course is to teach the fundamentals of major branches of spectroscopy and its applications. Spectroscopy is an important research tool in all areas of science (Chemistry and Biology). Student will gain understanding of-

- Determination of structure, property and interaction of molecules. In principle, the interaction of light with matter provides a great deal of physical, chemical and biological information about a system of interest, and ultimately defines many of the observational techniques used.
- Spectroscopy topics such as EPR and Mossbauer for metal ions. In this course, this radiation-matter interaction and the quantitative information it can provide about molecular systems will be examined.

C602: Inorganic Chemistry III

This is the extension of Inorganic Chemistry II. Student will gain detailed understanding of-

- Chemistry of transition metals group-wise and series-wise. The central theme of this course is to focus on the fundamental concepts.
- Transition metal chemistry relevant to their structure, bonding, properties such as spectral characteristics, reactivity, stereochemistry etc.

- Chemistry of f-block elements (lanthanide and actinide elements)

C603: Organic Chemistry III

The module deals with chemistry of natural products and student will gain understanding of-

- Basics, classification and role of several natural products like alkaloids, terpenoids, steroids, natural pigments.
- Stereochemical aspects of mentioned natural products and their characteristics reactions too
- Carbohydrates: Stereochemistry, reaction and conformation and
- Chemistry of Chemistry of vitamins A, B, C and E.

C604: Nuclear Chemistry

Student will gain understanding of-

- Fundamental nuclear particles, nuclear structure, stable and unstable atomic nuclei, nuclear reactions.
- Different type's nuclear models and their features with nuclear reactions and their energies.
- Nuclear structure, stable and unstable atomic nuclei, different modes of radioactive decay and also methods for measurements of radioactivity.
- Fundamentals of radiochemistry, radiation chemistry and the applications.

CL601: Chemistry Laboratory

1. To determine the total alkalinity in a given water sample.

2. To determine the CMC (Critical Micelle Concentration) of surfactant by fluorescence technique using pyrene as a probe.

3. Determination of Lead (Pb) in given water sample using Dithiozone by spectroscopically.

4. Determination of Molybdenum using Potassium Thiocynate by solvent extraction method.

5. To construct the phase diagram for three component system.

6. Synthesis of hexaammine cobalt(III) chloride, $[Co(NH_3)_6Cl]^{3+}$.

7. Synthesis of pentaammine cobalt(III) chloride.

8. Determination of the acid dissociation constant of methyl red using spectrophotometric method.

And some experiments based on analytical techniques.

C701: Photochemistry

This course will give idea to students that-

- How light can take a major role in many natural and chemical processes. Here the students will also get through knowledge about excited state processes (e.g. fluorescence, phosphorescence etc.) and the importance of the above mentioned processes in all fields of science.
- The course also covers organic photochemistry and describes photochemistry of, pericyclic reactions and sigmatropicreactions.

C703: Organometallics & Bio-inorganic Chemistry

This course will explore the-

- Inorganic chemistry behind the requirement of biological cells for metals such as zinc, iron, copper, manganese, and molybdenum.
- The reactivity of coordination complexes of metal ions will be discussed in the context of the reaction mechanisms of specific metalloenzymes..

C704: Physical Organic Chemistry

The main objective of this course is to expose students to-

- Fundamental concepts of structure and function in organic reactions.
- Learn the use of kinetics and thermodynamics to elucidate mechanisms of reactions will be dealt with.
- At the end of this course, students will be in a position to predict reactivity patterns and propose reasonable mechanisms.

CPr701: Reading project

- Project is kept as a provision in CBS curriculum to give training to students and motivate to pursue research as a career.
- This is the first phase where the students are made familiar to preliminary aspect of research which starts with reading and understanding a research problem through review articles / research articles.

CL701: Advanced Chemistry Laboratory-I

1. Green synthesis and characterization of silver nanoparticle (AgNPs) using leaf extract of basil (*Ocimum sanctum*).
2. Green synthesis and characterization of silver nanoparticle (AgNPs) using mango (*Magnifera indica*) leaf extract.
3. To synthesize and characterize the CdTe quantum dots using UV-VIS and Fluorescence.

Also calculate the diameter (size), Band gap and FWHM (Full Wave Half Maxima) of quantum dot.

4. Determination of salinity of given water sample using conductivity meter.
5. Determination of solubility and solubility product of sparingly soluble salt ($BaSO_4$) conductometrically.
6. To determine the distribution coefficient of iodine between CCl_4 and H_2O at room temperature.
7. To extract the essential oil of *Eucalyptus citriodora* leaves using Clevenger's apparatus
8. To extract the essential oil of ginger using Clevenger's apparatus
9. To extract the essential oil of *Ocimumtenuiflorum* (Tulsi) leaves using Clevenger's apparatus.
10. Determination of SO_4^{-2} (sulphate) ion concentration in given water sample by nephloturbidity meter.
11. To Synthesize the Gold Nanoparticles using Tea Powder extracts.
12. To investigate the adsorption of acetic acid from aqueous solution by activated charcoal, verifying Freundlich and Langmuir adsorption isotherm.

C801: Chemistry of Materials

Student will gain understanding of-

- Basic aspects of the solid state, their structures, defects and types of defects.
- Thermal properties of solids and conductors. It describes High Tc Materials, Defect pervskites and their Magnetic and Optical Properties.
- Synthesis of multiphase materials, thin films and properties.
- Liquids crystals: mesmorphic behavior.

C802: Macro and Supra-molecular chemistry

This chemistry course is aimed to provide-

- Fundamental aspects of self-assembly in chemistry and its application for supramolecular architectures.
- This course is beneficial for students who are interested in molecular materials, nanomaterials, biology-chemistry interface and self-assembly in chemical and biological systems.
- The course also consists of student's seminars on selected topics, problem solving, and idea

generation and laboratory experiments on making and testing of self-assembled objects.

C803: Reaction Dynamics

Reaction dynamics is a very important branch of physical chemistry; It explains-

- Why chemical reactions occur and how to predict their behavior to control them. It's closely related to chemical kinetics.
- Chain reactions, collision theory, potential energy surfaces, and details of the reaction path and molecular dynamics of few reactions as H2 + H reaction. Course also covers dynamics of transition state theory.

C804: Computational Chemistry

This module covers advance quantum chemistry and explains-

- The concept of wave function, oscillators, time dependent perturbation theory.
- Hartee-fock theory with reference to computation aspects and
- The electronic properties of molecules by Semi-empirical method, density functional method and configuration interaction and its limitations with applications.

CL801: Advanced Chemistry Laboratory-II

CPr801: Project

- The main objective of such projects is to develop research aptitude in students at early stage.
- This is the second phase where the students will undertake some research problem and solve it through experiments.
- Further a report is submitted and presented for discussion.

CPr901: Project

- This whole semester is fully dedicated to research.
- Students will undertake six month research training from any of the recognized premier institute or university.
- The course aims to provide a full fledged exposure to students to experience fully devoted research environment, learn techniques and develop writing skills too.

Electives for 10^{th} Sem

CE-1 (Environmental Chemistry)

This course demonstrates knowledge of-

- Chemical and biochemical principles of fundamental environmental processes in air, water, and soil and pollution.

• Basic chemical concepts to analyze chemical processes involved in different environmental problems (air, water & soil) with experimental methods for analysis of water and soil analysis and pollution. • Classification of industrial waste waters, hard water - softening - purification of water for drinking purposes, water treatment for industrial use and Water analysis (physical and chemical parameters) in detail.
CE-2 (Inorganic Rings, Cages and Clusters) This module covers advance inorganic chemistry. It describes- • Main group clusters, transition metal clusters their synthesis and reactivity. • Inorganic homo- & heterocycles of borides, carbides, silicides, nitrides, phosphides, oxides and sulphides of transition elements. • Inorganic rings and polymers: Definition, variety and merits, P, Si, S, N, & O based polymers, poly-phosphazenes, poly-thiazenes, poly-siloxanes and poly-silanes etc.
CE-3 (Medicinal Chemistry) This course is intended to provide insights into applications of organic chemistry in the field of drug discovery and development. Student will gain understanding of- • History of medicinal chemistry, drug discovery and classifications. • Approaches to lead identification followed by structure-activity determination for optimization of a drug's activity. • Modern methods of drug delivery including formulations and prodrug approaches will be briefly discussed. Finally, we will present a brief introduction to pharmacology, target identification, pre-clinical and clinical development of a drug candidate.
CE-4 (Nanochemistry and Nanoscience) The course gives an overview of nano-science and nanochemistry. Student will gain understanding of- • Their preparations methods, fundamental physicochemical principles, size dependence of the properties of nanostructured matter, their quantum confinement, single electron charging, the central importance of nanoscale morphology. • Further the characterization techniques are covered with special emphasis to SEM, TEM, AFM, XRD, other spectroscopic methods etc. • Some interesting nano-materials like metal nano-particles, quantum dots, carbon

nanotubes.

CE-5 (Surface Chemistry)

Student will gain understanding of-

- Introduction to surface and interface chemistry with surface active reagents, their classifications and applications.
- Idea of colloidal systems and their properties and adsorption on soilds and porous materials.
- Very important research aspect of surface chemistry i.e. Membranes and their applications artificial and natural membranes, Donnan membrane equilibrium, transport of electrolytes, membrane potential and ion selective electrodes.

CE6- Heterocyclic Chemistry

Student will gain understanding of-

- Heterocyclic aromatic organic compounds, classifications and explains their reactivity based on their properties.
- Reactions and synthesis of important electron deficient nitrogen containing heterocycles; pyridines, diazines and their benzo-condenced analogs.
- A mechanistic level, reactions and synthesis of important electron rich. heterocycles; furans, pyrroles and thiophenes and 1,3 azoles, and benzo-condenced analogs.

CE7- Advanced Polymer Chemistry

This course is very important for all the students who wish to learn and practice macromolecular and organic chemistry. Student will gain understanding of-

- Fundamental knowledge in polymer science.
- New physical chemistry concepts in macromolecules, organic synthetic methodologies for polymers and applications of polymers in the industrial applications.
- This course is beneficial for students who are interested in polymeric materials, nanomaterials, biology-chemistry interface and macromolecular assemblies in chemical and biological systems.

Center for Basic Sciences (CBS)

COURSE STRUCTURE
and
LEARNING OUTCOMES
of

M.Sc. Integrated in Physics

UNDER

FACULTY OF SCIENCE

Center of Basic Sciences
Pt. Ravishankar Shukla University
Raipur (C.G.) 492010
ph: - 0771-2262864 website: -www.prsu.ac.in

: Vision & Mission :

Same as “Vision & Mission” of Center for Basic Sciences

: Objectives :

The objective of Integrated M. Sc. in Physics is to create a pool of highly qualified talented and motivated young students with professional competence in physics with ability

- to embark on careers in front line research and development in physics.
- to take research challenges in the interdisciplinary nature of contemporary physics subjects (e. g. biophysics, medical physics, computational physics).
- to recognize and respond to the scientific demands relevant to need of the country.
- to contribute to the society with their skill and knowledge for uplifting the scientific temperament of the society.

Title of the Program: Integrated Master of Science in Physics

: Program Educational Objectives :

PE01: Development of scientific reasoning skills
Student should be able to find a way to comprehand and analyze a new physical process (not discussed in class) in real life by applying adequate sequence of reasoning, starting from fundamental principles of physics leading to come up with predictions or inference about the process.

PEO2: Development of organised knowledge of the major branches of Physics
Student should have knowlwdge of various branches of physics in enough depth and width to be able to recognise properties of real system by making connectins/ links between concepts covered in different courses.

PEO3: Development of quantitative understanding of physical theories and problem solving abilities
Student should be well versed with use of appropriate mathematical tools and should be able to connect the different representations viz. Mathematical expressions, verbal descriptions, Graphs, diagrams. Student should be able to understand approximations used to arrive at the result and its amplication on the ranges of validity.

PEO4: Development of familiarity with laboratory techniques and computational skills
Student should be able to perform laboratory exercises, document and analize the observations, understand sources of error, and ultimately should be able to design an experimet in domain of physics. Student should have familiriety with basic programing techniques, numerical methods and statistical techniques.

PEO5: Development of ability of communicating science to peers and to the society
Student should be able to communicate consisely and clearly about a subjet thorugh presentaion or writing to various audience, including peers and general public.

PEO6: Development of ability to complete a guided research project
Student should have ability to do an effective liteature search, apply adequate method to collect, document and process and analyze the data draw inferences and interpret the results obtain. Should have ability to write a research proposal and formal research paper.

: Program Learning Outcomes :

- Student should aquire knowledge and problem-solving skills to pass National level CSIR/UGC NET and State level SET/SLET examination in Physical Science Subject during final year of the course .
- Student should have competence to get selected for Ph. D. Programs in reputed national and international research institutes/universities.
- Student should be able to approach eminent scientists and research institututes with a research proposals to carry out short term/ long term projects.
- Students should have conceptual clarity of the learned topics to be a potentially science teacher of high calibre

: General Pattern of the Program :

The course structure of five year Integrated-M.Sc. Physics is designed to start the journey
so as to help the student to perform a journey from introduction of the subject in the first semester to an advanced level of understanding in the final semester and also give him/her glimpses of contemporary research in the stream of specialization and/or other interdisciplinary areas.

- The curriculum for the first two semesters (first year) is common to all students (10+2 PCM and PCB group) and consist of (i) Introductory theory courses in biology, chemistry, mathematics and physics, (ii) Laboratory courses, and (iii) courses in communication skills, computer basics as well as electronics.
- At the beginning of the second year (third semester), a student will opt for specialization in one of the streams (Biology, Chemistry, Mathematics or Physics)
according to their choice.
- In the second and third years of study, the students are taught courses not only in the specialised discipline, but often courses from other science disciplines as well, as recommended for an integrated understanding of the subject matter.
- The courses in fourth and fifth years of the integrated M.Sc. Programme are more advanced in nature and are mainly from the respective disciplines, although there are some interdisciplinary courses.
- The Centre focuses on imparting a complete education and prescribes some compulsory courses which belong to humanities, social sciences, technical communication, history of science, environmental and energy sciences, etc.
- In order to expose the young minds to research early in their career, the students are offered projects from 4^{th} year onward. Thus, in 7^{th} semester they are exposed to supervised learning of a research topic, followed by a mini research project in 8^{th} semester. The 9^{th} semester entails a dissertation, where the students need to go outside of the CBS to carry out a full semester external project.
- The students are thus encouraged to take up summer projects and visit reputed national, international laboratories and universities, so as to broaden their vision and widen their horizon.
- Students also get an opportunity to learn from and interact with eminent scientists from India and abroad who are invited to the Centre at regular intervals to deliver colloquia and seminars.

Course structure for the M. Sc. (Integrated) Physics Stream
Effective from July, 2015

(B: **B**iology, C: **C**hemistry, M: **M**athematics, P: **P**hysics, G: **G**eneral, H: **H**umanities,

BL: **B**iology **L**aboratory, CL: **C**hemistry **L**aboratory, PL: **P**hysics **L**aboratory, GL: **G**eneral **L**aboratory, PE: **P**hysics **E**lective, PPr: **P**hysics **Pr**oject)

FIRST YEAR

SEMESTER –I

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
B101	Biology – I	[2 + 1]	3
C101	Chemistry – I	[2 + 1]	3
M100/101	Mathematics – I	[2 + 1]	3
P101	(A) Physics – I (PCM Stream) (B) Physics-I (Biology Stream)	[2 + 1]	3
G101	Computer Basics	[2 + 1]	3
H101	Communication Skills	[2 + 1]	3
		Contact Hours /Week Laboratory	
BL101	Biology Laboratory – I	[4]	1
CL101	Chemistry Laboratory – I	[4]	2
PL101	Physics Laboratory – I	[4]	2
GL101	Computer Laboratory	[4]	2

25
(25 of 240 credits)

SEMESTER –II

Subject Code	Subject	Contact Hours /Week Theory+Tutorials	Credits
B201	Biology – II	[2 + 1]	3
C201	Chemistry – II	[2 + 1]	3
M200/201	Mathematics – II	[2 + 1]	3
P201	Physics – II (PCM & Bio Stream)	[2 + 1]	3
G201	Electronics and Instrumentation	[2 + 1]	3
G202	Glimpses of Contemporary Science	[2 + 1]	3
		Contact Hours /Week Laboratory	
BL201	Biology Laboratory – II	[4]	1
CL201	Chemistry Laboratory – II	[4]	2
PL201	Physics Laboratory – II	[4]	2

GL201	Electronics Laboratory	[4]	2

25
(50 of 240 Credits)

SECOND YEAR

SEMESTER –III

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
P301	Mathematical Physics – I	[3 + 1]	4
P302	Classical Mechanics – I	[3+ 1]	4
P303	Electromagnetism	[3 + 1]	4
P304	Waves and Oscillations	[3 + 1]	4
H301	World Literature	[2 + 0]	2
H302	History and Philosophy of Science	[2 + 0]	2
		Contact Hours / Week Laboratory	
PL301	Physics Laboratory – III	[6]	3
GL301	Applied Electronics Laboratory	[4]	2

25
(75 of 240 Credits)

SEMESTER –IV

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
P401	Mathematical Physics – II	[3 + 1]	4
P402	Quantum Mechanics – I	[3+ 1]	4
P403	Statistical Mechanics – I	[3 + 1]	4
PCB401	Physical and Chemical Kinetics	[3 + 1]	4
G401	Statistical Techniques and Applications	[3+ 1]	4
		Contact Hours / Week Laboratory	
PL401	Physics Laboratory – IV	[6]	3
GL401	Computational Laboratory and Numerical Methods	[4]	2

25
(100 of 240 Credits)

THIRD YEAR

SEMESTER –V

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
P501	Quantum Mechanics – II	[3 + 1]	4
P502	Classical Mechanics – II	[3+ 1]	4
P503	Atomic and Molecular Physics	[3 + 1]	4
PM501	Numerical Analysis	[3 + 1]	4
G502	Earth Science and Energy & Environmental Sciences	[3+ 1]	4
		Contact Hours / Week Laboratory	
PL501	Physics Laboratory – V	[6]	3
PML501	Numerical Methods Laboratory	[4]	2

25
(125 of 240 Credits)

SEMESTER –VI

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
P601	Electrodynamics	[3 + 1]	4
P602	Nuclear Physics – I	[3+ 1]	4
P603	Condensed Matter Physics – I	[3 + 1]	4
P604	Lasers	[3 + 1]	4
P605	Nonlinear Dynamics and Chaos	[3+ 1]	4
H601	Ethics of Science and IPR	[2+ 0]	2
		Contact Hours / Week Laboratory	
PL601	Physics Laboratory – VI	[6]	3

25
(150 of 240 Credits)

<u>FOURTH YEAR</u>
SEMESTER –VII

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
P701	Fluid Mechanics	[3 + 1]	4
P702	Quantum Mechanics – III	[3+ 1]	4
P703	Statistical Mechanics – II	[3 + 1]	4
P704	Reactor Physics and Radiation Science	[3 + 1]	4
		Contact Hours / Week Laboratory	
PL701	Advanced Physics Laboratory – I	[10]	5
PPr701	Reading Project		4

25
(175 0f 240 Credits)

SEMESTER –VIII

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
P801	Astronomy and Astrophysics	[3 + 1]	4
P802	Accelerator Physics and Applications	[3+ 1]	4
P803	Nuclear and Particle Physics	[3 + 1]	4
P804	Condensed Matter Physics – II	[3 + 1]	4
		Contact Hours / Week Laboratory	
PL801	Advanced Physics Laboratory – II	[10]	5
PPr801	Project		4

25
(200 of 240 Credits)

SEMESTER- IX

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
PPr901	Project		20

20
(220 of240 Credits)

SEMESTER- X

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
PE1001	Quantum Field Theory	[4 + 1]	5
PE1002	General Relativity and Cosmology	[4+ 1]	5
PE1003	Experimental Techniques	[4 + 1]	5
PE1004	CCD Imaging and Spectroscopy	[4 + 1]	5
PE1005	Biophysics	[4+1]	5
PE1006	Particle Physics	[4+1]]	5

Min. 20
(240 of 240 Credits)

***Four subjects will be offered according to the availability of instructors and minimum number of interested students offering a course.**

SEMESTER- I

P101: (B) Physics-I (Classical Physics): (For Biology Stream)

UNIT- I

Concepts of energy and mass, Linear kinematics and dynamics. Concept of force: Conservative and non-conservative forces, Friction. Conservation of momentum, energy, and angular momentum. Work-energy theorem, Centre of mass.

UNIT- II

Moment of inertia. Rotational kinematics and dynamics, Rigid body motion. Impulse and collisions, Central forces, Kinetic theory of gases, Equipartition of energy.

UNIT- III

Free oscillations in one, two, and many degrees of freedom. Linearity and superposition principle. Normal modes; Transverse and longitudinal modes. General notion of a continuous string; Resonance; Coupled pendula and oscillators, Normal coordinates.

UNIT- IV

Probability (chance, fluctuations, random walk, probability distribution, Matter wave, Wave Packet, De-Brogle's theory, uncertainty principle); Curvilinear Coordinates.

UNIT- V

Vector calculus (differentiation and integration, gradient, divergence, curl, Green's theorem, Gauss' theorem, Stokes' theorem); Fourier series (an introduction).

Suggested texts and References:

1. "The Feynman lectures in Physics" volume 1, by R. P. Feynman, R. B. Leighton, M. Sands.
2. "An introduction to mechanics", by D. Kleppner and R. Kolenkow.
3. "Mechanics", by Charles Kittel, Walter D. Knight and Malvin A. Ruderman, Berkeley Physics Course Volume 1.
4. "Waves", by F. S. Crawford, Berkeley Physics Course Volume 3.

P101: (A) Physics – I (For Physics, Chemistry and Mathematics Stream)

UNIT- I

Mechanics: Energy, mass and momentum – evolution of the concepts and definitions. Newton's three laws of mechanics; conservative forces, potential energy functions; Conservation of mechanical energy, linear momentum and angular momentum; Applications to athletics; harmonic oscillator, inverse square law force; Kepler's laws.

UNIT- II

Elementary dynamics of rigid bodies: moment of inertia, angular momentum, rotational kinetic energy, displacement and rotation of rigid bodies. Friction, illustrations of non conservative forces. Impulse, elastic and inelastic collisions, Poisson's hypothesis, deformation energy, Karate punch. Dimensional analysis via examples illustrating Buckingham Pi theorem.

UNIT- III

Thermodynamics and kinetic theory: Thermodynamics: Basic notions of thermodynamics; Macroscopic equilibrium, quasistatic processes, reversible processes; Equation of state; Zeroth law; First law for closed systems; Notion of heat, work and internal energy; Notion of state variable and path.

UNIT- IV

Exact and inexact differentials; Ideal gas and Van der Waal's gas equation, some examples of non – pV systems (qualitative); Second law (Kelvin – Planck and Clausius statements); Carnot cycle; Entropy formulation of Second law; Third law (statement); Thermodynamic potentials.

UNIT- V

Kinetic theory: Kinetic theory of ideal gas; Kinetic interpretation of temperature; Adiabatic reversible compression; Boltzmann factor; Derivation of Maxwell's velocity distribution; Average, *RMS* and most probable speed; Elementary theory of transport processes (viscosity, thermal conducting and diffusion coefficient); Failure of classical physics.

Suggested texts and References:

1. Mechanics, Berkeley Physics Course Vol. 1, 2nd Edition, C. Kittel *ET AL.*, Tata McGraw – Hill Education, 2011.

2. An Introduction to Mechanics, 1st Edition, D. Kleppner and R. J. Kolenkow, Tata McGraw – Hill Education, 2007

3. Thermodynamics, Kinetic theory and Statistical Thermodynamics, 3rd Edition, F. W. Sears and G. L. Salinger, Narosa Publishing House, 1998.

4. Heat and Thermodynamics, 8th Edition, M. W. Zemansky and R. H. Dittman, Tata McGraw – Hill Education, 2011.

5. University Physics, 7th Edition, Francis W. Sears, Mark Zemansky and Hugh D. Young, Massachusetts: Addison Wesley, 1987.
6. Mechanics, D. S. Mathure
7. Thermal Physics, B. K. Agrawal
8. A Treaties on Heat, M. N. Saha and B. N. Shrivastav.
9. Physics: Structure and Meaning L. N. Cooper University press of New England, 1992

10. Fundamentals of Physics, 8th Edition David Halliday, Robert Resnick & Walker New Jersey: John Wiley, 2 2008
11. Mechanics 3rd Edition Keith R. Simon Massachusetts: Addison Wesley Pub. Co., 1987

PL101: Physics Laboratory – I

Introduction to experimental physics – conceptual and procedural understanding, planning of experiments; Plots (normal, semi-log, log-log); uncertainty / error in measurements and uncertainty / error analysis. Introduction to measuring instruments – concepts of standards and calibration; determination of time periods in simple pendulum and coupled strip oscillator system with emphasis on uncertainty in the measurements and accuracy requirements; study of projectile motion – understand the timing requirements; determination of surface tension of a liquid from the study of liquid drops formed under the surface of a glass surface; determination of Young's modulus of a strip of metal by double cantilever method (use of travelling microscope); study of combination of lenses and nodal points and correspondence to a thick lens; study of thermal expansion of metal – use of thermistor as a thermometer; measurement of small resistance of a wire using Carey- Fosterbridge and determine electrical resistivity of the wire; study of time dependence of charging and discharging of capacitor using digital multimeter – use of semi-log plot.

Suggested Texts and References:

1. Advanced Practical Physics for Students, B. L. Worsnop and H. T. Flint, Methuen and Co. Ltd., London

SEMESTER-II

P201: Physics – II (For Physics, Chemistry and Mathematics Stream) & (For Biology Stream)

UNIT- I

Electricity and Magnetism: Electrostatics: Coulomb's law and Gauss' law; Electrostatic potential, uniqueness theorem, method of images; Electrostatic fields in matter; Conductors and insulators; Capacitors and capacitance; Electric current.

UNIT- II

Magnetostatics: Biot – Savart law, Ampere's law; Electromagnetic induction; Mutual inductance and self inductance; Magnetic fields in matter. Displacement current; Maxwell's equations; Alternating current circuits; Electric and magnetic properties of matter.

UNIT- III

Plane electromagnetic waves in vacuum; Polarisation; Energy and momentum in electromagnetic waves; electromagnetic radiation (qualitative); Dipole radiation formula; Larmor's formula for radiation due to accelerated charge (without proof); Synchrotron radiation (descriptive).

UNIT- IV

Optics: Interference of two beams and involving multiple reflections; Young's experiment, Fresnel's biprism, Lloyd's mirror.

UNIT- V

Optical instruments; Telescope and microscopes; Magnifying power and resolving power. Sources of light and spectra; Dispersion, polarisation, double refraction; Optical activity.

Suggested texts and References:

1. Electricity and Magnetism, Berkeley Physics Course Vol. 2, 2nd Edition, Edward M. Purcell, Tata McGraw Hill, 2011.
2. The Feynman Lectures on Physics Vol. 2, R. P. Feynman, R. B. Leighton and M. Sands, Narosa Publications, 2010.
3. The Feynman Lectures on Physics Vol. 3, R. P. Feynman, R. B. Leighton and M. Sands Narosa 2010.
4. Waves, Berkeley Physics Course Vol. 3, Frank S. Crawford, Tata McGraw – Hill, 2011.
5. Fundamentals of Optics, 4th Edition, F. A. Jenkins and H. E. White, Tata McGraw Hill, 2011.
6. University Physics, 7th Edition, Francis W. Sears, Mark Zemansky and Hugh D. Young, Massachusetts: Addison Wesley, 1987.
7. Optics , 4th Edition Eugene Hecht Massachusetts: Addison Wesley
8. "Foundations of Electromagnetic Theory 4th edition, "John R. Reitz, Fredrick Milford & RobertChrist" Massachusetts: Addison Wesley, 1993

9. Fundamentals of Optics 4th Edition Francis A. Jenkins and Harvey E. White "New York Mc Graw Hill Book Company Inc. 2001"
10. Optical Physics 3rd Edition "Stephen G. Lipson, Henry Lipson & D. S. Tannhauser" New York Cambridge University Press 1995
11. Fundamental of Optics 4th Edition Francis A. Jenkins and Harvey E. White Tata Mc Graw Hill 2011.
12. Introduction to Electrodynamics 3rd Edition David J. Grifiths New Jersey: Prentice hall

PL201: Physics Laboratory – II

Review of uncertainty / error analysis; least squares fit method; introduction to sensors / transducers; determination of ‘g’ (acceleration due to gravity) by free fall method; study of physical pendulum using a PC interfaced apparatus – study variation of effective ‘g ‘ with change of angle of plane of oscillation - investigation of effect of large angle of oscillation on the motion; study of Newton’s laws of motion using a PC interfaced apparatus; study of conservation of linear and angular momentum using ‘Maxwell’s Wheel’ apparatus; study of vibrations of soft massive spring; study of torsional oscillatory system; study of refraction in a prism - double refraction in calcite and quartz; study of equipotential surface using different electrode shapes in a minimal conducting liquid medium; determination of electrical inductance by vector method and study effect of ferromagnetic core and study the effect of non-linearity of inductance with current.

Suggested Texts and References:

1. Advanced Practical Physics for Students, B. L. Worsnop and H. T. Flint, Methuen and Co. Ltd., London

SEMESTER-III

P301: Mathematical Physics – 1

UNIT- I

Review of first order differential equations, the notion of Wronskian and its properties, Series solutions of second order differential equations, Frobenius method. Rodrigues formula and classical orthogonal polynomials, recurrence relations, symmetry properties, special values, orthogonality, normalisation.

UNIT- II

Generating functions. Legendre, Hermite, Laguerre, Bessel and Hypergeometric differential equations. Integral representations of special functions. Expansion of functions in orthonormal basis.

UNIT- III

Complex variables: Notion of analyticity, Cauchy – Riemann conditions, Harmonic functions; Contour integrals, Cauchy theorem, simply and multiply connected domains, Cauchy integral formula, derivatives of analytic functions.

UNIT- IV

Laurent series, uniform convergence; Notion of residues, residue theorem, notion of principal values, applications of residues to evaluation of improper integrals, definite integrals, indentation, branch points and branch cuts.

UNIT- V

Fourier series and simple applications. Fourier transforms, Parseval's theorem, convolution, and their simple applications. Laplace transforms, initial value problems, simple applications, transients in circuits, convolution.

Suggested Texts and References:

1. Complex Variables and Applications, R. V. Churchill and J. W. Brown, McGraw-Hill, 2009
2. Complex Variables: Introduction and Applications, 2nd Edition, M. J. Ablowitz and A. S. Fokas, Cambridge 2003
3. Differential Equations, G. F. Simmons, McGraw-Hill, 2006
4. Ordinary Differential Equations, V. I. Arnold, MIT Press 2009
5. Mathematical Methods for Physicists, 7th Edition, G. Arfken and Hans J. Weber, Elsevier 2012

P302: Classical Mechanics – I

UNIT- I

Recap- Newton's laws, vector algebra, gradient; momentum, energy, constraints, conservative forces, potential energy, angular momentum. Inertial and non – inertial frames, fictitious forces.

UNIT- II

Foucault pendulum, effects of Coriolis force. Central forces, conservation of energy and angular momentum, trajectories, orbits, 1/r potential (quadrature), classical scattering, two body problem, centre of mass and relative motions.

UNIT- III

Rigid body motion, moment of inertia tensor, energy and angular momentum, Euler's theorem, motion of tops, gyroscope, motion of the Earth. Introduction to Lagrangian through variational principle, applications of variational principle.

UNIT- IV

Relativity: Historical background, inconsistency of electrodynamics with Galilean relativity. Einstein's hypothesis and Lorentz transformation formula, length contraction, time dilation.

UNIT- V

Doppler shift. Energy, momentum and mass, mass – energy equivalence. Four vector notation, consistency of electrodynamics with relativity.

Suggested texts:

1. An Introduction to Mechanics, 1st Edition, D. Kleppner and R. J. Kolenkow, Tata McGraw – Hill Education, 2007
2. Classical Mechanics, 5th Edition, T. W. B. Kibble, F. Berkshire, World Scientific 2004.
3. Introduction to Special Relativity, R. Resnik, Wiley (India), 2012
4. Spacetime Physics, 2nd Edition, E. F. Taylor, J. A. Wheeler, W. H. Freeman and Co. 1992.
5. Classical mechanics, N. C. Rana, P. S. Joag, Tata McGraw-Hill Education, 2001.

P303: Electromagnetism

UNIT- I

Electrostatics: Coulomb's law, Electric field, Gauss' law in differential and integral forms, Scalar potential, Poisson and Laplace equations, Discontinuities in Electric field and potential: electrostatic boundary conditions, Uniqueness theorem, conductors and second uniqueness theorem, method of images, multipole expansion, work and energy in electrostatics.

UNIT- II

Electric Fields in matter: dielectrics, polarisation, bound charges, notion of electric displacement, Gauss' law in presence of dielectrics, boundary conditions, linear dielectrics: susceptibility, permittivity, dielectric constant, boundary value problems, energy in dielectric systems.

UNIT- III

Magnetostatics: Lorentz force law, steady currents, Biot – Savert law, Ampere's law, vector potential, magnetostatic boundary conditions, multipole expansion for vector potential, magnetic scalar potential. Diamagnets, paramagnets and ferromagnets, magnetisation, bound currents, the H field, boundary conditions, magnetic susceptibility and permeability.

UNIT- IV

Electrodynamics: Electromotive force, electromagnetic induction and Faraday's law, induced electric fields and inductance, energy in magnetic fields. Maxwell's equations: equation of continuity and Modification in Ampere's law, Gauge transformations, Lorentz and Coulomb gauge. Maxwell's equations in matter, integral and differential forms, boundary conditions.

UNIT- V

Poynting's theorem, conservation of momentum, angular momentum. Lossy media, Poynting's theorem for lossy media. Wave equation, electromagnetic waves in vacuum, plane waves, propagation in lossless and lossy linear media, absorption and dispersion, reflection at the interface of two lossy media, guided waves.

Suggested Texts and References:

1. Introduction to Electrodynamics, 4th Edition, D. J. Griffiths, Addison-Wesley 2012
2. Classical Electricity and Magnetism, 2nd Edition, W.K.H. Panofsky and M. Phillips, Dover 2005.
3. Engineering Electromagnetics, 2nd Edition, Nathan Eda, Springer 2007

P304: Waves and Oscillations

UNIT- I

Free oscillations, Simple harmonic motion, damped and forced oscillations; Coupled oscillators, normal modes, beats, infinite coupled oscillators and dispersion relation of sound; vibrating string; travelling and stationary waves; Amplitude, phase and energy. Derivation of wave equation for a string; Longitudinal and transverse waves.

UNIT- II

Waves in two and three dimensions, the wave vector, wave equation, linearity, superposition, Fourier decomposition of a wave, notion of wave packets, phase and group velocity. Example of mechanical waves (sound waves), speed of sound in air, effect of bubbles, natural observations and qualitative explanations.

UNIT- III

String and wind instruments. Chaldni plates. Propagation in changing media, continuity conditions, characteristic impedance. Snell's laws and translation invariant boundary, prism, total internal reflection, evanescent waves. Water waves, ocean waves, Tsunami.

UNIT- IV

Electromagnetic waves, polarisation, interference.

UNIT- V

Fraunhofer diffraction. Shocks waves, boat wakes, linear analysis of the Kelvin wake. Alfven waves (qualitative).

Suggested Texts and References:

1. Waves, Berkeley Physics Course Vol. 3, Frank S. Crawford, Tata McGraw – Hill Education, 2011
2. Introduction to the Physics of Waves, Tim Freegarde, Cambridge Univ. Press 2012
3. The Physics of Waves, Howard Georgi (http://www.people.fas.harvard.edu/~hgeorgi/new.htm)

H301: Introduction to World Literature

What is Literature? - a discussion; Introduction to literary terms, genres, and forms of various periods, countries, languages, etc. The Novel: Class study of 'Brave New World' by Aldous Huxley; Group discussions and student presentations on other genres such as the graphic novel, detective fiction, children's literature, etc. Plays: Introduction to the history of theatre, class study of (mainly) two plays: 'Pygmalion' by G. B. Shaw and 'Fire and Rain' by Girish Karnad, the setting up of play – reading group through which the students can be introduced to several other plays. Poetry: Brief introduction; Study of poetic genres, forms, topics, figures of speech, poetic language etc. by analysing various poems from around the world. Short stories, essays and other types of writing by various authors. Screening of films based on literary works, such as Pygmalion (My Fair Lady), Fire and Rain (Agnivarsha), Persepolis (a graphic novel) and a few others.

H302: History and Philosophy of Science

History of World Science up to the Scientific Revolution: Introduction about stone age, beginning of agriculture, urban civilization and science. Science in Sumeria, Babylonia and Egypt. Natural philosophy of pre-Socratic Greece. Natural philosophy in Athens. Greek science in the Alexandrian period. Rome and decline of Ancient European science. Science and technology in China. Science and technology in the Muslim world. Technology and the craft tradition in medieval Europe. The scholarly tradition during the middle ages. Renaissance, the Copernican system of the world. Gilbert, Bacon and the experimental method. Galileo and the science of mechanics. Descartes – the mathematical method and the mechanical philosophy. The Protestant reformation and the scientific revolution. Newton –the theory of universal gravitation and optics. Alchemy and iatrochemistry. Medicine, theory of circulation of blood. Growth and characteristics of the scientificrevolution.

History of Ancient Indian Science: Indian civilization from pre-historic times to the Indus Valley Civilization. Ancient Indian mathematics and astronomy. Ancient Indian medicine and biology. Chemistry, metallurgy and technology in general in ancient India. Strengths, weaknesses and potentialities of ancient Indian science.

Introduction to Philosophy of Science: What is science? Scientific reasoning; Explanation in science; Realism and instrumentalism; Scientific change and scientific revolutions.

Great Scientific Experiments: Group wise study and presentations by students of historically significant experiments in science.

Suggested Texts and References:

1. A History of the Sciences, Stephen F. Mason, Collier Books, Macmillan Pub. Co. (1962)
2. A Concise History of Science in India, D. M. Bose, S. N. Sen, B. V. Subbarayappa, INSA (1971)
3. Philosophy of Science – A Very Short Introduction, Samir Okasha, Oxford Univ Press (2002)
4. Great Scientific Experiments – Ron Harre, Oxford University Press (1983)
5. The Story of Physics, Lloyd Motz and Jefferson Hane Weaver, Avon Books (1992)
6. The Cambridge Illustrated History of World Science, Colin A. Ronan, Cambridge-Newnes (1982)
7. Encyclopaedia of Classical Indian Sciences, Ed. Helaine Selin and Roddam Narasimha, University Press (2007)

1. Articles from Wikipedia on History and philosophy of science

PL301: Physics Laboratory – III

Frequency response of R-C circuit (concept of cut-off freq and filter) and frequency response of LC circuit; concepts of phase difference between voltage and current in these circuits, phase factor for appliances using AC mains supply; R-L-C (series / parallel) resonance; transient response in RL- C series circuit; study of Newton's rings and interference in wedge shaped films; study of double refraction in calcite / quartz prisms, polarisation of the refracted light rays, optical activity in dextrose and fructose; soldering experience – make a gated timer with indicator; measurement of heat capacity of air; Use of thermocouple / platinum resistance thermometer, use of instrumentation amplifier in amplifying signal from thermocouple; study of the laws of a gyroscope; determination of the charge of an electron by Millikan's oil drop experiment.

Suggested Texts and References:

1. Advanced Practical Physics for Students, B. L. Worsnop and H. T. Flint, Methuen and Co. Ltd., London

GL301: Applied Electronics Laboratory

The course is based on the micro-controller system expEYES and 'Microhope' based on ATmega32 micro controller, developed at IUAC, under a UGC programme.

Use of expEYES kit for monitoring pendulum motion, charge and discharge of capacitor etc to appreciate the goal of the course; Revision of concepts of binary numbers: ‘Bit’, ‘Byte’, ‘Word’, hexa-decimal numbers; Concepts of microprocessor and microcontrollers - CPU, registers, memory (RAM, ROM, different kinds of ROM), data and address bus, decoder, encoder, instruction set, etc. Review of concepts of Digital to Analogue Conversion (DAC) and Analogue to Digital Conversion (ADC), Introduction to micro-controller ATmega32 (which is used in expEYES). Concepts of programming, flow chart, assembly language, and simulator. Concept of I/O programming for ATmega32 Examples of simple I/O program in assembly language, assemble it in an assembler in a PC and download the hex code into microcontroller kit 'microhope' through USB port and verify the operation. C language for writing larger programmes, such as monitoring temperature, which uses ADC of ATmega32. Concept of interrupt and its use in real time data acquisition. Introduction to elements of PYTHON language. Concepts of how expEYES system program resident in ATmaga32 is interfaced to commands from PC in Python language; Automated measurement of simple experiments under expEYES, such as, applications such as temperature monitor, pH meter, colorimeter, protein measurement experiments, etc., will be done. As a part of these applications, ntroduction will be given to sensors, such as temperature sensors, pressure sensors, humidity, pH sensors, photodetectors etc, The experiments will also include I/O programme for keypad inputs and LCD display.

Suggested Texts and References:

1. Phoenix: Computer Interfaced Science Experiments, B.P. Ajith Kumar at http://www.iuac.res.in/~elab/phoenix/
2. expEYES micro-controller system B.P. Ajith Kumar at http://www.iuac.res.in/~elab/phoenix/
3. The AVR micro-controller and embedded systems using assembly and C, by A.A. Mazidi, S. Naimi and S. Mnaimi, Pearson Publications, Delhi, 2013.

SEMESTER-IV

P401: Mathematical Physics – II

UNIT-I

Review of curvilinear coordinates, scale factors, Jacobian. Partial differential equations in curvilinear coordinates, classification. Laplace equation, separation of variables, boundary conditions and initial conditions, examples.

UNIT-II

Inhomogeneous equations, Green's functions in 1, 2 and 3 dimensions.

UNIT-III

Tensors calculus: contravariant and covariant notation, Levi-Civita symbol, pseudotensors, quotient rule, dual tensors.

UNIT-IV

Integral equations: Fredholm and Volterra equations, separable kernel, applications. Elementary group theory and group representations, cyclic, permutation groups; isomorphism, homomorphism.

UNIT-V

subgroups, normal subgroup, classes and cosets; orthogonal, rotation group, Lie group; equivalent, reducible, irreducible; Schur's lemma.

Suggested Texts and References:

1. Mathematical Methods for Physicists, 7th Edition, G. Arfken and Hans J. Weber, Elsevier 2012
2. Mathematics for Physicists, P. Dennery and A. Krzywicki, Dover 1996
3. Mathematics for Quantum Mechanics, 4th Edition, J. D. Jackson, Dover 2009.
4. Elements of Group Theory for Physicists, A. W. Joshi
5. Lectures on Groups and Vector Spaces for Physicists, C. J. Isham, World Scientific 1989
6. Group Theory and Its Application to Physical Problems, M. Hemmermesh, Dover 1989
6. Elements of Green's Functions and Propagation, G. Barton, Oxford 1989

P402: Quantum Mechanics – 1

UNIT- I

Origins of quantum theory (short version); Wave – particle duality, wave packets, uncertainty relation; Time dependent and time independent Schrödinger equation; Interpretative postulates; Hermitian operators, eigenfunctions and eigenvalues; nodal lines and domains; Orthonormality and completion.

UNIT- II

Energy and momentum eigenfunctions; Illustrative one dimensional phenomena (short revision if done in an earlier semester) rigid box; square well and barrier; Linear harmonic oscillator (detailed treatment).

UNIT- III

Abstract vector space formulation of quantum mechanics; Hilbert space, Dirac notation; Hermitian and unitary operators, momentum space representation; Schrödinger and Heisenberg pictures; Linear Harmonic oscillator (matrix theory).

UNIT- IV

Schrödinger equation for a central potential; Orbital angular momentum eigenfunctions (spherical harmonics) and eigenvalues; Bound state solution of Schrödinger equation for Coulomb potential, Hydrogen atom orbits and energies, degeneracy; Electron spin; Addition of two angular momenta, Clebsch – Gordon coefficients.

UNIT- V

Approximation methods: stationary perturbation theory (non – degenerate and degenerate); Stark effect; Zeeman effect; Time dependent perturbation theory; Harmonic perturbations, transition probability (Fermi's golden rule).

Suggested Texts and References:

1. Introduction to Quantum Mechanics, 2nd Edition, D. J. Griffiths, Pearson Education 2008.
2. Quantum Mechanics, 3rd Edition, L. I. Schiff, Tata McGraw-Hill 2010.
3. Quantum Mechanics I and II, Claud Cohen Tannoudji, B. Diu and F. Laloe, Wiley 2006
4. Lectures on Quantum Mechanics, S. Weinberg, Oxford University Press 2012.

P403: Statistical Mechanics – I

UNIT- I

Elementary probability theory; random walk; binomial, Poisson, log normal distributions; the Gaussian. Kinetic theory of gases.

UNIT- II

Ensembles; micro-canonical ensemble; canonical ensemble; grand canonical ensemble. Partition functions and their properties; calculation of thermodynamic quantities; Gibbs paradox; the equipartition theorem.

UNIT- III

Two level system and paramagnetism. Validity of the classical approximation; identical particles and symmetry; quantum distribution functions; Bose-Einstein statistics; Fermi-Dirac statistics;

UNIT- IV

Quantum Statistics in the classical limit; physical implications of the quantum-mechanical enumeration of states; conduction electrons in metals.

UNIT- V

Special topics: the Chandrasekhar Limit; Saha Ionization formula. Systems of interacting particles; Debye approximation; van der Waals equation; Weiss molecular-field approximation

Suggested Texts and References:

1.Thermodynamics and an Introduction to Thermostatistics, 2nd Edition, H. B. Callen, Wiley 2006
2. Fundamentals of Statistical and Thermal Physics, F. Reif, McGraw-Hill Book Company
3. Statistical Physics part 1, 3rd Edition, L. D. Landau and E. M. Lifshitz, Elsevier 2008
4. Statistical Mechanics: A Set of Lectures, R. P. Feynman, W. A. Benjamin, Inc. 1998
5. A Modern Course in Statistical Physics, L. E. Reichl, Wiley 2009

PCB 401: Physical and Chemical Kinetics

UNIT- I

Basic Concepts: Rate, order and molecularity of a reaction, First, second and third order reactions – effect of concentration on reaction rate, rate expressions and integrated form, pseudo-unimolecular and second order autocatalytic reactions, nth order reaction of a single component, effect of temperature on reaction rate – Arrhenius equation and activation energy.

UNIT- II

Complex Reactions: parallel first order reactions, series first order reactions – determination of rate constants by graphical method and the time ratio method. The stationary state, radioactive decay, general first order series and parallel reactions. Competitive, consecutive second order reactions, reversible reactions, equilibrium from the kinetic view point, complex mechanisms involving equilibria.

UNIT- III

Kinetic Measurements: Experimental determination of reaction rates and order of reactions – correlation of physical properties with concentrations, reactions in the phase, reactions at constant pressure, fractional-life period method, initial rate as a function of initial concentrations.

UNIT- IV

Reactions in Solutions: General Properties, Phenomenological theory of reaction rates, Diffusion limited rate constant, Slow reactions, Effect of ionic strength on reactions between ions, Linear free energy relationships, Relaxation methods for fast reactions.

UNIT- V

Catalysis: Homogeneous catalysis in gas phase, in solution, basis of catalytic action, catalysis and the equilibrium constant, acid base catalysis, The Bronsted catalysis law, linear free energy changes, general and specific catalysis. Heterogeneous catalysis. Negative catalysis and inhibition, Surface reactions – effect of temperature and nature of surface. Industrial catalysis.

Suggested Texts and References:

1.Chemical Kinetics : A Study of Reaction Rates in Solution, K.A. Connors, V.C.H. Publications 1990.

2.Chemical Kinetics and Dynamics, J.I. Steinfeld, J.S. Francisco and W.L. Hase, Prentice Hall 1989.

3. Chemical Kinetics and reaction dynamics, Paul L. Houston.
4. Chemical Kinetics, 3rd ed., K.J.Laidler, Harper and Row, 1987.
5. Kinetics and Mechanisms, J.W. Moore and R.G. Pearson, John Wiley and Sons, 1981.
6. Kinetics and Mechanism, A. A. Forst and R. G. Pearson, Wiley International Edition.

7. Chemical Kinetics and Reaction Dynamics, Sanjay K. Upadhay, Springer, 2006

G401: Statistical Techniques and Applications

UNIT- I

Purpose of Statistics, Events and Probabilities, Assignments of probabilities to events, Random events and variables, Probability Axioms and Theorems. Probability distributions and properties: Discrete, Continuous and Empirical distributions. Expected values: Mean, Variance, Skewness, Kurtosis, Moments and Characteristics Functions.

UNIT-II

Types of probability distributions: Binomial, Poisson, Normal, Gamma, Exponential, Chi-squared, Log-Normal, Student's t, F distributions, Central Limit Theorem.

UNIT- III

Monte Carlo techniques: Methods of generating statistical distributions: Pseudorandom numbers from computers and from probability distributions, Applications. Parameter inference: Given prior discrete hypotheses and continuous parameters, Maximum likelihood method for parameter inference. Error Analysis: Statistical and Systematic Errors, Reporting and using uncertainties.

Propagation of errors, Statistical analysis of random uncertainties, Averaging Correlated/ Uncorrelated Measurements.

UNIT- IV

Deconvolution methods, Deconvolution of histograms, binning-free methods. Least-squares fitting: Linear, Polynomial, arbitrary functions: with descriptions of specific methods; Fitting composite curves. Hypothesis tests: Single and composite hypothesis, Goodness of fit tests.

UNIT- V

P-values, Chi-squared test, Likelihood Ratio, Kolmogorov- Smirnov test, Confidence Interval. Covariance and Correlation, Analysis of Variance and Covariance. Illustration of statistical techniques through hands-on use of computer programs.

Suggested Texts and References:

1.Statistics: A Guide to the Use of Statistical Methods in the Physical Sciences, R.J. Barlow, John Wiley 1989

2. The Statistical Analysis of Experimental Data, John Mandel, Dover Publications 1984

3. Data Reduction and Error Analysis for the Physical Sciences, 3rd Edition, Philip Bevington and Keith Robinson, McGraw Hill 2003

PL401: Physics Laboratory – IV

Application of PHOENIX (IUAC, New Delhi) microcontroller system for automation in 20 experiments (six sessions); study of acoustic resonance in Helmholtz resonator using PHOENIX system; Resolving power of optical grating; study of atomic spectra in hydrogen, helium, mercury; Application of gamma counts from detected by G.M. counter for study of Poisson and Gaussian distributions; study of black body radiation by optical and thermal thermal radiations; study of electrically coupled oscillators – normal and transient response. Assembling components for an experiment on thermal and electrical conductivity of metals and making of measurements.

Suggested Texts and References:

1. Phoenix: Computer Interfaced Science Experiments – http://www.iuac.res.in/~elab/phoenix/
2. The Art of Experimental Physics, D. W. Preston and D. R. Dietz, Wiley 1991

3. Manual of Experimental Physics with Indian Academy of Sciences, Bangalore kit, R. Srinivasan and K.R.S. Priolkar

GL401: Computational Laboratory and Numerical Methods

GNU Plot, FORTRAN90, Pointers and Object Oriented Programming

I. The nature of computational physics: Machine representation, precision and errors in computation. Errors and uncertainties. E.g. One should understand how to analyze whether a calculation is limited by the algorithm or round-off error. Single/double precision.

II. Basic tools for numerical analysis in science: Solution of algebraic functions – Fixed point method, Newton-Raphson method, Secant method. Numerical Integration – Rectangular method, trapezoidal method. Lagrange's interpolation.

III. Matrix Algebra: Approximate solution of a set of linear simultaneous equations by Gauss-Sidel iteration method. Exact solution by Gaussian elimination. Inversion of a matrix by Gaussian elimination. Determining all the eigenvalues of a real symmetric matrix by Householder's method of tridiagonalization followed by QR factorization of the tridiagonalized matrix.

IV. Differential Equations (ODE and PDE): Solution of an ODE by Euler's method and Runge-Kutta (4) method – comparison of convergence Solution of partial differential equation (Laplace's equation and Poisson's equation) – Boundary Value Problem – solved using Gauss-Sidel iteration followed by plotting using GNUPlot

V. Nonlinear Systems, dynamics: Fractals – generating the Mandelbrot set and Julia sets. Definition of each. Solution of nonlinear set of ODEs – Lorenz equations – Observation and definition of strange attractor and sensitive depencence upon initial conditions (butterfly effect). Study of the logistic map – non linear dynamical system – obtaining a bifurcation diagram and estimating Feigenbaum's constant.

VI. Fourier analysis of nonlinear systems: Getting used to programming using FFT subroutines. Understanding the relationship between time-domain and frequency domain. Transforming a Gaussian, understanding how temporal FWHM and spectral FWHM are related. Solving a nonlinear PDE which is amenable to solution by multiple steps of FFTs.

SEMESTER-V

P501: Quantum Mechanics – II

UNIT- I

Collision theory: Scattering cross section; Scattering by spherically symmetric potential; Differential cross section, phase shift; Scattering by rigid sphere; Born approximation.

UNIT- II

Path integral formulation of quantum mechanics; The WKB approximation, solution near a turning point, the connection formulas; Tunnelling through a barrier; The adiabatic approximation.

UNIT- III

Variational method, expectation value of energy, application to excited states, ground state of He-atom, Zero point energy of one dimensional harmonic oscillator, Vander-waals interaction.

UNIT- IV

Foundations (Introductory ideas): The EPR paradox, quantum entanglement; Bell's theorem, the No-clone theorem, Schrodinger's cat; Decoherence, quantum Zeno paradox.

UNIT- V

Symmetry in quantum mechanics; Translation, rotation and space inversion operators; Identical particles; Symmetrical and anti-symmetrical wave functions; Spin – statistics connection (empirical); Density matrix; Equation of motion of density matrix.

Suggested Texts and References:

1. Introduction to Quantum Mechanics, 2nd Editon, D. J. Griffiths, Pearson Education 2008.
2. Quantum Mechanics, 3rd Edition, L. I. Schiff, Tata McGraw-Hill 2010.
3. Quantum Mechanics I and II, Claud Cohen Tannoudji, B. Diu and F. Laloe, Wiley 2006
4. Lectures on Quantum Mechanics, S. Weinberg, Oxford University Press 2012.

P502: Classical mechanics – II

UNIT-I

Variational principle (revisited), Lagrangian formulation, constraints, generalised coordinates, applications. Hamilton's equations of motion (from Legendre transformation), Hamiltonian and total energy, cyclic coordinates, variational principle.

UNIT-II

Small oscillations, single oscillator, damped and forced oscillations, coupled oscillators, normal modes.

UNIT-III

Canonical transformations, Poisson brackets, conservation theorems.

UNIT-IV

Hamilton – Jacobi theory, action – angle variables. Canonical perturbation theory, time dependent and time independent.

UNIT-V

Lagrangian formulation of continuous media as a limiting case, extensions.

Suggested Texts and References:

1. Classical mechanics, N. C. Rana, P. S. Joag, Tata McGraw-Hill Education, 2001.
2. Mechanics, L. D. Landau, E. M. Lifshitz, Elesevier 2005.
3. Regular and Chaotic Dynamics, 2nd Edition, A. J. Lichtenberg, M. A. Lieberman, Springer 1992.
4. Classical mechanics, 3rd Edition, H. Goldstein, C. P. Poole, J. Safko, Pearson Education 2011.

P503: Atomic and Molecular Physics

UNIT- I

Many – electron atoms: One – electron wavefunctions and energies in Coulomb potential (revision); Atomic orbitals, spin – orbit coupling, Thomas precession, fine structure; Alkali atoms; Helium ground state and excited states, direct and exchange integrals; Many – electron atoms: LS and jj coupling schemes; Hartree – Fock method; Pauli's principle and the Periodic Table; Nuclear spin and hyperfine structure.

UNIT- II

Atoms in External Fields: Quantum theory of normal and anomalous Zeeman effect, Linear and quadratic Start effect; Semi – classical theory of radiation; Absorption and induced emission; Einstein's A and B coefficients, dipole approximation, intensity of radiation, selection rules.

UNIT- III

Two level atom in a coherent radiation field, Rabi frequency, radiative damping, optical Bloch equation, Broadening of spectral lines (Doppler, pressure and power broadening).

UNIT- IV

Lasers: Basic concepts, rate equation and lasing conditions, working of some common lasers. Doppler free laser spectroscopy; Crossed – beam method, saturated absorption spectroscopy, two photon spectroscopy; Laser cooling and trapping (descriptive); Atom interferometry (descriptive).

UNIT- V

Molecules: Ionic and covalent bonding, Hydrogen molecular ion (H2 +), Born – Oppenheimer approximation; Bonding and anti – bonding orbitals, Hydrogen molecule; Heitler – London method, Molecular orbital method, hybridisation, quantum mechanical treatment of rotational and vibrational spectra (diatomic and polyatomic molecules); Electronic spectra, Raman effect (classical and quantum theory); Vibrational and rotational Raman spectra; Electron spin resonance.

Suggested Texts and References:

1. Atomic Physics, Christopher Foot, Oxford University Press, 2005.
2. Intermediate Quantum Mechanics, 3rd Edition, H. A. Bethe and R. W. Jackiew, Persius 1997
3. The Physics of Atoms and Quanta: Introduction to Experiments and Theory, H. Haken, H. C. Wolf and W. D. Brewer, Springer 2005
4. Molecular Physics and Elements of Quantum Chemistry: Introduction to Experiments and Theory, H. Haken, H. C. Wolf and W. D. Brewer, Springer 2010.

PM501: Numerical Analysis

UNIT- I

Error, its sources, propagation and analysis; Errors in summation, stability in numerical analysis. Linear algebraic equations: Gaussian elimination, direct triangular decomposition, matrix inversion.

UNIT- II

Rootfinding: review of bisection method, Newton's method and secant method; real roots of polynomials, Laguerre's method. Matrix eigenvalue problems: Power method, eigenvalues of real symmetric matrices using Jacobi method, applications.

UNIT-III

Interpolation theory: Polynomial interpolation, Newton's divided differences, forward differences, interpolation errors, cubic splines. Approximation of functions: Taylor's theorem, remainder term; Least squares approximation problem, Orthogonal polynomials.

UNIT- IV

Numerical integration: review of trapezoidal and Simpson's rules, Gaussian quadrature; Error estimation. Numerical differentiation. Monte Carlo methods.

UNIT- V

Least squares problems: Linear least squares, examples; Non – linear least squares. Ordinary differential equations: stability, predictor – corrector method, Runge – Kutta methods, boundary value problems, basis expansion methods, applications. Eigenvalue problems for differential equations, applications. Solutions of PDE's using differential quadrature: elementary treatment. Applications to diffusion equation, wave equation, etc.

Suggested Texts and references:

1. An introduction to Numerical Analysis, 2nd Edition, Kendall Atkinson, Wiley 2012
2. Numerical Methods for Scientists and Engineers, H. M. Antia, Hindustan Book Agency 2012.
3. Numerical Receipes in Fortran, 2nd Edition, W. H. Press *ET AL.*, Cambridge University Press 2000.

G501: Earth Science and Energy & Environmental Sciences Earth Science

Origin of the earth, type of rocks in different layers, their physical and chemical properties, mechanism of their formation and destruction. Radioactivity and its role in geochronology, Plate tectonics and geodynamics and the role of mantle plumes in sustaining these processes. Gravity, electrical and magnetic properties of the different layers in the earth. Their variations in different geological terrains. Instrumentation, field procedures used in these studies. Response of the earth to the elastic (Seismic) and electromagnetic waves, use of this phenomena to study the earth's interior. Geodynamo and the internal magnetic field of the earth. Paleomagnetic studies, Polar wandering and reversal, possible theoretical arguments for understanding the phenomena. Seismology and its use in understanding of the different layers in the earth's interior. Utility of the different geophysical techniques (discussed above) in exploration for academic as well as for harnessing resources.

Suggested Texts and references:

1. The magnetic field of the Earth, Merill, R.T. McElhinny, M.W. and McFadden, P.L. International Geophysical Series.
2. Earth Science by Edward J. Tarbuck, E.J. and Lutgens, F.K.
3. Introduction to Applied Geophysics: Exploring the Shallow Subsurface Burger, H.R., Sheehan, A.F., C.H.
4. Mantle Plumes and Their Record in Earth History, Condie, K.C., 2001, Cambridge University Press, Cambridge, UK

1. Applied Geophysics (Paperback) W M Telford, Robert E Sheriff and L P Geldart.

Energy and Environmental Sciences

Introduction to Environmental Science. Natural Environments: Ecosystems and ecology, biodiversity. Socio-cultural environments: demography, population density, human rganizations. Land use and its planning. Global climate change and effects on environment. Carbon cycle from human activity, calculation of carbon budgets. Water harvesting, storage and treatment. Natural calamities, hazards, and effects of human activity: Chemical and other technological hazards. Various case studies of natural calamities and human-induced disasters. Causes, effects, forecasting, preparedness, planning measures, technological solutions, social interventions. Concept of sustainability, individual and social, and local and global actions for a sustainable future. Introduction to energy Sources - evolution of energy sources with time. Power production, per capita consumption in the world, and relation to development index. Energy scenario in India: Various issues related to consumption and demands -energy crisis issues in India. Renewable and non-renewable energy sources - technology and commercialization of energy sources, local (decentralized) versus centralized energy production, constraints and opportunities of renewable energy (hydrocarbon and coal based energy sources). Energy conservation – calculation of energy requirements for typical and home and industrial applications. Alternative to fossil fuels - solar, wind, tidal, geothermal. Bio-based fuels. Hydrogen as a fuel. Energy transport and storages, comparison of energy sources - passage from source to delivery (source, production, transport, delivery) - efficiencies, losses and wastes. Nuclear energy: Power production: Components of a reactor and its working, types of reactors and comparison. India's three stage nuclear program. Nuclear fuel cycle. Thorium based reactors. Regulations on nuclear energy.

Energy and Environmental Sciences

1. Energy in Perspective, J. B. Marion, University of Maryland, Academic Press, (1974)
2. Energy and Environment, Robert A. Ristinen and Jack J. Kraushaar, 2nd Edn., John Wiley and Sons, Inc. (2006).
3. Renewable Energy, Boyle Godfrey, Oxford University Press (2004)
4. Environment, Problems and Solutions, D.K. Asthana and Meera Asthana, S.Chand and Co.(2006)

5.Text Book on Environmental Chemistry, Balaram Pani, I.K.International Publishing House(2007).

PL501: Physics Laboratory – V

Study of diffraction by single slit, double slit and multiple slits leading to grating, quantitative determination and compare with simulation; Study of Michelson interferometer and determination of refractive index of air; study of Fabry-Perot interferometer; Study of Zeeman effect using Fabry- Perot Interferometer; study of characteristics of scintillation counter used in nuclear radiation detection; study of Hall effect in semiconductors; Introduction to Labview software for automation and use of NI data acquisition card in PC (six sessions).

Suggested Texts and references:

1. The Art of Experimental Physics, D. W. Preston and D. R. Dietz, Wiley 1991

PML501: Numerical Methods Laboratory

The methods developed in Numerical Analysis (P501) are to be implemented on a computer. Emphasis to be given on applications to physical problems.

Suggested Texts and references:

1. Numerical Receipes in Fortran, 2nd Edition, W. H. Press *ET AL.*, Cambridge University Press 2000
2. An Introduction to Computational Physics, 2nd Edition, Tao Pang, Cambridge University Press 2010

SEMESTER-VI

P601: Electrodynamics

UNIT- I

Review of Maxwell's equations, vector and scalar potentials, gauge transformations.

Radiating systems: electric dipole fields and radiation, magnetic dipole and electric quadrupole fields, antenna, spherical wave solutions of the scalar wave equation.

UNIT- II

Multipole expansion of the electromagnetic fields, energy and angular momenta of multipole radiation, angular distribution of multipole radiation, multipole moments, multipole radiation in atoms and nuclei, multipole radiation from linear centre fed antenna.

UNIT- III

Scattering and Diffraction problems: scattering at long wavelength, perturbation theory of scattering, explaination of blue sky (due to Rayleigh), scalar diffraction theory.

UNIT- IV

Covariant formulation of electrodynamics: four vector potential, electromagnetic field tensor, covariant description of sources in material media, field equations in a material medium. Retarded potentials, Jefimenko's generalisations of Coulomb and Biot – Savert laws, Lienard – Wiechert potentials.

UNIT- V

Fields of a moving charge. Cerenkov radiation. Covariant formulation of the conservation laws of electrodynamics.

Suggested Texts and References:

1. Introduction to Electrodynamics, 4th Edition, D. J. Griffiths, Addison-Wesley 2012
2. Classical Electricity and Magnetism, 2nd Edition, W.K.H. Panofsky and M. Phillips, Dover 2005.
3. Classical Electrodynamics, 3rd Edition, J. D. Jackson, Wiley 2012
4. Lectures on Electromagnetism, 2nd Edition, Ashok Das, Hindustan Book Agency 2013.

P602: Nuclear Physics – I

UNIT- I

Nuclear Properties: Size – nuclear radius, charge distribution, matter distribution. Mass- binding energy, liquid drop model/mass formula. Spin, Parity, isospin. Electromagnetic moments-magnetic dipole and electric quadrupole moments/nuclear shapes.

UNIT- II

Nuclear stability, alpha, beta, gamma decays, fission. Experimental methods for size, mass, spin, moments to be included.

UNIT-III

Nuclear Forces: Nuclear interaction, saturation of nuclear density, constancy of binding energy per nucleon. Bound two nucleon system, Deuteron problem, absence of bound pp, nn. N-N scattering – as a function of energy, phase shift, cross section. Salient features of nuclear force. Yukawa’s theory of nuclear interaction (basics).

UNIT- IV

Nuclear Structure: Magic numbers, shell model, spin orbit interaction, deformed shell model. Nuclear excited states vibration, rotation, Collective model. Electromagnetic interactions in nuclei: multipole transitions, selection rules, life times, electron capture, internal conversion, isomers, Coulomb excitation.

UNIT- V

Nuclear Reactions: Kinematics, Q value, excitation energy, conservation laws, cross section, mean free path. Types of nuclear reactions, experimental observables, excitation function, angular distribution, spectra. Compound nuclear reactions, Resonances, level density, temperature, Bohr model. Direct nuclear reactions, optical model, pick up and stripping reactions, spectroscopic factor Nuclear fission and fusion reactions.

Suggested Texts and References:

1. Introductory Nuclear Physics, K.S. Krane, Wiley 2008
2. Concepts of Nuclear Physics, B. L. Cohen, McGraw Hill 1971
3. Introductory Nuclear Physics, S. S. M. Wong, Prentice – Hall 2010
4. Introduction to Nuclear and Particle Physics, 2nd Edition, A. Das and T. Ferbel, World Scientific 2004

P603: Condensed Matter Physics – I

UNIT- I

Crystal Structure and x-ray diffraction: Crystalline and amorphous solids, translational symmetry. Elementary ideas about crystal structure, lattice and bases, unit cell, reciprocal lattice, fundamental types of lattices, Miller indices, lattice planes, simple cubic, f.c.c. and b.c.c. lattices. Simple crystal structures, Closed packed structure, Determination of crystal structure with X-rays, Neutrons and Electron diffraction-Diffraction of waves by crystals, Laue and Bragg equations, Brillouin Zones, Fourier Analysis of the basis. Debye waller factor, X ray broadening -size and temperature effects. X-ray diffraction of liquids and disordered solids- introduction to radial distribution functions.

UNIT- II

Lattice Vibrations: Elastic waves, Thermal properties: Einstein's and Debye's theories of specific heats of solids, Thermal conductivity, Phonons, Lattice waves, Dynamics of a chain of similar atoms and chain of two types of atoms; optical and acoustic modes; Inelastic scattering of x-rays, neutrons and light by phonons, Optical properties of solids: interaction of light with ionic crystals. Raman scattering and Brillouin scattering.

UNIT- III

The Free electron model: Drude Model, Electon conductivity, Heat capacity of conduction electrons, Fermi surface, Sommerfield model, Thermal conductivity of metals, Hall effect, AC conductivity and optical properties, Wiedemann-Franz law, Failure of the Free-electron model, optical properties of metals.

UNIT- IV

Basics of Semiconductors and device: Crystal structure, Band structure, Intrinsic and extrinsic semiconductors, Concept of majority and minority carriers, Energy gap, Mobility, conductivity, Hall effect, Diffusion, Optical properties: Absorption, Luminescence, Photoconductivity, effect of disorder on absorption. Interpretation of energy band diagrams. Devices: p-n diode (derivation of Shockley equation), tunnel diode, photodiode, solar cell, LED, Lasers.

UNIT- V

Superconductivity: Introduction (Kamerlingh Onnes experiment), effect of magnetic field, Type-I and type-II superconductors, Isotope effect. Meissner effect. Heat capacity. Energy gap. Electrodynamics of superconductivity: London’s equation, Thermodynamics of the transition, Intermediate state of Type 1, Mixed state of type 2, Flux Quantization, Salient points of BCS theory, Cooper problem, Definition of coherence length, Josephson effect

Suggested Texts and References:

1. Elementary Solid State Physics, M. Ali Omar, Pearson Education 2008.
2. Introduction to Solid State Physics, 8th Edition, C. Kittel, Wiley 2012.
3. Solid State Physics, N. W. Ashcroft and N. D. Mermin, Cengage 2003.
4. Physics of Semiconductor Devices, 3rd Edition, S. M. Sze and K. K. Ng, 2007.
5. Introduction to Superconductivity, A. C. Rose -Innes, E. H. Rhoderik, Pergamon Press
6. Solid State Physics, J. P. McKelvey, Krieger Publishing Co. 1993.
7. Electron theory of solids, J. M. Ziman, Cambridge University Press, 2011.

P604: Lasers

Unit- I

Laser Characteristics –Spontaneous and stimulated emission, Einstein's quantum theory of radiation, theory of some optical processes, coherence and monochromacity, kinetics of optical absorption, line broadening mechanism, Basic principle of lasers, population inversion, laser pumping, two & three level laser systems, resonator, Q-factor, losses in cavity, threshold condition, quantum yield.

Unit – II

Laser Systems- Solid state lasers- the ruby laser, Nd:YAG laser, ND: Glass laser, semiconductor lasers – features of semiconductor lasers, intrinsic semiconductor lasers, Gas laser -neutral atom gas laser, He-Ne laser, molecular gas lasers, CO2 laser, Liquid lasers, dye lasers and chemical laser.

Unit-III

Advances in laser Physics, Production of giant pulse -Q-switching, giant pulse dynamics, laser amplifiers, mode locking and pulling, Non-linear optics, Harmonic generation, second harmonic generation, Phase matching, third harmonic generation, optical mixing, parametric generation and self-focusing of light.

Unit – IV

Multi-photon processes; multi-quantum photoelectric effect, Theory of two-photon process, three- photon process, second harmonic generation, parametric generation of light, Laser spectroscopy : Rayleigh and Raman scattering, Stimulated Raman effect, Hyper-Raman effect, Coherent anti-stokes Raman Scattering, Photo-acoustic Raman spectroscopy.

Unit – V

Laser Applications – ether drift and absolute rotation of the Earth, isotope separation, plasma, thermonuclear fusion, laser applications in chemistry, biology, astronomy, engineering and medicine.

Communication by lasers: ranging, fiber Optics Communication, Optical fiber, numerical aperture, propagation of light in a medium with variable index, pulse dispersion.

TEXT AND REFERENCE BOOKS:

1. Laud, B.B.: Lasers and nonlinear optics, (New Age Int.Pub.1996).
2. Thyagarajan, K and Ghatak, A.K.: Lasers theory and applications (Plenum press, 1981).
3. Ghatak, A.K.and Thyagarajan, K : Optical electronics (Cambridge Univ. Press 1999).
4. Seigman, A.E.: Lasers (Oxford Univ. Press 1986)
5. Maitland, A. and Dunn, M.H. : Laser Physics (N.H.Amsterdam, 1969).
6. Hecht, J.The laser Guide book (McGraw Hill, NY, 1986).

7. Demtroder, W. : Laser Spectroscopy (Springe series in chemical physics vol.5,Springe verlag, Berlin, 1981).

8. Harper, P.G.and Wherrett B.S. (Ed.): Non-linear-optics (Acad.press, 1977).

P605: Nonlinear Dynamics and Chaos

UNIT-I

Dynamical Systems, phase portraits, vector fields, nullclines, flows, discrete dynamical systems, 1-d maps. Fixed points, linearization of vector fields, canonical forms, generalized eigenvectors, semisimple – nilpotent decomposition, Jordan canonical form.

UNIT-II

Classification of fixed points. Hartman -Grobman theorem, homeomorphism, Stable Manifold Theorem, Centre Manifold Theorem, examples of manifolds. Index theory, Lyapunov functions and stability analysis, Limit cycles, Poincare-Benedixon Dynamical Systems, phase portraits, vector fields, nullclines, flows, discrete dynamical systems, 1-d maps, Fixed points.

UNIT-III

Linearization of vector fields, canonical forms, generalized eigen vectors, semisimple-nilpotent decomposition, Jordan canonical form, classification of fixed points. Hartman-Grobman theorem, homeomorphism, Stable Manifold Theorem, Centre Manifold Theorem, examples of manifolds. Index theory, Lyapunov functions and stability analysis, Limit cycles, Poincare-Benedixon Theorem. Gronwall's inequality.

UNIT-IV

The Variational Equation, exploring neighbourhoods, Lyapunov exponents, Monodromy matrix, Floquet exponents. Bifurcations: Saddle-Node, Transcritical, Pitchfork and Hopf Bifurcation. 1-d maps, linear stability of fixed points and higher order fixed points, chain rule, lyapunov exponent, bifurcation diagram, finding period-n orbits in 1-d maps. 2-d maps, Linearization, the Henon map.

UNIT-V

Poincare surface of section. Symbolic dynamics, Sensitivity to initial conditions, Chaos, Partitions, Transition matrix, Entropies, Smale Horseshoe. Invariant density, the Perron-Frobenius operator. Fractals. Hamiltonian Dynamics.

Suggested Texts and References:

1. Nonlinear Dynamics And Chaos: With Applications To Physics, Biology, Chemistry and Engineering, S. Strogatz, Addison-Wesley 2001
2. Chaos: An Introduction to Dynamical Systems, K.T. Aligood, T.D. Sauer, J.A. Yorke, Springer 2000
3. Differential Equations, Dynamical Systems and an Introduction to Chaos, M. Hirsh, S. Smale and R. Devaney, Elsevier Academic Press, 2012
4. Chaos and Integrability in Nonlinear Dynamics: An Introduction, M. Tabor, John Wiley & Sons,1989
5. Chaos: Classical and Quantum, P. Cvitanovic *et al.*

H601: Ethics of Science and IPR

Introduction to a Collective, Participatory Teaching-learning Program: A Science of Our own. Science Stands the Test of Ethics … Some indicators. Levels of Moral Development - Does it mean anything? Medical Ethics: Different themes pertaining to medical ethics including ethical issues in public health. History, Philosophy and Psychology of Ethics: History of Political Economy and Modern Ethics. Environmental Ethics.

Intellectual Property Rights and Associated Issues: History of Patenting. Digitalizing Culture-I: Free Software and Free Culture. Digitalizing Culture-II: Concentration and appropriation of Power by the few as well as Possibility of Distributive Justice.

Journals and Publishers: Monopolistic practices by Academic Publishers. Quest for Determining what is Virtuous: Ethics in Practice. Collaborative Projects by the Class. Teaching the Teachers and other Virtuous Inquiries.

PL601: Physics Laboratory – VI

Study of quantum mechanics through acoustic analogue (four sessions); Fourier analysis / synthesis – use of simulation; Study of characteristics of a coaxial cable and determination of speed of electromagnetic waves in the coaxial cable; determination of specific charge (e/m) of electron; Study of Faraday rotation and determination of Verdit's constant in a glass material; investigation of chaos in a spring based coupled oscillator system; Introduction to workshop practice (two sessions); Introduction to vacuum practice (two sessions).

Suggested Texts and References:

1. The Art of Experimental Physics, D. W. Preston and D. R. Dietz, Wiley 1991

Semester-VII

P701: Fluid Mechanics

UNIT-I

Validity of hydrodynamical description. Kinematics of the flow field. Stress-strain relationship. Basic equations governing conservation of mass, momentum & energy.

UNIT-II

Navier-Stokes equation for viscous flows. Shear and bulk viscosity and radiative diffusivity in fluids. Viscous and thermal boundary layers, Potential flows, Water waves. Kelvin's circulation theorem, Stokes's flow Lubrication theory.

UNIT-III

Virial theorem in the tensor form. Magnetohydrodynamic flows. Generalized Ohm's law in the presence of Hall current &Ambipolar diffusion, Magneto-gravity-acoustic modes.

UNIT-IV

Classical hydrodynamic and hydromagnetic linear stability problems: Rayleigh-Taylor and Kelvin- Helmholtz instabilities. Jeans' gravitational instability; Benard convection. Parker instability and magnetic buoyancy. Thermal instability. Non-linear Benard problem.

UNIT-V

Spherical accretion flows onto compact objects and accretion disks. High Speed flow of gases. Shock waves and blast waves. Supernova hydrodynamics. Physiological hydrodynamics. Blood flow in human heart.

Suggested Texts and References:

1. Hydrodynamics, 6th Edition, H. Lamb, Dover 1945
2. An Introduction to Fluid Dynamics, G.K. Batchelor, Cambridge University Press, 2000
3. Fluid Mechanics, 2nd Edition, L.D. Landau and E.M. Lifshitz, Elsevier 1987

4. Magnetohydrodynamics, 2nd Edition, T.G. Cowling, Hilger 1976
5. Introduction to Physics of Fluids and Solids, J. Trefil, Dover 1975.

P702: Quantum Mechanics – III

UNIT- I

Relativistic Equations: Lorentz transformations, covariant notation, Klein – Gordon equation, difficulties with probability interpretation of one – particle K-G equation; Dirac equation; Properties of γ matrices.

UNIT- II

Dirac equation in external electromagnetic field; Non – relativistic reduction; Gyrofactor for spin; Lorentz covariance of Dirac equation; Bilinear covariants.

UNIT- III

Solutions of Dirac equation: Plane wave solutions; Negative energy solutions; Hole theoretic interpretation; Spin; Dirac momentum space spinors; Orthonormality and completeness relations; Projection operators for energy, helicity and spin; Trace theorems; Exact solution of Dirac equation for Coulomb potential; Energy levels of Hydrogen atom in Dirac theory; Fine structure splitting; Relativistic corrections and Lamb shift.

UNIT- IV

Introduction to quantum field theory: Lagrangian field theory, symmetry and conservation laws, Klein – Gordon field (real and complex); Covariant commutators, the K-G propagator; Dirac field; Anti-commutation relations, the Fermion propagator; Electromagnetic field; Covariant quantisation, the photon propagator.

UNIT- V

Feynman rules for QED: Dyson expansion of S – matrix; Feynman diagrams in momentum space, Feynman rules, QED processes in lowest order.

Suggested Texts and References:

1. Relativistic Quantum Mechanics vol. 1: J. D. Bjorken and S. D. Drell, McGraw-Hill 1998
2. Intermediate Quantum Mechanics, H. A. Bethe and R. W. Jackiew, Perseus Books 1997
3. Quantum Field Theory, 2nd Edition, F. Mandl and G. Shaw, Wiley 2010
4. Advanced Quantum Mechanics, F. Schwabl, Springer 2008

P703: Statistical Mechanics – II

UNIT-I

Transport theory using the relaxation time approximation; Boltzmann differential equation formulation; examples of the Boltzmann equation method. Stochastic Processes; Random Walk; Auto-catalytic processes.

UNIT-II

Diffusion equation; Langevin equation; Fokker- Planck equation.

UNIT-III

Ising Model; mean-field theory; Landau theory of second order phase transition; Peierls argument; the Bethe-Peierls approximation; Kramers-Wannier duality argument; Pade Approximant.

UNIT-IV

Phase transition and Critical Phenomenon: critical exponents; exponent inequalities; static scaling hypothesis; block spins and the Kadanoff construction.

UNIT-V

Renormalization Group: Decimation; Migdal-Kadanoff method; general renormalization group prescription; examples. Monte-Carlo Methods in statistical mechanics; Metropolis algorithm; Gilespie method.

Suggested Texts and References:

1. Fundamentals of Statistical and Thermal Physics, F. Reif, McGraw-Hill Book Company
2. Statistical Physics part 1, 3rd Edition, L. D. Landau and E. M. Lifshitz, Elsevier 2008
3. Statistical Mechanics: A Set of Lectures, R. P. Feynman, W. A. Benjamin, Inc. 1998
4. A Modern Course in Statistical Physics, L. E. Reichl, Wiley 2009

P704: Reactor Physics.

UNIT- I

Fission process: Liquid drop model, fission rate, reactor power, prompt and delayed neutrons, fission gammas, fission products energy balance, photo neutrons. fissile, fertile and fissionable materials. Fission product activity and decay heat after shut down.

Interaction of Neutrons with Matter: Production of neutrons and nuclear reactions with thermal and fast neutrons, transmutation.

UNIT- II

Concept of microscopic cross section: Inelastic and elastic scattering, Maxwell-Boltzmann distribution and its departure Variation of cross-section with energy, **f**ast, resonance and thermal ranges. 1/v law of neuron cross-section, Resonance absorption, Doppler effect. Eta vs E curve, conversion & breeding concepts-Thorium utilization.

Diffusion of neutrons: Fick's law and its validity, steady state neutron diffusion equation, concepts of neutron flux and current, interface conditions, diffusion coefficient, diffusion length and extrapolation distance.

UNIT- III

Chain Reaction: Four Factor formula, conceptual treatment of diffusion of one group neutrons in non multiplying and multiplying media, infinite and effective multiplication factors bare homogeneous reactor-concepts of material and geometric buckling, sub criticality and super criticality, critical mass, non leakage probabilities in bare homogeneous cores, neutron cycle and lifetime in finite and in infinite reactor system.

Slowing down process: Neutron slowing down, slowing down power and moderating ratio for moderators. Slowing down with spatial migration, Fermi age concepts, migration length, use of reflectors/blankets, reflector savings.

Heterogeneous reactors: Multigroup neutron diffusion with special reference to 2 group approach, Heterogeneous reactors, comparison with homogeneous reactors, unit-cell concepts.

UNIT- IV

Reactor kinetics: Time dependent neutron diffusion equation, one group kinetic equation, prompt neutron life time, Point kinetic model to illustrate importance of delayed neutrons, reactor period, reactivity and its units. Fuel burn-up units.

Neutron Poisons: Xenon and Samarium Poisons, Xenon loads (operating and post shutdown), Variation of xenon load with power and enrichment. Xenon oscillations and their control.

UNIT- V

Reactivity coefficients: Temperature coefficients of reactivity and void coefficient of reactivity, their relevance to reactor safety. techniques to control reactors, typical reactivity balance, long-term burnup, fuel management. Reactor control system – requirements of physics aspects. Reactor shutdown mechanisms and neutron monitoring during operation and shut down. Approach to criticality, physics measurements and calibrations/validations. Reactivity worth measurements of control rods.

Research Reactors at Trombay, Indian PHWRs.

Suggested Texts and References

1. Nuclear Reactor Engineering: Reactor Systems Engineering, Samuel Glasstone and Alexander Sesonske, 4th Edition, 2012
2. Introduction to Nuclear Engineering, 3rd Ed., John R. Lamarsh and Anthony J. Baratta, 2001.
3. Nuclear Reactor Analysis, James J. Duderstadt and Louis J. Hamilton, 1976
4. Nuclear Energy: An Introduction to the Concepts, Systems, and Applications of Nuclear Processes, 6th Ed., Raymond Murray and Keith E. Holbert, 2008.
5. Fundamentals of Nuclear Reactor Physics, Elmer E. Lewis, 2008.
6. Nuclear Reactor Physics, 2nd Ed., Weston M. Stacy, 2007
7. Nuclear Energy: Principles, Practices and Prospects, David Bodansky, 2008.

PL701: Advanced Physics Laboratory – I Nuclear Physics

Spectral features of photoelectric absorption and Compton scattering with scintillation detectors

(i) Inorganic: NaI(Tl), BaF2 (ii) Organic: BC501A and plastic. Energy calibration, energy resolution, photopeak and total efficiency, relative intensity, photoelectric and Compton cross-sections, radiation shielding. Alpha spectroscopy with a silicon surface barrier detector. Fine structure of alpha spectrum and determination of age of source. Fast timing and coincidence measurements using BaF2 and BC501A detectors. Angular correlation of gamma rays using NaI(Tl) detectors. High resolution, low-energy photon measurements with a silicon drift detector: Internal conversion studies, elemental composition through X-Ray Fluorescence (XRF) analysis. Geiger-Muller counter: operating characteristics, dead time measurement, determination of mass absorption coefficient, verification of inverse square law. Lifetime measurements: from nanoseconds through minutes using fast coincidence and decay studies. High-resolution gamma ray measurements with high-purity germanium detectors. Classic experiments: Rutherford scattering, cloud chamber, beta spectrometer. Spectrum analysis techniques and fitting routines: data/peak fitting, energy and efficiency calibration, 1D and 2D histograms.

(Selected experiments from the above list are performed based on number of contact hours prescribed)

Condensed Matter

Growth of metallic thin films by physical vapor deposition techniques like thermal evaporation and DC magnetron sputtering. Tuning of growth parameters to change the deposition rate and hence thickness of the films. Introduction to vacuum techniques: vacuum pumps, rotary pump, diffusion pump and turbo molecular pumps. Measurement of vacuum: thermocouple gauges, hot and cold cathode gauges. Thickness measurement of thin films by quartz crystal monitor.

Structural characterization of materials (some known and some unknown) by X-ray diffraction (XRD) and X-ray fluorescence (XRF) (a) Phase identification (b) Chemical composition (c) difference between powder diffraction pattern of single and polycrystalline systems (d) Reasons for line broadening in XRD: Rachinger correction and estimation of particle size from Debye-Scherer formula. (e) Identifying crystal structure and determination of lattice constant.

Introduction to low temperature measurements: operation of a closed cycle cryostat, low temperature thermometers, controlling temperatures using PID feedback using temperature controllers, making electrical contacts on thin films and measuring DC resistance with sourcemeter using four probe method-advantages and disadvantages of the technique, temperature dependent (300-20K) measurement of electrical resistivity of metallic thin films and comparing the room temperature value with the standard. Determination of superconducting transition temperature of a high temperature superconductor using electrical transport measurements. Determination of band gap of a semiconductor: highly doped Si by fitting the temperature dependent resistance to the standard variation in semiconductors. Concepts of measuring electrical resistance in labs: from metals to dielectrics. Introducing GPIB interfacing of electronic instruments with the computer and writing LABVIEW programs to interface temperature controller and sourcemeter.

Introduction to phase sensitive measurements: using of a dual phase lock-in amplifier. Measurement of the superconducting transition temperature of a superconducting thin film using a mutual inductance technique down to 2.6K (working of a cryogen free system). Measuring AC resistance of a milliohm resistor using phase sensitive detection and studying the frequency and amplitude variation of the resistance: introduction to noise, White noise and 1/f noise.

Suggested Texts and References:

1. Radiation Detection and Measurement, Glenn F. Knoll, John Wiley 2010
2. Techniques for Nuclear and Particle Physics Experiments: William R. Leo, Springer 1995
3. Basic Vacuum technology, 2nd Edition, A. Chambers, R. K. Fitch and B. S. Halliday, IOP 1998
4. Physical Vapor Deposition, R. J. Hill, McGraw-Hill 2005
5. Elements of X-ray Diffraction, 3rd Edition, B. D. Cullity and S. R. Stock, Prentice Hall 2001
6. Introduction to Solid State Physics, 8th Edition, C. Kittel, Wiley 2012.

SEMESTER-VIII

P801: Astronomy and Astrophysics

UNIT-I

Stellar Physics: Equations governing the structure of stars: Mechanical & Thermal equilibrium. Virial theorem. Modes of energy transfer in stars: radiative & convective transport of energy. Auxiliary input: equation of state, opacity and energy generation by thermonulcear processes. Boundary conditions at the stellar surface & at the centre.

UNIT-II

Models with linear & quadratic density profiles. Polytropic models. Mass-luminosity-radius relations for low, intermediate & high mass stars. Sources of opacity and nucleosynthesis in stars. Manufacturing of iron-peak and heavier elements by rapid neutron capture processes. Mixing length theory of convective transport of hear. Completely convective stars. Hertzsprung-Russel diagram. Pre-main sequence contraction and the Hayashi phase. Zero-age main sequence.

UNIT-III

Stellar evolution: main sequence, red giant and asymptotic giant branch. Advanced stages of stellar evolution: white dwarfs, neutron stars & black holes. Physics and astrophysics of collapsed objects: pulsars, X-ray &gamma ray sources. Spherical accretion and Bondi solution. Physics of accretion discs. Stellar rotation and magnetism.

UNIT-IV

Galactic Physics: Units in astronomy, co-ordinate system, multi-wavelength sky (radio, IR, Optical, UV, X-ray, Gamma ray), distance ladder, Milkyway Galaxy, interstellar medium, basics of star formation, spiral and elliptical galaxies (morphology, content and kinematics), evidences for dark matter, . astronomy and society (including citizen science), constraints and prospects of astronomy and astrophysics research in India.

UNIT-V

AGNs, evidences for supermassive black holes, M-sigma and similar correlations, radio galaxies, synchrotron radiation, accretion onto black hole, physical processes behind black holegalaxy co-evolution (merger, infall and feedback), clusters of galaxies (contents and kinematics), high redshift galaxies, cosmic evolution of galaxies and black holes, hierarchical structure formation, cosmic-web, GMRT

Suggested Texts and References:

1. The Internal Constitution of Stars, A. S. Eddington, Cambridge University Press, 1988.
2. An Introduction to the Study of Stellar Structure, S.Chandrasekhar, Dover Publications, 2003.
3. The stucture & Evolution of the Stars, M.Schwarzschild, Dover Publications, 1962.
4. Cox and Giuli's Principles of Stellar Structure, 2nd Ed., A. Weiss et al., Cambridge, 2003.
5. The Physical Universe: An Introducing to Astronomy, F. H.Shu, University Science Books, 1982.
6. Galactic Astronomy, James Binny and Michael Merrifield, Princeton University Press, 1998.
7. An Introduction to Active Galactic Nuclei, B. M. Peterson, Cambridge University Press, 1997.
8. Extragalactic Astronomy and Cosmology: An Introduction, Peter Schneider, Springer, 2006. 9.Physics of the Interstellar & Intergalactic Medium, Bruce T. Draine, Princeton Univ. Press, 2011.

P802: Accelerator Physics and Applications

UNIT-I

Transverse beam dynamics: Accelerator coordinates; Canonical transformation to accelerators coordinates; Guide field; Dipole and Quadrupole Magnets; Hills equation and solution; Twiss parameters; Matrix formulation; Dispersion; Design of lattices; Field and gradient errors; Chromaticity; sextupole magnets and dynamics aperture.

UNIT-II

Longitudinal beam dynamics: Fields and forces; acceleration by time varying fields; relativistic equations; Overview of acceleration; transit time factor; main RF parameters; momentum compaction factor; transition energy; Equations related to synchrotron; synchronous particle; synchrotron oscillations; principle of phase stability; RF acceleration for synchronous and for non-synchronous particle; small amplitude oscillations; Oscillations with Hamiltonian formalism; limits of stable region; adiabatic damping.

UNIT-III

Linear accelerators: Basic methods of linear acceleration; Fundamental parameters of accelerating structures; Energy gain in linear accelerating structures; Q, Shunt-impedance, transit-time factor; periodic accelerating structures; RFQs; Microwave topics for linacs; Single particle dynamics in linear accelerators; Multi-particle dynamics in linear accelerators.

UNIT-IV

Synchrotron radiation: Introduction to electromagnetic radiation; Radiation of accelerated charged particles; radiation from wigglers and undulators; Electron dynamics with radiation; Low emittance lattices; synchrotronradiation sources.

UNIT-V

Free-electron lasers: Introduction; electron dynamics in the undulator; spontaneous emission; electron dynamics in the laser field; dynamics of the laser field; dimensionless equations of motion; solution in the small-signal, small-gain regime; Madey theorem; three-dimensional effects; undulators; X-ray laser. Advanced accelerator concepts: Photo injectors; laser-wakefield acceleration; plasma-wakefield acceleration; linear colliders; muon colliders.

Suggested Texts and References:

1. An Introduction to the Physics of High-Energy Accelerators, D. A. Edwards & M. J. Syphers
2. An Introduction to Particle Accelerators, Edmund Wilson
3. Introduction to Accelerator Physics, Arvind Jain
4. R. F. Linear Accelerators, T. P. Wangler
5. Classical Electrodynamics, 3rd Edition, J. D. Jackson, Wiley 2012

P803: Nuclear and Particle Physics

UNIT-I

Nuclear Reactions: Partial wave decomposition, phase shifts and partial wave analysis of the cross sections in terms of phase shifts. Behaviour of phase shifts in different situations. Black sphere scattering. Optical theorem and reciprocity theorem. Unitarity.

Optical potential: Basic definition. Relation between the imaginary part, W of the OP and σabs , and between W and mean free path. Folding model and a high energy estimate of the OP.

UNIT-II

Catagorisation of Nuclear Reaction mechanisms:

Low energies: Discrete region, Continuum Region: (a) Discrete Region: Decaying states. Relation between the width and the mean life time. Energy definition: Lorentzian or Breit-Wigner. Resonance scattering. Derivation of the resonance cross section from phase shift description of cross section. Transmission through a square well and resonances in continuum. Coulomb barrier penetration for charged particles scattering and centrifugal barrier for l non-zero states. Angular distributions of the particles in resonance scattering. Application to hydrogen burning in stars. (b) Continuum Region: Bohr's compound nucleus model.

UNIT-III

Direct Reactions: Cross section in terms of the T-matrix. Phase space, and its evaluation for simple cases. Lippmann Schwinger equation for the scattering wave function, and its formal solution. On-shell and off-shell scattering. Plane wave and distorted wave approximation to the T-matrix(PWBA, DWBA). Application to various direct reactions like, stripping, pick-up, knock-out etc.High energy scattering. Glauber theory. Eikonal approximation to the scattering wave function.Evaluation of scattering cross section in eikonal approximation. Introduction to heavy-ion scatteringand the physics with radioactive ion beams.

UNIT-IV

Nuclear Structure: Generalization of the single-particle shell model, residual interactions, Fermi gas model. Single-particle energies in a deformed potential, shell corrections and the Strutinski method. Pairing: BCS model and the Bogolyubov transformation. Hartree-Fock method: general variational approach, Hartree-Fock equations and applications. Nuclear shape parametrization, quadrupole and higher- order deformations. Collective rotation and vibration; Giant resonances. Cranking model, phenomena at high spin including super-deformation. introduction to Density-Functional Models, including relativistic mean field. Selected contemporary research topics: Superheavy nuclei; Spectroscopy of drip-line nuclei.

UNIT-V

Particle Physics: Symmetries and conservation laws, conserved quantities in reactions of particles. Relativistic kinematics in particle reactions, invariants, resonances, decays of resonances and their decays etc. Particle classification, mesons and baryons, SU(3) multiplets, quark model. Quarks, gluons, QCD interaction, colour neutrality. Detection of quarks and gluons, structure function in deep inelastic reactions. Quark and lepton families, weak interactions as guage theory, W and Z bosons. Symmetry breaking and generation of masses, Higgs bosons. Present boundary (strings, grand unification, matter-anti-matter asymmetry, dark matter and energy - seminar, qualitative)

Suggested Texts and References:

1. Subatomic Physics, E. M. Henley & A. Garcia, World Scientific
2. Concepts of Nuclear Physics, B. C. Cohen, McGraw-Hill.
3. Introduction to Nuclear and Particle Physics, A. Das and T. Ferbel, World Scientific.
4. Structure of the Nucleus: M.A. Preston and R.K. Bhaduri, Levant Books, 2008
5. Nuclear Models: W. Greiner and J.A. Maruhn, Springer, 1996
6. Nuclear Structure from a Simple Perspective: R. F. Casten, Oxford University Press, 1990
7. Theory of Nuclear Structure: M.K. Pal, Affiliated East-West Press, 1982
8. An Introduction to Quarks and Partons, F. E. Close, Academic Press 1980
9. Quarks and Leptons: An Introductory Course in Modern Particle Physics, F. Halzen and A. D. Martin, John Wiley 1984
10. Introduction to High Energy Physics, 4th Edition, D. Perkins, Cambridge 2000

P804: Condensed Matter Physics – II

UNIT-I

Superconductivity: Revision, Introduction to second quantization, BCS theory, Electron tunneling and energy gap, Josephson effect (AC and DC). GL theory and concept of penetration depth, coherence length and surface energy, Flux quantization.

UNIT-II

Modified London Equation of Mixed Phase, Interaction between Flux tubes, Flux flow, Flux pinning, Magnetization of Mixed State: Bogoliubov transformation, Boundary between normal metal and superconductor, Andreev Reflection and Proximity effect.

UNIT-III

Magnetism: Quantum theory of magnetism: Rationalization of the Heisenberg Hamiltonian, Hubbard model and Stoner Model: Derivation of susceptibility, Spin wave using Holstein-Primakov transformation.

UNIT-IV

Introduction to Density Functional Theory

Introduction to Special topics: Integer and Fractional Quantum hall effect, unconventional superconductivity, frustrated magnets, Josephson junction qubits, Graphene physics, Topological insulators.

UNIT-V

Kondo Physics, Metamaterials, Physics of photonic band gap materials, quantum cascade lasers, free electron lasers, organic electronics etc.

Note: Special topics in Fermi Liquid Theory may be covered if time permits.

Suggested Texts and References:

1. Introduction to Superconductivity, 2nd Edition, M. Tinkham, Dover 2004
2. Superconductivity, J. B. Ketterson and S. N. Song, Cambridge 1999
3. Basic Solid State Physics by A. K. Raychaudhuri
4. Magnetism in Solids, D. H. Martin, Butterworth 1967
5. Quantum theory of Magnetism, 3rd Edition, R. M. White, Springer 2006
6. Electronic Structure, Basic Theory & Practical Methods, R. Martin, Cambridge 2008

PL801: Advanced Physics Laboratory – II

Introduction to Observational Astronomy: Transmission of radiation through atmosphere in different bands, need for space platforms for invisible astronomies, Introduction to Optical, Infrared, Ultra-violet, X-ray and Gamma-ray astronomy, what do me measure and learn from different wavebands.

Introductory Astronomy and Different types of Optical Telescopes: Astronomical parameters like Apparent and Absolute magnitude, Flux, Luminosity and its dependence on size and temperature of stars, Atmospheric Extinction, Coordinate System in Astronomy Refracting and Reflecting telescopes, different focal plane configurations, their applications and relative merits and demerits. Reflectivity and its wavelength dependence, "seeing" and factors affecting it, use of active and adaptive optics in modern telescopes to overcome atmospheric and thermal effects, calculation of focal length, focal ratio, magnification, field of view, plate scale, diffraction limit of telescopes.

Introduction to Focal Plane Detectors for Optical, infrared and UV astronomy: Developments and evolution of modern Optical and Infrared imaging detectors: Photographic Plates, Phototubes, Image Intensifiers, Charge Coupled Devices (CCDs), Bolometers and how they work, their characterization and parameters (charge transfer efficiency, quantum efficiency, flat fielding etc.). CCDs uses in Imaging, morphological and Spectroscopic studies, Infrared Detectors and IR Arrays, UV Imaging and Photon Counting Detectors.

Different types of Focal Plane Instruments: Imagers, Photometers, Fast Photometers for photon counting, limitations of PMT and CCD bases photometers, Importance of spectroscopy, Design and description of Low and High Resolution Spectrometers and their applications, Polarimeters and their applications.

Interaction of radiation with matter: (a) Passage of charged and neutral particles through matter, Ionization loss formulae and dependence on different parameters, relativistic rise in ionization loss, detection of neutrons, Bremsstrahlung process, Cerenkov radiation and its application (b) Interaction of photons with matter: Photoelectric interaction, mass absorption formula and dependence on energy, atomic number etc, Thompson scattering, Compton scattering, Pair production process, formula and dependence on energy, atomic number, radiation length, critical energy

Introduction to Different Types of Gas-Filled Radiation Detectors: Role of development of new detection techniques in new discoveries in high energy physics and astrophysics, different kind of detection techniques for charged and neutral radiation Dependence of charge multiplication on high voltage and pressure, Townsend coefficient, need for use of inert gases, quench gas, mobility of electrons and ions (a) Ionization Chamber (IC), description of a typical IC, its characteristics, application of IC in physics (b) Proportional Counters (PC): Single and multi cell PCs, filling gases, Penning effect, charge multiplication process, energy resolution of PC, Fano factor, use of PCs in high energy physics, and astronomy especially in X-ray astronomy

(c) Geiger Mueller (GM)Counter: Typical GM counter, its characteristics, applications of GM counter

Scintillation Counters, Cerenkov Detectors and other Solid State Detectors: Scintillation processes, dependence on energy, charge and atomic number, Photomultiplier (PMT) for detection of light, PMT characteristics, charge multiplication and use of PMTs with scintillators

(a) Organic Scintillation Counters: Plastic Scintillators and light yield, their use in charged particle detection, a typical PS detector and its characteristics (b) Inorganic Scintillation Counters: Scintillation medium and need for activators, Sodium Iodide (NaI) and Caesium Iodide detectors, their light output, application of these detectors in physics and astrophysics (c) Silicon detectors and their applications in X-ray Astronomy, Germanium Detectors, Cadmium -Telluride devices and their arrays

Observational X-ray Astronomy: Birth and evolution of X-ray Astronomy, different types of X-ray sources, Discovery of X-ray Binaries, their broad properties, optical identification, classification in Low Mass X-ray binaries (LMXBs) and High Mass X-ray Binaries (HMXBs), their unique characteristics, estimation of mass of the compact star in X-ray binaries from the binary parameters (a) Neutron Star Binaries (NSB): X-ray Pulsars in Binaries, Rotation powered pulsars in SNRs, detailed discussion of their timing and spectral properties, New physics and astrophysics learnt from their studies (b) Black Hole Binaries (BHB): Inference about black hole nature, time variability, spectral measurements, mass of black hole

X-ray Radiation Processes: (a) Thermal Emission, Black Body emission, Thermal Bremstrahlung (free-free emission),spectral line formation in thermal plasma, examples of thermal spectra, measurement of temperature and elemental abundances from spectral data (b) Non-thermal Emission: Synchrotron mechanism (magnetic bremstrahlung), spectral shape, polarized emission, Inverse Compton Scattering, spectrum of radiation, examples of non-thermal spectra, Cyclotron process in strongly magnetized stars and formation of cyclotron lines, determination of magnetic field of the stars

Experiments to be performed:

1. Measuring energy resolution (R) of a Cadmium Telluride Detector using X-rays of different energies (E) from radioactive sources and deriving expression for variation of R with E.
2. Solar Constant measurement.
3. Measurement of Solar Limb Darkening.
4. Observing an Optical Binary Star and deriving its light curve.
5. Determine Pulsation period and binary light curve of an accreting Neutron star from X-ray data.
6. Measuring X-ray Energy Spectrum of a Black Hole Binary and fit it with different spectral models.
7. Characteristics of a Proportional Counter and dependence of its energy resolution on different parameters of the PC.

SEMESTER X

PE1001 Quantum Field Theory

UNIT-I

Preliminaries: Why Quantum Field Theory, Creation and annihilation operators, Special relativity, Space and time in relativistic quantum theory, natural units

UNIT - II

Canonical Quantization: General Formulation. Conjugate Momentum and Quantization. Neutral Scalar Field. Commutation Relations, Normal Ordering, Bose Symmetry, Fock Space. Charged Scalar Field. U(1) Invariance, Charge
Conservation, Particles and Antiparticles. Time Ordered Product, Feynman Propagator for Scalar Fields, Bose- Einstein Distribution, Propagators at Finite Temperature.

UNIT - III

Dirac Field: The Dirac Equation, Relativistic Covariance. Anti-Commutators. Quantization of the Dirac Field, Electrons and Positrons. Connection between Spin and Statistics. Discrete Symmetries, Parity, Charge Conjugation, Time Reversal, CPT Theorem.

UNIT - IV

Gauge Field: Gauge Invariance and Gauge Fixing. Quantization of the Electromagnetic Field, Propagator, Vacuum Fluctuations.

UNIT - V

Interacting Theory and Elementary Processes: Wick's Theorem. Feynman Rules and Feynman Diagrams for Spinor Electrodynamics, Lowest Order Cross-Section
for Electron-Electron, Electron-Positron and Electron- Photon Scattering.

References:

1. Quantum Field Theory, C. Itzykson and J. B. Zuber, McGraw-Hill Book Co, 1985.
2. Quantum Field Theory, L. H. Ryder, Cambridge University Press, 2008.
3. Field Theory, A Modern Primer, P. Ramond, Benjamin, 1980.
4. The Quantum Theory of Fields, Vol I, S. Weinberg, Cambridge University Press, 1996.
5. Introduction to The Theory of Quantum Fields, N. N. Bogoliubov and D. V. Shirkov, Interscience, 1960.
6. An Introduction to Quantum Field Theory, M. E. Peskin and D. V. Schroeder, Westview Press, 1995.
7. Quantum Field Theory: Mandl and Shaw

8. A first book of Quantum Field Theory, Amitabha Lahiri, Palash B. Pal, Alpha Science International Ltd., 2000

PE1002 General Relativity and Cosmology

UNIT - I

Review of Newtonian Mechanics. Special theory of relativity. Prelude to General relativity, historical developments, 4-Vectors and 4-tensors, examples from physics

UNIT - II

Principle of Equivalence, Equations of motion, Gravitational force, Tensor Analysis in Riemannian space, Effects of Gravitation, Riemann-Christoffel curvature tensor, Ricci Tensor, Curvature Scalar, Einstein Field Equations, Experimental tests of GT, Scwartzchild Solution,

UNIT - III

Introduction to Cosmology, The cosmic history and inventory, The expanding Universe

UNIT- IV

Friedmann Equations and Cosmological Models, The Standard cosmological model, The inflationary Universe, Big-Bang Hypothesis

UNIT- V

Primordial nucleosynthesis and the thermal history of the Universe. Perturbations in an expanding Universe, Growth of perturbations, Dark Matter Halos

References:

1. A first course in General Relativity- B. Schutz
2. Gravity: HJ. Hartle
3. The Classical Theory of Fields: Landau and Lifshitz
4. Gravitation and Cosmology: S. Weinberg5. Introducing Einstein's Relativity: D'Inverno
5. Introducing Einstein's General Relativity - Ray D'Inverno
6. The Early Universe - Kolb and Turner
7. Introduction to Cosmology - Barbara Ryden4. Modern Cosmology - Scott Dodelson
8. Principles of Physical Cosmology - P.J.E. Peebles
9. Large Scale Structure of the Universe - P.J.E. Peebles
10. Structure Formation in the Universe - T. Padmanabhan

PE1003 Experimental Techniques

UNIT – I

Vacuum technology: gases, gas flow, pressure and flow measurement, vacuum pumps, pumping mechanisms, ultrahigh vacuum, leak detection

UNIT – II

Optical systems: optical components, optical materials, optical sources Charge particle optics: electrostatic lenses, charged-particle sources, energy and mass analyzer

UNIT – III

Detectors: optical detectors, photoemission detectors, particle and ionizing radiation detectors, signal to noise ration detection, surface barrier detector.

UNIT – IV

Particle detectors and radioactive Decay: Interactions of charged particles and photons with matter; gaseous ionization detectors, scintillation counter, solid state detectors

UNIT – V

Electronics: electronic noise, survey of analog and digital I/Cs, signal processing, data acquisition and control systems, data analysis evaluation

References:

1. The art of Measurement, by Bernhard Kramer, VCH publication
2. Building Scientific apparatus by J. H. Moore et al.
3. Experiments in Modern Physics, Second Edition by Adrian C. Melissinos, Jim Napolitano
4. Vacuum Technology, A. Roth North-Holland Publisher
5. Charge Particle Beams, by Stanley Humphries, John Wiley and Sons
6. Principles of charged Particles Acceleration, by Stanley Humphries, John Wiley and Sons
7. Radiation detection and Measurements, G. Knoll, 3rd Edition
8. Techniques for Nuclear and particles physics experiments, W. R. Leo, 2nd edition, Springer
9. The Physics of Micro & Nanofabrication, Ivor Brodie,and Julius J. Muray, Springer
10. Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM, R.Egerton, Springer, 2005
11. Egerton, Springer, 2005Modern Spectroscopy, J. M. Hollas, John Wiley, 4th Edition, 2004

PE1004 CCD Imaging and Spectroscopy

UNIT-I

Introduction : Why use CCDs?, CCD manufacturing and operation, CCD operation, CCD types, CCD coatings, Analog-to-digital converters

UNIT-II

Characterization of charge-coupled devices: Quantum efficiency, Charge diffusion, Charge transfer efficiency, Readout noise, Dark current, CCD pixel size, pixel binning, full well capacity, and windowing, Overscan and bias, CCD gain and dynamic range,

UNIT-III

CCD imaging, Photometry and astrometry: Image or plate scale, Flat fielding, Calculation of read noise and gain, Signal-to-noise ratio, Basic CCD data reduction, CCD imaging, Stellar photometry from digital images, Two-dimensional profile fitting, Difference image photometry, Aperture photometry, Absolute versus differential photometry, High speed photometry, PSF shaped photometry, Astrometry, Pixel sampling

UNIT-IV

Review of spectrographs: CCD spectrographs, CCD spectroscopy, Signal-to-noise calculations for spectroscopy, Data reduction for CCD spectroscopy, Extended object spectroscopy, Slitless spectroscopy

UNIT-V

CCDs used in space and at short wavelengths : CCDs in space, Radiation damage in CCDs, CCDs in the UV and EUV (300–3000 Å) spectral range, CCDs in the X-ray, (<500 Å) spectral range

References:

1. Handbook of CCD Astronomy, Second editionS. B. Howell
2. Stellar Magnitudes from Digital Pictures, Adams, M., Christian, C., Mould, J., Stryker, L., & Tody, D., 1980, Kitt Peak National Observatory publication.
3.The Next Generation Space Telescope, Bely, P.-Y., Burrows, C., & Illingworth, G. (eds.), 1989, Space Telescope Science Institute publication.
4. Blouke, M., Yang, F., Heidtmann, D., & Janesick, J., 1988, in Instrumentation for Ground-Based Optical Astronomy, ed. L. B. Robinson, Springer-Verlag, p. 462.
5. Bonanno, G., 1995, in New Developments in Array Technology and Applications, eds. A. G. D. Philip, K. A. Janes, & A. R. Upgren, Kluwer, p. 39.
6. Born, M. & Wolf, E., 1959, Principles of Optics, MacMillan, Chap. VIII.
7. Bowen, I. S., 1960a, in Astronomical Techniques, ed. W. A. Hiltner, University of Chicago Press, Chap. 2.
8. Brown, R. (ed.), 1993, The Future of Space Imaging, Space Telescope Science Institute publication, Chap 8.

PE1005 Biophysics

UNIT- I

Mathematical Methods in Biophysics : Functions of One Variable and Ordinary Differential Equations, Functions of Several Variables: Diffusion Equation in One Dimension., Random Walks and Diffusion, Random Variables, Probability Distribution, Mean, and Variance , Diffusion Equation in Three Dimensions., Complex Numbers, Complex Variables, and Schrodinger's Equation , Solving Linear Homogeneous Differential Equations., Fourier Transforms, Nonlinear Equations: Patterns, Switches and Oscillators

UNIT- II

Quantum Mechanics Basic to Biophysical Methods: Quantum Mechanics Postulates, . One-Dimensional Problems, The Harmonic Oscillator, The Hydrogen Atom, Approximate Methods, Many Electron Atoms and Molecules , The Interaction of Matter and Light

UNIT- III

Computational Modeling of Receptor–Ligand Binding and Cellular Signaling Processes: Differential Equation-Based Mean-Field Modeling, Application: Clustering of Receptor–Ligand Complexes, Modeling Membrane Deformation as a Result of Receptor–Ligand Binding, Limitations of Mean-Field Differential Equation-Based Modeling, Master Equation: Calculating the Time Evolution of a Chemically Reacting System,

UNIT- IV

Stochastic Simulation Algorithms: Stochastic Simulation Algorithm (SSA) of Gillespie, Application of the Stochastic Simulation Algorithm (SSA), Free Energy-Based Metropolis Monte Carlo Simulation, Application of Metropolis Monte Carlo Algorithm, Stochastic Simulation Algorithm with Reaction and Diffusion: Probabilistic Rate Constant–Based Method,Mapping Probabilistic and Physical Parameters, Modeling Binding between Multivalent Receptors and Ligands, Multivalent Receptor–Ligand Binding and Multi-molecule Signaling Complex Formation, Application of Stochastic Simulation Algorithm with Reaction and Diffusion,Choosing the Most Efficient Simulation Method

UNIT- V

Fluorescence Spectroscopy: Fundamental Process of Fluorescence,
Fluorescence Microscopy, Types of Biological Fluorophores, Application of Fluorescence in Biophysical Research, Dynamic Processes Probed by Fluorescence

Electrophysiological Measurements of Membrane Proteins :
Membrane Bioelectricity, . Electrochemical Driving Force, Voltage Clamp versus Current Clamp, Principles of Silver Chloride Electrodes, Capacitive Current and Ionic Current.Gating and

Permeation Functions of Ion Channels, Two-Electrode Voltage Clamp for Xenopus Oocyte Recordings , Patch-Clamp Recordings , Patch-Clamp Fluorometry

References

1. Fundamental Concepts in Biophysics, Thomas Jue
2. Alon U. 2006. An introduction to systems biology: design principles of biological circuits. Boca Raton: Chapman & Hall.
3. Berg HC. 1993. Random walks in biology. Princeton: Princeton UP.
4. Nelson P. 2004. Biological physics: energy, information and life. New York: W.H. Freeman and Company.
5. Van Kampen NG. 1992. Stochastic processes in physics and chemistry. Amsterdam: North Holland.
6. Shankar R. 1994. Principles of quantum mechanics. New York: Plenum.
7. Cohen-Tannoudji C, Diu B, Laloe F. 1977. Quantum mechanics. Trans SR Hemley, N Ostrowsky, D Ostrowsky, New York: Wiley.
8. Lauffenburger DA, Linderman JJ. 1993. Models for binding, trafficking and signaling. Oxford: Oxford UP.
9. Fall CP, Marland S, Wagner JM, Tyson JJ, eds. 2002. Computational cell biology. New York: Springer

PE1006 Particle Physics

UNIT-I

Elementary particles, discrete symmetries and conservation laws, Symmetries and Quarks.

UNIT-II

Klein-Gordon equation, concept of antiparticle, Lorentz symmetry and scalar / vector / spinor fields.

UNIT-III

Dirac equation, Scattering processes of spin-1/2 particles (Feynmans rules as thumbrule QFT course), propagators.

UNIT-IV

Current-current interactions, weak interaction, Fermi theory, Gauge symmetries, spontaneous symmetry breaking, Higgs mechanism

UNIT-V

Electroweak interaction, Glashow-Salam-Weinberg model, Intoduction to QCD, structure of hadrons (form factors, structure func-tions), parton model, Deep inelastic sattering.

References:

1. Quarks and Leptons: An Introductory Course in Modern Particle Physics - FrancisHalzen, Alan D. Martin
2. Introduction to Elementary Particles, David Griffiths
3. Concepts of Particle Physics, Volume I, Kurt Gottfried and Victor F. Weisskopf, 1986, Oxford University Press,
4. Classical Electrodynamics second edition, J.D. Jackson, 1975, John Wiley & Sons, Inc., (chapters 11 and 12)
5. Introduction to High Energy Physics, fourth edition, Donald H. Perkins, 2000, Cambridge University Press,
6. Experimental Techniques in High Energy Physics, Thomas Ferbel (editor), 1987, Addison Wesley
7. Gauge Theory of Elementary Particle Physics, Ta-Pei Cheng and Ling-Fong Li, 1984, Oxford University Press
8. Weak Interactions of Leptons and Quarks, E.D. Commins and P.H. Bucksbaum, 1983, Cambridge University Press

: SEMESTER WISE COURSE OUTCOMES:

Int. M. Sc. Physics program

P 101: (A) Physics-I (PCM Stream)

This course provides a refresher of what science students study in Physics till 10+2 level. While a portion of the content significantly overlaps with 10+2 , the approach taken in delivery is meant to be inclined towards developing the thought process that leads to the conclusions that are being familiarized. The scope of content covered includes -

- A review of Newtonian Mechanics, including Statics and Dynamics of varied variety of mechanical problems
- A review of Thermodynamics, as a Macroscopic study of complex systems, mostly in the context of ideal gases.
- A review of microscopic analysis of ideal gases using the kinetic theory of gases.

P101: (B) Physics-I (Biology Stream)

This course qualitatively introduces basic concepts of classical physics to the PCB group. After successfully completing course, student will be able to

- define and understand basic mechanical concepts related to discrete and continuous mechanical systems,
- describe and understand the vibrations of discrete and continuous mechanical systems,
- describe and understand planar and spatial motion of a rigid body,
- understand gradient, divergence and curl of fields

PL101: Physics Laboratory – I

After sucessfully cmopleting the laboratory exercises

- Student should have working knowledge of Plots (normal, semi-log, log-log).
- Student should have understanding of uncertainty / error in measurements and uncertainty / error analysis.
- Student should have understanding of concepts of standards and calibration.

P201: Physics – II (PCM & Bio Stream)

After sucessfully completing this course

- student should have understanding of electrostatistics, magnatostatistics, and plane electromagnetic waves
- Student should have understanding of concept of Interference of light
- Student should have understanding of working of optical instruments

G201: Electronics and instrumentation

This course covers a theoretical understanding of functionality of electronic components in circuitry and also develops the thought process for instrumentation. In this course, students will gain understanding of-

- Basic circuit analysis and network theorems
- foundational electronic components like diodes and transistors.
- More complex electronic components and a variety of applications of the same
- Introductory level digital electronics that includes fundamental memory devices
- Introductory instrumentation which includes and understanding of concepts like sensing and transduction.

G202: Glimpses of Contemporary Science

After sucessfully completing this course

- Student should gain introductory knowledge of astrophysics,
- Student should have familiarity with the scale of the universe, big-bang theory, dark-energy and dark matter
- Student should have familiarty with the uncertainity principal, dual nature of the light and the particles

PL201: Physics Laboratory – II

After sucessfully completing laboratory exrcises of this course

- Student have thorough understanding of uncertainty and sources of error in the experimets.
- Student should have working knwledge of error analysis, least squares fit method,
- Student should have familiarity with the sensors / transducers.

GL201: Electronics Lab

A study and analysis of superposition theorem

A study and analysis of Thevenin's and Norton's theorem

A study and analysis of maximum power transfer theorem

A study of specific resistance using Wheatstone bridge.

A study of charging and discharging of capacitance.

To draw diode characteristics in forward and reverse biasing mode.

To draw the input and output characteristics of PNP and NPN transistor.

P301 Mathematical Physics – I

After sucessfully completing this course

- The students will be able to understand and apply the mathematical skills to solve
- quantitative problems in the study of physics.
- Will enable students to apply integral transform to solve mathematical problems of
- interest in physics.
- he students will be able to use Fourier transforms as an aid for analyzing experimental data.
- The students should be able to formulate and express a physical law in terms of tensors, and simplify it by use of coordinate transforms.

P302: Classical Mechanics-I

Student will gain understanding of-

- Fundamental concepts of forces, energy, potentials, linear and angular momentum
- A rigorous exercise in Newtonian Mechanics including that of its applications in Rigid bodies
- Frames of reference
- Statics and Dynamics of Einstein's special relativity
- Introduction to four vectors and concept of spacetime

This course would serve as a foundation in ensuring an appropriate level of understanding of the statics and dynamics necessary for other advanced subjects of physics.

P303: Electromagnetism

After sucessfully completing this course

- Student should be able to explain and solve advanced problems based on classical electrodynamics using Maxwell's equation.
- The students will be able to analyze s radiation systems in which the electric dipole, magnetic dipole or electric quadruple dominate.
- The students will have an understanding of the covariant formulation of electrodynamics and the concept of retarded time for charges undergoing acceleration.

P304: Waves and Oscillations

After completing this course student should

- be able to recognize and use a mathematical oscillator equation and wave equation, and derive these equations for certain systems, point out the limitations and be able to refer to very different solutions of identical oscillator equations due to different initial and boundary conditions.
- explain several phenomena we can observe in everyday life that can be explained as wave phenomena, and identify basic principles,
- Understand physical characteristics of SHM and obtaining solution of the oscillator using differential equations
- explain how several waves or parts of waves interact, and be able to calculate and analyse diffraction and interference phenomena, and explain the conditions required for such phenomena to appear.
- describe and calculate what happens when waves move from one medium to another, and be able to explain dispersion and group and phase velocity.
- use geometric optics to describe and explain optical instruments, and by simple measurements estimate what strength glasses a person needs
- use both analytical mathematics and numerical methods to explore the subjects mentioned above. In particular you should be able to analyse experimental oscillator or wave phenomena, such as sound, using suitable methods.

H302: History and Philosophy of Science

After sucessful completion of this course students should learn

- History of World Science up to the Scientific Revolution.
- History of Ancient Indian Science.
- Philosophy of Science and disction between science and psudo science.
- Great Scientific Experiments (though group activity)

PL301: Physics Laboratory – III

After sucessful completion of this course students should have the procedural and conceptual understanding of the following experiments

- Frequency response of R-C circuit (concept of cut-off freq and filter).
- frequency response of LC circuit.
- concepts of phase difference between voltage and current in these circuits.
- phase factor for appliances using AC mains supply.
- R-L-C (series / parallel) resonance.
- transient response in RL- C series circuit.
- study of Newton's rings.
- determination of the charge of an electron by Millikan's oil drop experiment.

GL301: Applied Electronics Laboratory

12. Study of Logic gates
13. Study of half and Full Adder
14. Study of De-Morgan’s Theorem
15. Study of edge triggered D-Flip Flop
16. Study of Half wave and Bridge rectifier
17. Study of filter circuits
18. Study of CE transistor amplifier
19. Study of Zener regulated power supply
20. Study of IC-723 regulated power supply

P401: Mathematical Physics – II

After sucessful completion of this course students should have understanding about

- Partial differential equations in curvilinear coordinates
- Inhomogeneous equations, Green's functions in 1,2 and 3-dimensions
- Tensors calculus
- Various integral equations
- subgroups, normal subgroup, classes and cosets;

P402: Quantum Mechanics – I

After sucessful completion of this course

- Student should have an understanding of the formalism and language of non-relativistic quantum mechanics.
- The students will be able to formulate and solve problems in quantum mechanics using Dirac representation.
- The students will be familiar with various approximation methods applied to atomic, nuclear and solid-state physics.

P403: Statistical Mechanics-I

Student will gain understanding of-

- Probability distribution and ensemble theory
- Differences and implications of dealing with a variety of systems under classical and quantum mechanical framework
- The natural differences and implications of Bosonic and Fermionic systems.
- Applications of this concept in explaining properties like paramagnetism and specific heat of materials.

This course introduces the phenomenon of dealing with physical properties of a complex system via a statistical microscopic analysis. Statistical Mechanics has limitless applications in understanding a variety of physical systems.

PL401: Physics Laboratory-IV

1. School Level Experiments
    1.1. Measuring Voltage
    1.2. Measuring Resistance

1.3. Measuring Capacitance
1.4. Measure resistance by comparison
1.5. Direct and Alternating Currents
1.6. AC mains pickup
1.7. Separating DC & AC components
1.8. Human body as a conductor
1.9. Resistance of human body
1.10. Light dependent resistors
1.11. Voltage of a lemon cell
1.12. A simple AC generator
1.13. AC Transformer
1.14. Resistance of water, using AC
1.15. Generating sound
1.16. Digtizing sound

2. Electronics
   2.1. Half wave recti?er using PN junction
   2.2. Fullwave recti?er using PN junctions
   2.3. Clipping using PN junction diode
   2.4. Clamping using PN junction diode
   2.5. IC555 Oscillator
   2.6. Inverting Amplifier
   2.7. Non-Inverting Amplifier
   2.8. Op-Amp Integrator
   2.9. Logic gates
   2.10. Clock Divider
   2.11. Diode I-V characteristics
   2.12. Transistor Output characteristics (CE)
   2.13. Opto-electric signal transmission
3. Electricity and Magnetism
   3.1. RLC circuits, steady state response
   3.2. Transient Response of RC circuits
   3.3. Transient Response of RL circuits
   3.4. Transient response of LCR circuits
   3.5. RC Integration & Differentiation
   3.6. Fourier Analysis
   3.7. Electromagnetic induction
4. Sound
   4.1. Frequency response of Piezo
   4.2. Velocity of sound
   4.3. Sound beats
5. Mechanics & Heat
   5.1. Acceleration due to gravity using Rod pendulum
   5.2. Angular Velocity of Pendulum
   5.3. Resonance of a driven pendulum
   5.4. Distance Measurement, by ultrasound echo
   5.5. Temperature measurement using PT100

This course is meant as an exercise in a basic understanding and application of ExpEyes kit in exercises of physics and electronics.

P501: Quantum Mechanics – II

After sucessful completion of this course

- Student should understand the basics of scattering theory.
- Student should learn Path integral formulation of quantum mechanics
- student should be able to use Variational method
- Studnt should have introductory ideas about: The EPR paradox, quantum entanglement; Bell's theorem, the No-clone theorem, Schrodinger's cat; Decoherence, quantum Zeno paradox.
- Student should understand Symmetry in quantum mechanics.

P502: Classical Mechanics – II

This is a second course in Classical mechanics will help students gain an understanding of -

- Lagrangian and Hamiltonian approach to dynamics
- Canonical Transformations
- Small oscillations in simple and coupled systems
- Brief understanding of application of this approach to continuous media

P503: Atomic and Molecular Physics

After sucessful completion of this course

- Student should learn Atomic Physics with problem solving approach towards spectroscopy.
- Student should have an understanding of the static properties of nuclei, nuclear force and nuclear models.
- students should have an understanding of the structure of the nucleus, radioactive
- decay, nuclear reactions and the interaction of nuclear radiation with matter.
- Students will have an understanding of quantum behavior of atoms in external electric and magnetic fields.

PL501: Physics Laboratory - V

1. Variable mass pendulum
2. Coupled pendulum
3. Study of EMI
4. Study of characteristics of solar cell
5. Velocity and acceleration measurement

The above experiments are to be implemented using Expeyes kit and other basic electronic components instead of readymade measuring instruments. This requires rigorous customization and python programming-based implementation of Expeyes.

P601: Electrodynamics

In this course students will develop understanding of

- Gauge theory, diff erent types of radiating systems, antenna, solution of scalar wave equation.
- Multipole expanson of electromagnetic fields
- Scattering and diff raction problems
- Covarient formulation of electrodynamics
- Field produced by moving charge

P602: Nuclear Physics - I

Understanding the properties of Nucleus is integral to various physical phenomenon. This course develops an understanding of -

- The various properties of nucleus
- Nuclear stability and factors affecting binding energy of nucleus
- Nuclear structure under different models
- Nuclear forces and scattering
- Nuclear decay
- Nuclear interactions and fission/fusion process

P603: Condensed Matter Physics - I

In this course, which is a primarily a study of ordered crystals, Student will gain understanding of-

- Crystallography
- Lattice vibrations and properties of solids
- Free electron model and electronic specific heat
- Understanding semiconductors, magnetic properties and superconductivity

P604: Lasers

After sucessful completion of this course

- Student should understand operational principles and construction of lasers
- Student should understand technological issues behind laser construction
- Student should understand optical components that can be used to tailor the properties of the laser
- Student should understand be able to relate the laser operation principles to atom and molecular physics, solid state physics, quantum mechanics and physical optics.

P605: Nonlinear Dynamics and Chaos

In this course students will develop understanding of

- Dynamical system and their classification, phase portrait representation of dynamical system,
- 1-D map, eigen value equation and concepts and properties of eigen values.
- Stability analysis of dynamical systems, concept of fixed point, limit cycle, manifold.
- Linearization of fields, classification of fixed point, manifold theorems.
- Concepts of neighborhood, bifurcations, classification of bifurcations, bifurcations diagram
- Introduction of chaos, fractals, Hamiltonian dynamics

PL601: Physics Laboratory – VI

After sucessful completion of this course student should have procedural and conceptual understanding of the following experiments:

- determination of specific charge (e/m) of electron.
- Study of Faraday rotation and determination of Verdit's constant in a glass material.
- Study of quantum mechanics through acoustic analogue (four sessions).
- Fourier analysis / synthesis – use of simulation.
- Study of characteristics of a coaxial cable and determination of speed of electromagnetic waves in the coaxial cable.
- Investigation of chaos in a spring based coupled oscillator system.

P701: Fluid Mechanics

In this course students will develop understanding of

- Concept of hydrodynamics, and description of hydrodynamical systems, flow fields, and basic equations governing conservation of mass, momentum & energy in hydrodynamical systems
- Equation governing viscous flow, concept of shear and bulk flow viscosity, boundary layers, potential flow, , water waves and lubrication theory of flow
- Tensor representation of viral theorem, flow in magnetic fluids, Generalized Ohm's law & Ambipolar diff usion, Magneto-gravity-acoustic modes
- Stability problem in classical hydrodynamic and hydromagnetic specially Rayleigh-Taylor and Kelvin-Helmholtz instabilities. Jeans' gravitational instability; Benard convection. Parker instability and magnetic buoyancy. Thermal instability.
- Concept of accretion flows and accretion disks, shock and blast waves, hydrodynamics in supernova and blood flow in human heart

P702: Quantum Mechanics – III

After sucessful completion of this course student should have

- an understanding of the founding principles of relativistic quantum mechanics;
- a working knowledge of Dirac gamma matrices and their role in the Lorentz transformations of Dirac Spinors;
- be able to use projection operators to filter spin and positive/negative energy solutions;
- an understanding of the modern field-theoretic description of negative energy states;
- be able to solve relativistic one-body problems for spin-0 and ½ particles;
- be able to identify particle interactions allowed by the Standard Model and describe the physical process by which they occur.

P703: Statistical Mechanics – II

In this course students will develop understanding of

- Transport phenomena and equations governing the transport in the presence and absence of collisions, random walk problem
- Concept of diff usion and equations governing diff usion
- phenomena of phase transition, types of phase transition and Landau theory of second order phase transition
- Critical phenomena, critical exponent, exponent inequalities

P704: Reactor Physics and Radiation Science

After sucessful completion of this course student should have understanding of

- Fission process
- Interaction of Neutrons with Matter
- Concept of microscopic cross section
- Diffusion of neutrons
- Chain Reaction
- Slowing down process
- Heterogeneous reactors
- Reactor kinetics
- Neutron Poisons
- Reactivity coefficients:

PL701: Advanced Physics Laboratory – I

After sucessful completion of this course student should have procedural and conceptual understanding of the following experiments

- Spectral features of photoelectric absorption and Compton scattering with scintillation detectors

- Growth of metallic thin films by physical vapor deposition techniques
- operation of a closed cycle cryostat, low temperature thermometers
- using of a dual phase lock-in amplifier. Measurement of the superconducting transition temperature of a superconducting thin film using a mutual inductance technique down to 2.6K

Ppr701: Reading Project

Student learn to carry out supervised leaning of a reseach topic, write the report on the topic on own words and make a presentation of the learned topic.

P801: Astronomy and Astrophysics

After sucessful completion of this course student should have understanding of

- Stellar physics: the equations governing the structure of stars
- various models of stellar structure with linear & quadratic density profiles.
- Stellar evolution from birth of stars to its possible end states
- structure of Milkyway and necesity of multiwavelength observations in astronomy
- active galactic nucleis

P802: Accelerator Physics and Applications

After this course:

- student will understand how different particle accelerators are designed (linear accelertors, cyclotrons and synchrotrons), as well as the possibilities and limitations of the different accelerator types
- student will master simple calculations and methods for numerical simulations describing how a particle beam is accelerated, focused and measured
- student will have knowledge of machines for high-energy physics, including studies for future linear and circular colliders
- student will have knowledge about the accelerator science research frontier, including laser- and plasma wakefield acceleration
- student will have knowledge about the most important applications of particle accelerators to particle physics, material science and medical technology
- student will master theory and techniques for numerical simulations of charged particle beams

P803: Nuclear and Particle Physics

In this course students will develop understanding of

• Concept of phase shift, partial wave decomposition, cross section, scattering, optical potential

• Derivation of the resonance cross section, description of cross section, barrier penetration, resonance scattering and compound nucleus model

• Direct reaction and application to various method, high energy scattering and evolution of scattering cross section, heavy ion scattering and physics with radioactive ion beams.

• Single particle shell model, gas models, deformation in nuclear shape, superheavy nuclei, and spectroscopy of drip-line model

• Basic classification of particles, types of fundamental forces, relativistic kinematics of particle reactions, conservation and symmetries, conservation laws for different quantum numbers, symmetry breaking and generating of masses, families of particles, gauge theory, detection of particles (quarks and gluons)

P804: Condensed Matter Physics - II

The objective of this Advanced course in condensed matter physics is to-

- Understand the Phenomenon that governs and explains superconductivity
- Look into various approaches that explain different kinds of magnetic phenomenon
- Introduce density functional theory and a view into some peculiar physical phenomenon in solids

PL801: Advanced Physics Laboratory – II

After sucessful completion of this course student should have learned methodology and conceptual understanding of the following experiments

- Study of orbit of a visual binary star Kruger 60. Construct an orbit diagram in order to verify that this binary system follows Kepler's law of motion
- Determine the rotational velocity of Saturn. Study the differential motion of ring particles to check that ring particles follow the Keplerian orbit, hence determine the mass of Saturn.
- Study of proper motion of 61 Cygni.
- Determine the period of Pulsars from their pulse profile in different radio frequencies. Find the dispersion by measuring delay in arrival time of pulses at two frequency bands and hence determine distances of the Pulsars.
- Study of Quasar 3C273 and determine its red-shift, recessional velocity, distance, apparent magnitude, absolute magnitude and size of the emitting region. Find that it is very compact yet very luminous object.
- Study of Hubble's law and expansion of the Universe using the spectra of different galaxy cluster fields. Determine the Hubble's constant and age of the Universe.
- Perform photoelectric photometry (in B and V filters) of Pleiades star cluster in order to construct HR Diagram and determine the distance using Main Sequence Fit method.
- Study of light curves of Cepheid Variable stars and determine the distance of Small Magellanic Cloud (SMC) using Cepheid Variable's Period Luminosity Relation.

Ppr801: Project

Student will learn to carryout inhouse supervised research project, submit a report and make a formal presentation of the project.

Ppr901: Project (External)

Student will learn to carryout full semester project outside of the institute with external superviser, submit a thesis desertation and make formal presenatation of research project.

PE1001: Quantum Field Theory

After sucessful completion of this course student should have understanding of

- reasons for the failure of relativistic quantum mechanics, such as the causality problem, and the need for quantum field theory
- the origin of particles and forces
- Analysis of the statistical distributions of identical particles and the repulsive/attractive nature of the forces as a function of spins
- Application of the Feynman rules to calculate probabilities for basic processes with particles (decay and scattering)

- Obtaining classical and/or non-relativistic limits of fully quantum and relativistic models, and identify the relativistic origin of effects such as the spin-orbit interaction
- Useing effective field theory techniques to develop models at large scales
- Describing qualitatively effects such as superconductivity, superfluidity, and ferromagnetism using the concepts of gauge invariance, Goldstone and Higgs mechanism, and spontaneous symmetry breaking.

- **PE1002: General Relativity and Cosmology**
- The objective of this course is to make the student develop an understanding of-
- The concept of spacetime in the context of Einstein's Relativity
- Gravity as curving of spacetime
- Results like precession of orbits and black holes
- Cosmology and expansion of the universe
- Gravitational and cosmological redshift

PE1003: Experimental Techniques
After sucessful completion of this course student should have understanding of

- Vacuum technology
- Optical systems experimental techniques
- Detectors and its properties used for the experiments
- Particle detectors and radioactive Decay
- Basic electronics of the detectors

PE1004: CCD Imaging and Spectroscopy
After sucessful completion of this course student should have understanding of

- Importance of CCD, manufacturing and operations
- Characterization of charge-coupled devices
- Method of CCD imaging, Photometry and astrometry.
- Working principle of CCD Spectrograph and astronomical spectroscopy
- CCDs used in space and at short wavelengths

PE1005: Biophysics
After sucessful completion of this course student should have understanding of

- Mathematical Methods in Biophysics
- Quantum Mechanics Basic to Biophysical Methods
- Computational Modeling of Receptor–Ligand Binding and Cellular Signaling Processes
- Stochastic Simulation Algorithms used in biophysics
- Fluorescence Spectroscopy: Fundamental Process of Fluorescence
- Electrophysiological Measurements of Membrane Proteins

PE1006: Particle Physics

After studying this course, student should be able to:

- recognise and name the six flavours of lepton and the six flavours of quark.
- understand that all leptons and quarks have corresponding antiparticles
- appreciate that quarks and antiquarks combine to form baryons, antibaryons and mesons.
- write balanced strong interactions, understanding the role of gluons
- write balanced weak interactions, understanding the role of W and Z bosons

PT. RAVISHANKAR SHUKLA UNIVERSITY

Centre for Basic Sciences

Outcome Based Curriculum

Integrated M. Sc.: Mathematics Stream

[Choice and Credit Based System]

(Semester- I to X)

INDEX

Title of the Program: Integrated Master of Science in Mathematics

Program Educational Objectives:

PEO1: To have fundamental as well as applied knowledge of the various fields of Mathematics.

PEO2: To develop good practical knowledge of computational techniques using various programming languages and its application.

PEO3: To orient the students to be able to work in research organizations of national and international repute and become the top future scientists of the country.

PEO3: To promote the students to explore and foster connections with other fields for interdisciplinary knowledge.

PEO4: To develop world class Mathematics teachers who can understand their responsibilities in solving social and ethical issues with a scientific approach for the betterment of society.

Program Learning Outcomes:

PLO1: Students will have knowledge of fundamental as well as applied aspects of various fields of Mathematics along with the foundation of Physics, Chemistry, Biology and Programming Languages.

PLO2: Students will have the knowledge of Mathematical Foundations, Algebra, Analysis, Topology, Geometry, Statistics, Probability Theory and Stochastic Process, Discrete Mathematics along with Numerical Techniques and mathematical computing with applications in various areas.

PLO3: Students will develop skills for interdisciplinary research, critical thinking and problem solving ability.

PLO4: Students will be able to not only design model for real life problems but alsoanalyse and interpret the model independently.

PLO5: Activities like reading project, review writing, presentations will inculcate the abilities of better written as well as oral expression of the scientific work.

General Pattern of the Program:

Courses offered during the first year (Semesters I to II) are meant as basic and introductory courses in Biology, Chemistry, Mathematics, Physics and Environmental Science. These are common and mandatory for all students. These courses are intended to give a flavor of the various approaches and analyses and to prepare the students for advanced courses in later years of study. In addition, there will be Interdisciplinary Courses for computational skills using mathematical methods. Students are also given training to develop skills in Communication, Creative & Technical Writing and History of Science through courses in Humanities and Social Sciences.

In the second year (Semester - III), students have the freedom to choose their stream for masters program on the bases of their interest. Courses offered in the first two years would help them make an informed judgment to determine their real interest and aptitude for a given subject.

One of the important features that the CBS has adopted is semester-long projects called Lab Training / Theory projects, which are given the same weightage as a regular course. By availing this, a student can work in an experimental lab or take up a theory project every semester. This is meant to help the student get trained in research methodology, which will form a good basis for the 9th semester project work in the fifth year. The subjects/courses are described further with their credit points. Few courses are common to different streams.

Center for Basic Sciences
Pt. Ravishankar Shukla University, Raipur

Course structure for the M. Sc. (Integrated) Mathematics
w.e.f.1st July, 2015
(B: **B**iology, C: **C**hemistry, M: **M**athematics, P: **P**hysics, G: **G**eneral, H: **H**umanities,
BL: **B**iology **L**aboratory, CL: **C**hemistry **L**aboratory, PL: **P**hysics **L**aboratory,
GL: **G**eneral **L**aboratory, ME: **M**athematics**E**lective, MPr: **M**atheamtics**Pr**oject)

SemesterScheme

There shall be 10 semesters in Integrated M.Sc. Mathematics Course. Four out of Eight elective courses should be taken from the electivecoursesoffered.Credit points in each semester is indicated in the table below. **Minimum creditpoints**requiredtopasseachsemesteris**10.** Atotalof**minimum 100 creditpoints** isrequiredtoget **IntegratedM.Sc.degreeinMathematics**fromCenter for Basic Sciences.

Year	Semester	Subjects			Credit Points Min	Credit Points Max	Cumulative Credit Points
		Theory	Practical	Project			
1st Year	Sem.I	5(x3)+ 1(x2)= 18	4(x2)= 08	----	10	25	25
	Sem.II	5(x3)+ 1(x2)= 18	4(x2)= 08	----	10	25	50
2nd Year	Sem.III	5(x4)+2(x2)=24	1(x1)= 01	----	10	25	75
	Sem.IV	5(x4)= 20	1(x4)+1(x1) = 05	----	10	25	100
3rd Year	Sem.V	6(x4)= 24	1(x1)= 02	----	10	25	125
	SemVI	5(x4)+1(x2)=22	1(x3)=03	----	10	25	150
4th Year	SemVII	5(x4)= 20	----	05	10	25	175
	SemVIII	5(x4)= 20	----	05	10	25	200
5th Year	SemIX	----	----	20	10	20	220
	SemX	ElectivePapers 4(x5)=20	----	----	10	20	240
Total CreditPoints							**240**
MinimumCreditPointsRequiredtogetM.Sc.degreein Mathematics							**100**

FIRST YEAR

SEMESTER –I

Subject Code	Subject	Contact Hours / Week Theory +Tutorials	Credits
B101	Biology – I	[2 + 1]	3
C101	Chemistry – I	[2 + 1]	3
M100/101	Mathematics – I	[2 + 1]	3
P101	Physics – I	[2 + 1]	3
G101	Computer Basics	[2 + 1]	3
H101	Communication Skills	[2 + 0]	2
		Contact Hours / Week Laboratory	
PL101	Physics Laboratory – I	[4]	2
CL101	Chemistry Laboratory – I	[4]	2
BL101	Biology Laboratory – I	[4]	2
GL101	Computer Laboratory	[4]	2
		Semester Credits	**25**
		Subtotal	**25**

SEMESTER –II

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
B201	Biology – II	[2 + 1]	3
C201	Chemistry – II	[2 + 1]	3
M200/201	Mathematics – II	[2 + 1]	3
P201	Physics – II	[2 + 1]	3
G201	Electronics and Instrumentation	[2 + 1]	3
G202	Glimpses of Contemporary Science	[2 + 0]	2
		Contact Hours / Week Laboratory	
PL201	Physics Laboratory – II	[4]	2
CL201	Chemistry Laboratory – II	[4]	2
BL201	Physics Laboratory – II	[4]	2
GL201	Electronics Laboratory	[4]	2
		Semester Credits	**25**
		Subtotal	**50**

SECONDYEAR

SEMESTER–III

Subject Code	Subject	ContactHours/ Week Theory+Tutorials	Credits
M301	Foundations	[3+1]	4
M302	Analysis I	[3+1]	4
M303	AlgebraI	[3+1]	4
M304	DiscreteMathematics	[3+1]	4
M305	ComputationalMathematicsI	[3+1]	4
H301	WorldLiterature	[2+0]	2
H302	HistoryandPhilosophyofScience	[2+0]	2
		LabHoursperWeek	
GL301	ComputationMathematics Laboratory	[2]	1
		Semester Credits	**25**
		Subtotal	**75**

SEMESTER–IV

Subject Code	Subject	ContactHours/ Week Theory+Tutorials	Credits
M401	Analysis II	[3+1]	4
M402	Algebra II	[3+1]	4
M403	Elementary Number Theory	[3+1]	4
M404	Topology I	[3+1]	4
G401	Statistical Techniques andApplications	[3+1]	4
		LabHoursperWeek	
GL401	Computational Laboratory & Numerical Methods	[8]	4
GL402	Statistical Techniques Laboratory	[2]	1
		Semester Credits	25
		Subtotal	**100**

THIRDYEAR

SEMESTER–V

Subject Code	Subject	ContactHours/ Week Theory+Tutorials	Credits
M501	Analysis III	[3+1]	4
M502	Algebra III	[3+1]	4
M503	Topology II	[3+1]	4
M504	Probability Theory	[3+1]	4
G501	Earth Science & Energy & Environmental Sciences	[3+1]	4
PM501	Numerical Analysis	[3+1]	4
		LabHoursper Week	
PML501	Numerical Methods Laboratory	[2]	1
		Semester Credits	**25**
		Subtotal	**125**

SEMESTER–VI

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
M601	Analysis IV	[3+1]	4
M602	Algebra IV	[3+1]	4
M603	Differential Geometry & Applications	[3+1]	4
M604	Differential Equations & Dynamical Systems	[3+1]	4
M605	Computational Mathematics II	[3+1]	4
PM601	Ethics of Science and IPR	[2+0]	2
		LabHoursper Week	
PML601	Numerical Methods Laboratory	[6]	3
		Semester Credits	**25**
		Subtotal	**150**

FOURTHYEAR

SEMESTER–VII

Subject Code	Subject	ContactHours/ Week Theory+Tutorials	Credits
M701	Functional Analysis	[3+1]	4
M702	Commutative Algebra	[3+1]	4
M703	Differential Topology	[3+1]	4
M704	Partial Differential Equations	[3+1]	4
M705	Representation Theory of Finite Groups	[3+1]	4
MPr701	Project		5
		Semester Credits	**25**
		Subtotal	**175**

SEMESTER–VIII

Subject Code	Subject	ContactHours/ Week Theory+Tutorials	Credits
M801	Fourier Analysis	[3+1]	4
M802	AlgebraicNumber Theory	[3+1]	4

M803	Algebraic Topology	[3+1]	4
M804	Stochastic Analysis	[3+1]	4
M805	Computational Mathematics III	[3+1]	4
MPr801	Project		5
		Semester Credits	**25**
		Subtotal	**200**

FIFTHYEAR

SEMESTER–IX

Subject Code	Subject	ContactHours/ Week Theory+Tutorials	Credits
MPr901	Project		20
		Semester Credits	**20**
		Subtotal	**220**

SEMESTER–X

Subject Code	Subject	ContactHours/ Week Theory+Tutorials	Credits
ME1001	Elective 1	[4+1]	5
ME1002	Elective 2	[4+1]	5
ME1003	Elective 3	[4+1]	5
ME1004	Elective 4	[4+1]	5
		Semester Credits	**20**
	Total Credits (with 4 Electives)		**240**
	Minimumrequired		**240**

FIRSTYEAR

SEMESTER–I

B 101: Biology I (Introductory to Biology)

Unit-I
Life: History and origin of life, Concepts of biological evolution, natural selection, speciation. Classification of living things: Classification and domains of life, Prokaryotes and Eukaryotes, Taxonomy of plants, animals and microorganisms.

Unit-II
Ecology & Ecosystem: Concept of ecology and ecosystem, ecological succession, ecosystem dynamics, flow of ecology and matter, biogeochemical cycling, ecosystem changes, biotic and biotic factors and stresses, food web, adaptation of individual organism to the environment through genetic
changes.

Unit-III
Cell Biology: Discovery of cell, cell theory, classification of cell types, cell membrane, cell-cellinteractions, energy and metabolism, respiration, photosynthesis, sexual reproduction.

Unit-IV
Cell Division and System Development: cell cycle, mitosis, meiosis, mechanism of development (stem cells), formation of tissues.

Unit-V
Physiology- Body Systems: Digestive system, circulatory system, Lymphatic system, nervous system, respiratory system, sensory system, homeostasis.

Books Recommended:

S.No.	Author	Book
1	Neil A Campbell and JB Reece (2007)	Biology with Mastering Biology (8^{th} Edition)
2	NA Campbell, JB Reece, MR Taylor and EJ Simon (2008)	Biology: Concepts & Connections with biology (6^{th} Edition)
3	Charles Darwin (2008)	On the Origin of Species
4	B Alberts, D Bray, K Hopkin and AD Johnson (2009)	Essential Cell Biology
5	Rene Fester Kratz (2009)	Molecular and Cell Biology For Dummies
6	MJ Behe (2006)	Darwin's Black Box: The Biochemical Challenge to Evolution
7	SD Garber (2002)	Biology: A Self-Teaching Guide, (2^{nd} Edition)

C 101: Chemistry –I [Structure & Bonding]

Unit-I
Atomic spectra, Bohr's theory of atomic structure, Sommerfeld's theory for complex electron spin and magnetic quantum number, Pauli exclusion principle, Hund's rule, electron configuration of elements, Sequence of energy levels and Periodic Table.

Size of atoms and ions, ionization energy, electron affinity, electronegativity – values by Pauling, Mulliken and Allred-Rochow, Metallic character, variable valence and oxidation states, horizontal, vertical and diagonal relationships in the periodic table.
Atomic Nucleus: Fundamental particles, classification of nuclides, nuclear stability, the neutron to proton ratio N/Z,

nuclear potential, binding energy, exchange force. Radioactivity and radioactive elements, radioactive decay and decay kinetics.

Unit-II

The covalent bond - the Lewis theory, Octet rule and its limitations. Shapes of the molecules –Sidgwick – powel theory. Valence shell electron pair (VSEPR) theory, effect of lone pair and electronegativity, isoelectronic principle, examples to apply VSEPR theory. Valence bond theory. Hybridization. Bond length, bond angle & dihedral angle, d-orbital participation in molecular bonding, sigma and pi bonding. Molecular orbital method – Linear combination of atomic orbitals (LCAO), MO treatment for di- and tri-atomic molecules and involving delocalized pi-bonding. Conjugation & aromaticity.

Unit-III

Metallic and organometallic bonds – general properties. Coordinate bond- coordination complexes. Physical properties and molecular structures – polaizability and dipole moments, melting point, solubility and acid-base properties, Intermolecular forces (dipole-dipole interaction) Hydrogen bonding and vander Waals's forces.

Unit-IV

Inductive and field effects and bond dissociation energy. $p\pi$-$d\pi$ bonding.
Delocalization –cross conjugation, resonance. Aromaticity and Huckel's rule – systems of 4n and 4n+2 electrons, antiaromaticity . Resonance and Hyperconjugation.
Reaction mechanism: Types of mechanisms, Arhenius theory, collision theory, types of reactions, redox reactions, displacement and addition reactions, thermodynamic and kinetic requirements.

Unit-V

Hammond postulate, Curtin-Hammett principle, transition states and intermediates, carbocations, carbanions, free radicals, methods of determining mechanisms, isotopic effects.
General concepts: Oxidation number and oxidation states, Oxidation – reduction reactions and the use of reduction potential, Bronsted acids and bases, gas phase vs. solution acidity, solvent levelling effects, hardness and softness, surface acidity.

Books Recommended:

S.No.	Author	Book
1	J.D.Lee	Concise Inorganic Chemistry, 4th Edition, ELBS, 1991
2	P.W.Atkins	Physical Chemistry, Oxford University Press, 7th Edition, 2006
3	G.M.Barrow	Physical Chemistry, 5th Edition, Tata McGraw-Hill, 1992
4	R. T. Morrison, R. N. Boyd, P. Sykes	Organic Chemistry, Prentice Hall of India
5	G.W. Castellan	Physical Chemistry, 3rd Ed. Addison - 1993

P 101 Physics- I (Classical Physics)

Unit-I

Concepts of energy and mass, Linear kinematics and dynamics. Concept of force: Conservative and non-conservative forces, Friction. Conservation of momentum, energy, and angular momentum. Work-energy theorem, Centre of mass, moment of inertia.

Unit-II

Rotational kinematics and dynamics, Rigid body motion. Impulse and collisions, Central forces, Kinetic theory of gases, Equipartition of energy.

Unit-III

Free oscillations in one, two, and many degrees of freedom. Linearity and superposition principle. Normal modes; Transverse and longitudinal modes

Unit-IV

General notion of a continuous string; Resonance; Coupled pendula and oscillators, Normal coordinates.

Unit-V
Probability (chance, fluctuations, random walk, probability distribution, uncertainty principle); Curvilinear Coordinates, Vector calculus (differentiation and integration, gradient, divergence, curl, Green's theorem, Gauss' theorem, Stokes' theorem); Fourier series (an introduction).

Books Recommended:

S.No.	Author	Book
1	R. P. Feynman, R. B. Leighton, M. Sands	The Feynman lectures in Physics" Volume-1
2	D. Kleppner and R. Kolenkow	An introduction to mechanics
3	C. Kittel, W. D. Knight and M. A. Ruderman	Mechanics [Berkeley Physics CourseVol. 1]
4	F. S. Crawford	Waves [Berkeley Physics Course Volume 3]

MB 101: Mathematics – 1

Unit-I
The idea of derivative of a function, polynomials, slope and tangent line, derivatives of trigonometric functions, product and quotient rules. Notion of limits and continuous functions. Elementary results pertaining to limits of functions: product and quotient rules. Higher order derivatives, examples. Maxima and minima, curve tracing, Conic sections: circle, ellipse, hyperbola and parabola; equations, focus, directrix, latus rectum. Generalised conic section equation, exponential and logarithmic functions and theirderivatives.

Unit-II
Application of derivatives to root finding: Newton's method (to be supplemented by an introduction to iterative processes). Mean value theorem of differential calculus, Rolle's theorem, applications. l'Hôpital's rule. The chain rule of differentiation, Implicit differentiation, Inverse functions and their derivatives, Inverse trigonometric functions, Applications.
Concept of infinite series, Geometric series, convergence tests; Taylor series, Maclaurin series for elementary functions, power series, simple applications.

Unit-III
Notion of an integral, integral as limit of sums; anti-derivatives, area under a curve, definite integrals, indefinite integrals. Rules of integration: integration by parts, integration by substitution. Properties of definite integrals including mean value theorem for integral calculus. Fundamental theorem of integral calculus. Integrals involving polynomial, exponential, logarithmic, trigonometric, inverse trigonometric functions. Application of integrals to areas, length of a plane curve, volumes of solids ofrevolution.

Unit-IV
Complex numbers: real and imaginary parts, The complex plane, Complex algebra (complex conjugate, absolute value, complex equations, graphs, physical applications). Elementary functions of complex numbers, Euler’s formula, Powers and roots of complex numbers. The exponential and trigonometric functions, Hyperbolic functions, Logarithms, Complex roots and powers, Inverse trigonometric and hyperbolic functions, Some applications.

Unit-V
Separable equations, Linear first order equations, Other methods for first order equations, Second order linear equations with constant coefficients and both zero and non-zero right hand side, Other second order equations.

Books Recommended:

S.No.	Author	Book
1	Gilbert Strang (MIT Courseware)	Calculus
2	M. Weir, J. Hass and F. R. Giordano (Pearson Education)	Calculus

H 101: Communication Skills

Unit-I
An interactive session (with examples) on what is communication, communication in the natural and civilized worlds, types of human communication: visual / non-verbal / verbal, written / spoken, etc

Unit-II
An overview of mass media; a brief discussion of their types (with examples). The concepts of facilitating factors, barriers, and filters in communication; the seven C's of effective communication.

Unit-III
Verbal communication: How to speak / listen effectively (in interpersonal communication), types of public speaking, tips for effective public speaking, how to make effective presentations. The role of written text in communication,

Unit-IV
Types of writing (academic/creative/general; formal/informal etc.) with examples of good/bad writing and their analysis.Introduction to letter writing, with stress on formal correspondence; email do's and don'ts.

Unit-V
Academic writing- an overview; explanation of various terms used in academic writing; parts of a paper/thesis; aspects such as formal language, grammatical accuracy, etc. Common grammatical/punctuation errors and how to avoid them (example-based instruction)

G101: Computer Basics

Unit-I
Introducing LINUX: getting started;

Unit-II
FORTRAN programming

Unit-III
LaTeX introduction (sufficient to make small documents); gnuplot - graph plotting and data fitting; xfig - simple drafting tool; MATHEMATICA - algebraic computations.

Unit-IV Projects on:
Some of the projects done by the students are listed below; Predator-prey problem; Harmonic oscillator with friction Coupled pendulum

Unit-V
Projects on:
Testing random number generator; Brownian motion as a random walk problem; Sorting function and its application to making ranked lists, SUDOKU solver

BL 101 Biology laboratory

1) Introduction to Biologylaboratory
2) Taxonomy
3) Methods ofClassification
   Dichotomous key; Hierarchical Classification; Phylogenetic Classification
4) NaturalSelection
5) Natural Selection usingDaphnia
6) Concept of pH &Buffers:
   Hydrogen ion concentration in solution; Inorganic ion concentration in solutions
   Inorganic Buffers and Biological fluids; Henderson-Hesselbach equation
7) MediaPreparation:
   Preparing and inoculating solid and liquid nutrient media for culturing microorganisms Pouring

nutrient agar plates and streaking bacterial culture on solid media Inoculating nutrient broth with bacterial culture Preparing nutrientmedia

8) Introduction to ResearchLaboratory

Different kinds of microbial plates, liquid growth media for microbes, Laminar air flow system, stem cells laboratory, Centrifuges, Spectrophotometer, Sonicator, PCR and Real-time PCR, Gel Documentation system, *Chlamydomonas* and *Drosophila* incubation systems, Stereomicroscope and various Incubators

9) Growth Curve:

Generating a bacterial growth curve under various pH and environmental conditions (steady and shaking); Calculations of Growth rate constant (μ); Calculation of generation time

10) EnzymeKinetics:Tostudyanenzymecatalyzedreactionusinghydroquinoneasasubstrateand peroxidase extracted fromcabbage.

11) IntroductiontoLightMicroscopy:Observingcellsinaleafpeelusingacompoundmicroscopeand to study the morphological characteristics of *Saccharomycescerevesiae.*

12) Dye exclusion method of differentiating dead v/s live cells: To use a vital stain to distinguish dead and live yeastcells.

13) Staining and Observing human cheek cells: To carry out staining of epithelial cells from the mouth using acetocarmine and methylene bluestains.

14) Staining human blood cells: To observe human blood cell types by differentialstaining.

15) Plant anatomy: Relationship between plant anatomy andhabitat.

16) Micrometry: Measuring size of a microscopicspecimen.

17) Haemocytometer

18) Gram Staining: To differentiate bacteria cells by Gramstaining.

CL 101: Chemistry Laboratory

Calibrations of pipette, burette, standard flasks etc., acid base titrations, recrystallization, thin layer chromatography, identification of organic functional groups, complexometric titrations based on EDTA complexation with metals, Synthesis of benzoic acid, diazotization etc.

Books Recommended:

S.No.	Author/Book
1	Vogel's Textbook of Quantitative Chemical Analysis (5th Edition; Longmann)
2	Vogel's Qualitative Inorganic Analysis (7th Edition)
3	ACS Journal of Chemical Education

PL 101: Physics Laboratory -I

Introduction to experimental physics – conceptual and procedural understanding, planning of experiments; Plots (normal, semi-log, log-log); uncertainty / error in measurements and uncertainty / error analysis.
Introduction to measuring instruments – concepts of standards and calibration; determination of time periods in simple pendulum and coupled strip oscillator system with emphasis on uncertainty in the measurements and accuracy requirements; study of projectile motion – understand the timing requirements; determination of surface tension of a liquid from the study of liquid drops formed under the surface of a glass surface; determination of Young's modulus of a strip of metal by double cantilever method (use of traveling microscope); study of combination of lenses and nodal points and correspondence to a thick lens; study of thermal expansion of metal – use of thermistor as a thermometer; measurement of small resistance of a wire using Carey-Fosterbridge and determine electrical resistivity of the wire; study of time dependence of charging and discharging of capacitor using digital multimeter –use of semi-log plot.

Books Recommended:

S.No.	Author	Book
1	Worsnop and Flint	Advanced Practical Physics for Students

GL 101 Computer Laboratory

History of computers; hardware basics. Concept of operating system; basic Unix/Linux commands; Office suite, including spreadsheets.
Flowcharts; computer arithmetic. Simple FORTRAN programming mathematical operators, input, output from keyboard, library functions.
Conditional statements - If-thenelse, Case, Go-to. Loops- Do loops, cycle, exit, nested loops. Arrays- 1 dimensional and multidimensional.
Formatting - input and output. Input and output from file.
Functions and Subroutines.; Creating HTML pages; Plotting utilities like GNU Plot.

MB101:Mathematics–1(ForBiologyStream)

Unit-I The idea of derivative of a function, polynomials, slope and tangent line, derivatives of trigonometricfunctions,productandquotientrules.Notionoflimitsandcontinuousfunctions.

Elementaryresultspertainingtolimitsoffunctions:productandquotientrules.Higherorderderivatives, examples.Maximaandminima,curvetracing,Conicsections:circle,ellipse,hyperbolaandparabola; equations,focus,directrix,latusrectum.Generalisedconicsectionequation,exponentialandlogarithmic functionsandtheirderivatives.

Unit-II Application of derivatives to root finding: Newton's method (to be supplemented by an introduction toiterativeprocesses).Meanvaluetheoremofdifferentialcalculus,Rolle'stheorem, applications.l'Hôpital'srule.The chainrule ofdifferentiation,Implicitdifferentiation,Inversefunctionsand theirderivatives,Inversetrigonometricfunctions,Applications.

Conceptofinfiniteseries,Geometricseries,convergencetests; Taylorseries,Maclaurinseriesfor elementaryfunctions,powerseries,simpleapplications.

Unit-III Notionofanintegral,integralaslimitofsums;anti-derivatives,areaunderacurve,definite integrals, indefinite integrals. Rules of integration: integration by parts, integration by substitution. Propertiesofdefiniteintegralsincludingmean value theoremforintegralcalculus.Fundamentaltheoremof integralcalculus.Integralsinvolvingpolynomial,exponential,logarithmic,trigonometric, inverse trigonometricfunctions.Application ofintegralstoareas,lengthofaplanecurve,volumesofsolidsof revolution.

Unit-IV Complexnumbers:realandimaginaryparts,Thecomplexplane,Complexalgebra(complex conjugate,absolutevalue,complexequations,graphs,physicalapplications). Elementaryfunctionsof complexnumbers,Euler'sformula,Powersandrootsofcomplexnumbers.Theexponential and trigonometricfunctions,Hyperbolic functions,Logarithms, Complexrootsandpowers,Inverse trigonometricandhyperbolicfunctions,Someapplications.

Unit-V Separableequations,Linearfirstorderequations,Othermethodsforfirstorderequations,Second orderlinearequationswithconstantcoefficientsandbothzeroandnon-zerorighthandside,Other secondorderequations.

SuggestedTextsandReferences:

1)Calculus:GilbertStrang(MITCourseware)
2)Calculus:M.Weir,J.HassandF.R.Giordano(PearsonEducation)

M101: Mathematics – I(ForPhysics,Mathematics&ChemistryStream)

Unit-I **Introductiontocoordinategeometry:**Equationofastraightlineandcircle.Introduction totrigonometry(includingadditionformulasforsineandcosine)throughcoordinategeometry.AP andGPandinequalitiesofthemean.Binomialtheoremforintegerpowers.

Unit-II **Complexnumbers:**real and imaginaryparts, the complex plane, complex algebra (complexconjugate, absolutevalue,complexequations, graphs,physicalapplications). ConsequencesofEuler'sformula.

Unit-III Theideaofderivativeofafunction,effectsofsmallchanges,slopeandtangentline, derivativesofpolynomialsandtrigonometricfunctions,productandquotient rules.Notionoflimits andcontinuous functions.Higherorderderivatives, examples.Maximaandminima.Graphical representationof elementaryfunctionssuch as polynomials,conics, trigonometricfunctions, exponentials, logarithmsandthesawtoothfunctions.Inversefunctionsandtheirgraphical representations. Derivativesofexponential,hyperbolicandlogarithmicfunctions.Applicationof derivativestorootfinding:Newton–Raphsonmethod.Thechainruleofdifferentiation, implicit differentiation,inversefunctionsandtheirderivatives.

Unit-IV Conceptofsumofinfiniteseries,geometric series,harmonic series,simpleconvergence tests.Taylorseries,applications toelementaryfunctions,binomialexpansionfornon-integral powers.Notionofanintegral,integralaslimitofsums;anti-derivatives,areaunderacurve,definite integrals,indefiniteintegrals.Rulesofintegration:integrationbyparts,integration bysubstitution. Propertiesofdefiniteintegrals.Integralsinvolvingelementaryfunctions.Application ofintegralsto areasandvolumesofsolidsofrevolution.

Unit-V Systemoflinearequations,notionofamatrix,determinant.Simplepropertiesofmatrices andtheirinverses.Examplesofinverting2X2and3X3matrices.Elementarydiscussionon scalarsandvectors,normofavector,dotproduct,projections, crossproduct,tripleproducts, applicationstoareasandvolumes.

SuggestedTextsandReferences:

1. Calculus,GilbertStrang(MITCourseware)http://ocw.mit.edu/resources/res-18-001-calculus-online-textbook-spring-2005/textbook/
2.Thomas'Calculus,11thEdition,M.Weir,J.HassandF. R.Giordano,Pearson

Education.
3.MathematicalMethodsinthePhysicalSciences,3rdEd.,MaryL.Boas,WileyStudentEd., WileyIndia(Reprint)2009(forcomplexnumbersanddifferentialequations)
4.ElementaryLinearAlgebra,10thEd.,HowardAntonandChrisRorres,Wiley,2011.
5.IntroductiontoLinearAlgebra,4thEdition,GilbertStrang,WellesleyCambridgePress, 2009.

M101:Mathematics–I(ForPhysics, Mathematics&ChemistryStream)

Unit I Numbers,Functionsand Sequences:RealNumbers,Functions,Sequences–Convergent, BoundedandMonotone,Limittheorems.LimitandContinuity:Limitofafunctionatapoint, Continuityoffunctions,Discontinuitiesoffunctions,Propertiesofcontinuousfunctions. Differentiation: Differentiation, Chainrule,Successivedifferentiation, Rolle’sTheoremandmean valuetheorem.

UnitII Maxima,MinimaandCurveSketching: Sufficientconditionsforafunctiontobe increasing/decreasing,Sufficientconditionsforalocalextremum,Absolute minimum/maximum, Convex/concavefunctions,Asymptotes,Curvesketching.
Integration: Integral from upper and lower sums, Integral as a limit of Riemann sums, Fundamental theoremofcalculusanditsapplications. LogarithmicandExponentialfunctions: Logarithmic functions,Exponential functions,Powerfunctions,l'Hôpital'srule.Applications of Integration:Arclengthofaplanecurve,Arclengthofaplanecurveinparametric form,Areaofa surfaceofrevolution,Volumeofasolidofrevolutionbyslicing,bythewashermethodandbythe shellmethod.

Unit-III LimitandContinuity ofScalarFields:Spaces**R^2andR^3**,Scalarfields,levelcurvesand contourlines,Limitofascalarfield,Continuityofascalarfield,Propertiesofcontinuous scalar fields. DifferentiationofScalarFields:Partialderivatives,Differentiability, Chainrules,Implicit differentiation, Directionalderivatives,Gradientofascalarfield,Tangentplaneandnormaltoa surface,Higherorderpartialderivatives, Maximaandminima,Saddlepoints,Secondderivative testformaxima/minima/saddlepoints.VectorFields:Vectorfieldsandtheirproperties,Curvesin space,Tangentvector,Basicideaofdivergenceandcurl.

Unit-IV ComplexNumbers:Realandimaginaryparts,Thecomplexplane,Complexalgebra (complexconjugate, absolutevalue,complexequations, graphs,physicalapplications), Elementary functions of complex numbers, Euler’s formula, Powers and roots of complex numbers, The exponential and trigonometric functions, Hyperbolic functions, Logarithms, Complexrootsandpowers,Inversetrigonometricandhyperbolicfunctions,Someapplications.

UnitV OrdinaryDifferential Equations:Separable equations,Linearfirstorderequations, Other methodsforfirstorderequations, Secondorderlinearequationswithconstantcoefficients and bothzeroandnon-zero righthandside,Othersecondorderequations, TheLaplacetransform, Solutionofdifferentialequationsby Laplacetransforms.

SuggestedTextsandReferences:
1.Calculus@iitb–Concepts,ExamplesandQuizzes,InderK. Rana,Version2,2010 (Math4all).
2.IntroductiontoRealAnalysis,3rdEd.,RobertG.BartleandDonaldR.Sherbert,Wiley
3. StudentEd.,WileyIndia(4thReprint)2007.

4.MathematicalMethodsinthePhysicalSciences,MaryL.Boas,3rdEdition,WileyStudent Ed.,WileyIndia(Reprint)2009(forcomplexnumbersandordinarydifferentialequations).

SEMESTER–II

B 201: Biology –II [Introduction to Macro Molecules]

Unit-I

Cell – Overview: Cellular organization, Biomembranes, Nucleus, Cytoplasmic organelles, Bacteriophages. Nucleic Acids, Genomes and Proteomics: Building blocks- nucleotides, DNA structure, RNA structure and function, chromatin structure, genome code, genes, repetitive DNA sequences.

Unit-II

Gene Transcription: Overview of gene expression, overview of transcription, gene's regulatory elements, transcription mechanisms in prokaryotes and eukaryotes (a comparison).

Unit-III

Protein Structure and Function: Building blocks- amino acids, peptides, secondary structure, three dimensional structure, membrane proteins, miscellaneous proteins, enzymes.

Unit-IV

Cell Signaling: Overview, signaling via hydrophobic molecules, signaling via ion channels, Signaling via G-protein coupled receptors, signaling via cell surface enzymes, intracellular signaling.

Unit-V

Biotechnology: DNA cloning, Uses of recombinant DNA technology, Polymerase chain reaction (PCR), Production of recombinant proteins and SDS-PAGE.

Books Recommended:

S.No.	Author	Book
1	B Alberts, A Johnson, J Lewis, and M Raff	Molecular Biology of the Cell
2	J D. Watson, T A. Baker, S P. Bell, & A Gann	Molecular Biology of the Gene (6th Edition)
3	John Wilson and Tim Hunt (2007)	Molecular Biology of the Cell: The Problems
4	Benjamin Lewin (2007)	Genes IX (Lewin, Genes XI)

C 201: Chemistry- II [Chemical Thermodynamics]

Unit-I

Classification of system, intensive and extensive properties, equilibrium and Heat, work and energy, irreversible and reversible expansion work of an ideal First law of thermodynamics, heat content or enthalpy of a system; Thermochemistry – Enthalpy of a reaction, exothermic and endothermic

Unit -II

Second law of thermodynamics, Carnot cycle, entropy, entropy change and Free energy functions and Maxwell's relations, Gibb's Helmholtz relations, nonequilibrium states, reversible and irreversible processes. gas, internal energy in a cyclic process. heat capacities, Joule- Thomson effect, Adiabatic expansion of an ideal gas and work done. reactions, thermochemical equation, Kirchoff's equation, heat of reaction and flame temperature, heat of combustion, heat of solution, heat of neutralization, heat of fusion, heat of vaporization, Bond energy and dissociation energy, Hess's law and its applications. irreversible processes and Clausius inequality, entropy and available work. criteria of spontaneity and conditions of equilibrium, Heat capacity relations (C_p/C_v and $C_p – C_v$), change of phase and Clapeyron equation, Trouton's rule.

Unit -III
Electrode potential and free energy, electrochemical series. Nernst heat Theorem and third law of thermodynamics, experimental Elements of statistical thermodynamics

Unit -IV
Chemical equilibrium and chemical potential (μ): chemical potential of an determination of entropy. ideal gas and gas mixture, Gibbs free energy and entropy of mixing, Chemical Phase equilibrium in simple systems: Equilibrium condition, stability of the Ideal solutions and colligative properties: ideal solutions, chemical potential equilibrium in a mixture of ideal gases and real gases, Equilibrium constants – Kx and Kc between ideal gases and pure condensed phase. Lechatelier principle and applications. phases of a pure substance, pressure dependence of μ vs. T curves, Clapeyron equatons.

Unit -V
Phase equilibrium: solid- liquid, liquid-gas, solid-gas, phase diagram – water, carbondioxide, sulphur, Effect of pressure on the vapour pressure, the phase rule. of a solute in a binary ideal solution – Gibbs-Duhem equation, Colligative properties – freezing pointing depression, solubility, elevation of boiling point, Osmotic pressure, Vant Hoff equation.

Books Recommended:

S.No.	Author	Book
1	P.W. Atkins	Physical Chemistry, Oxford University Press, 7th Edition, 2006
2	G.W. Castellan	Physical Chemistry, 3rd Ed. Addison - Wesley/Narosa Publishing House, 1993
3	G.N.Lewis and Randall	Thermodynamics, (Revised by K.S.Pitzer and L.Brewer), International Students Edition,
4	K. Denbigh	The principles of Chemical Equilibrium
5	B. G. Kyle	Chemical & Process Thermodynamics

P 201: Physics – II: [Electricity, Magnetism and Optics]

Unit-I
Electrostatics: Coulomb's law and Gauss' law; Electrostatic potential, uniqueness theorem, method of images; Electrostatic fields in matter; Conductors and insulators; Capacitors and capacitance; Electric current.

Unit-II
Magnetostatics: Biot – Savart law, Ampere's law; Electromagnetic induction; Mutual inductance and self inductance; Magnetic fields in matter.

Unit-III
Displacement current; Maxwell's equations; Alternating current circuits; Electric and magnetic properties of matter; Plane electromagnetic waves in vacuum; Polarisation;

Unit-IV
Energy and momentum in electromagnetic waves; electromagnetic radiation (qualitative); Dipole radiation formula; Larmor's formula for radiation due to accelerated charge (without proof); Synchrotron radiation (descriptive).

Unit-V
Optics Interference of two beams and involving multiple reflections; Young's experiment, Fresnel's biprism, Lloyd's mirror, Optical instruments; Telescope and microscopes; Magnifying power and resolving power.Sources of light and spectra; Dispersion, polarization, double refraction; Optical activity.

Books Recommended:

S.No.	Author	Book
1	Edward M. Purcell	Electricity and Magnetism Berkeley Vol. 2
2	Frank S. Crawford	Waves, Berkeley Vol. 3
3	Jenkins and White	Fundamentals of Optics

4	Feynman	Feynman Lectures Vol. 2

G201- Electronics & Instrumentation

Unit-1
Analog electronics: Introduction to passive electronic components -resistance, capacitance, inductance; Circuit theorems: Thevenin's theorem, Norton's theorem and Maximum power transfer theorem; basic concepts of semiconductor diode and transistor; application of Bipolar Junction Transistor (BJT) – biasing circuits: The CE configuration, fixed base bias, emitter bias, and potential-divider or voltage divider bias; CE amplifier, amplifier as a switch, concept of negative feedback.

Unit-2
Principle of DC power supply; half and full wave bridge rectifier, capacitor filter – ripple factor, concept of load and line regulation, concept of constant voltage source and constant current source; concept of short circuit protection and current limit protection; Zener regulator; concept of Switch Mode Power Supply (SMPS), power supply ICs, charge pump ICs for stepping up voltage and for bipolar supply.

Unit-3
Differential amplifier; Operational Amplifier (OPAMP): principle, basic characteristics and parameters relevant for general use; non-inverting and inverting amplifier, voltage follower, difference amplifier, summing amplifier, voltage controlled current source; OPAMP comparator, Schmidt trigger; Digital to Analog Converter (DAC) with weighted resistance and R-2R ladder network; Anlog to Digital Converter (ADC); filters: low pass, high pass; band pass; Butterworth filter.

Unit-4
Digital electronics: Review of basic logic gates; DeMorgan's theorem, Use of NAND / NOR as universal building blocks; arithmetic circuits; binary addition, half adder, full adder, binary subtraction - 1s and 2s complement, controlled inverter, adder / subtracter, parity checker; Flip-Flops (FF): RS-FF, D-FF, JK-FF; counters and shift registers: binary counter, ripple counter.

Unit-5
Basic concepts of instrumentation, generalized instrumentation systems block diagram representation; Sensingelements:electrodesandtransducers.Electrode-electrolyteinterface,stabilityofelectrodepotentials, circuit models, external and internal electrodes, pH, pO2 and pCO2 electrodes. Transducer, definition, types, displacement, velocity, acceleration, pressure, temperature vibration, ultrasound etc., calibration, sensitivity andresolution.
Books Recommended:

S.No.	Author	Book
1	R. L. Boylestad, L. Nashelsky, K. L. Kishore, Pearson	Electronic Devices and Circuit Theory
2	Malvino and Bates	Electronic Principles
3	Donald A. Neamen, Tata McGraw Hill	Electronic Circuit Analysis and Design
4	David A. Bell	Electronic Devices and Circuits
5	Leach, Malvino and Saha	Digital Principles and Applications
6	R.P. Jain	Modern Digital Electronics, Tata McGraw-Hill (2003)
7	M. Morris Mano, Michael D. Ciletti	Digital Design, Pearson Education Asia, (2007)
8	Thomas L. Floyd	Digital Fundamentals, Pearson Education Asia (1994)
9	DVS Murthy	Measurement & Instrumentation
10	A.K. Sawhney	Electrical Measurements & Electronic Measurements

G202- Glimpses of Contemporary Science

Unit-I

Physics in life systems: size and scale, diffusion, cell locomotion, force generated by actin growth and flagellum rotatory motion, ion channels, resting potential across the membrane, nerve conduction velocity, action potential, macromoleculaes of life, random walk model of polymer, single molecular experiments, optical tweezers, magnetic tweezers.

Unit-II

Complex systems: dynamical chaos, logistic map, bifurcation, Universality, Feigenbaum constants, Mechanical demonstrations of chaos, Nanomechanical oscillators, Patterns, Reaction-diffusion systems, Nodal patterns, thermodynamics and human population, Falling leaves, Smoke ring physics.

Unit-III

At the turn of 1900: Silver threads, Discovery of the electron, Rutherford's nuclear atom Wien's law, Blackbody radiation and Max Planck's action.

Unit-IV

Astrophysics, Astrochemistry and Astrobiology

Unit-V

Quantum mechanics, atoms : Entanglement Light-atom interaction, Bringing atoms to rest, Laser tweezers, How bright is laser, Quantum computing.

Books Recommended:

S.No.	Author	Book
1	Darcy Wentworth Thompson	Growth and Forms
2	Rob Phillips	Physical biology of the cell
3	Harward Berg	Random walks in biology
4	L. Cooper	Physics: Structure and Meaning
5	R. P. Feynman, R. B. Leighton, and M. Sands	The Feynman Lectures on Physics vol. 3
6	S. Chandrasekhar	Introduction to the study of stellar structure

BL 201: Biology Practical

1. Observing instruments to be used in semester II, their use and maintenance: (a) micro-pipettes, (b) tissue homogenizer, (c) electrophoresis apparatus, (d) centrifuges, (e) ultraviolet and visible (uv-vis) absorptionspectrophotometer
2. Centrifugation of the cell contents at varying speeds such that the subcellular fractions separate out based on their densitydifferences
3. Photosynthesis - floating leaf disc experiment under various conditions (light, dark & light -dark)
4. Visit toTIFR
5. Nucleic acid extraction - from plant & animal tissue using ethanolprecipitation
6. Agarose gelelectrophoresis
7. Analysis of DNA under various conditions – pH andTemperature
8. Protein extraction & separation using polyacrylamide gel electrophoresis(PAGE)
9. Carbohydrateextraction&estimation-extractionofsugarsfromgrapes&estimationofthesameby DNSAmethod
10. Proteinextraction&estimationdeterminationoftotalproteincontentinmicroorganismsbyfolin- ciocaltaeumethod
11. Lipidextraction&separation-Extractionoftotallipidsfromlivertissue&separationbythinlayer chromatography
12. Separation of biomoleculesusing:
    Adsorption chromatography; Partitioning of indicators in various solvent systems. ;
    Separation of a mixture of solutes by partitioning; Separation of leaf pigments by paper chromatograhy Separation of flower pigments by paper chromatography ; Reverse phase thin layer chromatography (PRTLC) - Separation of photosynthetic pigments

CL 201: Chemistry Laboratory

Colorimetric titrations, Beer Lambert law, Estimation of concentration by colorimetric methods, conductometric methods, estimation of concentraion of acid base bt pH meter, identification of inorganic anions and cations, finding of pka values, short project of 2 weeks based on the experiments available in Journal of Chemical Education.

Books Recommended:

S.No.	Suggested text and references:
1	Vogel's Textbook of Quantitative Chemical Analysis (5th Edition; Longmann)
2	Vogel's Qualitative Inorganic Analysis (7th Edition)
3	ACS Journal of Chemical Education

PL 201- Physics Laboratory

Review of uncertainty / error analysis; least squares fit method; introduction to sensors / transducers; determination of ‘g’ (acceleration due to gravity) by free fall method; study of physical pendulum using a PC interfaced apparatus – study variation of effective ‘g ‘ with change of angle of plane of oscillation - investigation of effect of large angle of oscillation on the motion;

Study of Newton’s laws of motion using a PC interfaced apparatus; study of conservation of linear and angular momentum using ‘Maxwell’s Wheel’ apparatus; study of vibrations of soft massive spring; study of torsional oscillatory system; study of refraction in a prism - double refraction in calcite and quartz; study of equipotential surface using different electrode shapes in a minimal conducting liquid medium; determination of electrical inductance by vector method and study effect of ferromagnetic core and study the effect of non- linearity of inductance with current.

Books Recommended:

WorsnopandFlint Advanced Practical Physics forStudents

GL 201 Electronics laboratory

1. To study the Half wave & Full wave rectifier and study the effect of Cfilter.
2. To design a Single Stage CE amplifier for a specific gain andbandwidth.
3. Study of Operational amplifier in inverting and non-invertingmode.
4. To verify and design AND, OR, NOT and XOR gates using NANDgates.
5. Measurement of pressure, strain and torque using straingauge.

MB201:Mathematics–II(ForBiologyStream)

UnitI Functionsofseveralvariables,partial derivatives,geometricinterpretation,propertiesofpartial derivatives,chainrule,applications.Elementarydiscussiononscalarsandvectors,normofavector,dot product,projections.Linearequationsand matrices,matrixoperations.Conceptof a determinant,its properties,evaluationofadeterminant,crossproductasadeterminant,linesandplanes.Elementaryideas oftensors.

UnitII Vectorfunctions.Gradientofa function,geometricinterpretation,propertiesandapplications; divergenceandcurlofa vectorfunction,geometricinterpretation,propertiesandapplications;higher derivatives,Laplacian.Lineintegrals.Double andtripleintegrals,theirpropertiesandapplicationstoareas, volumes,etc.

UnitIIIGradienttheorem,Green'stheorem,Stokes'theorem,divergencetheorem,applications.Proofsof Stokes'anddivergencetheoremsthroughphysicalexamples(suchascirculationina 2dimensionalplane andaccumulationoffluidina givenvolume).

UnitIVCurvilinearcoordinatesystems,sphericalandcylindricalcoordinates,areaandvolumeelements, illustrations.Gradient,divergenceandcurlincurvilinearcoordinatesystems.

UnitV Introductiontolinearalgebra.Vectorspaces,lineardependenceandindependence,notionofbasis, and dimension, subspaces. Examples. More on matrices: special kinds of matrices, theirproperties.Eignevaluesand eigenvectors,seculardeterminant,characteristicpolynomial.Eigenvaluesand eigenvectors ofa real symmetricmatrix.Illustrativeexamples.Applicationsoflinearalgebra.

SuggestedTextsandReferences(forM100andM200)
1)Calculus:GilbertStrang(MITCourseware)
2)Calculus:Thomas
3)ElementaryLinearAlgebra:HowardAntonandChrisRorres
4)IntroductiontoLinearAlgebra:GilbertStrang(MITCourseware)
5)Mathematical MethodsforScientistsandEngineers:GeorgeB.ArfkenandHansJ.Weber(for curvilinearcoordinates,betaandgammafunctionsonly)

M201:Mathematics–II (ForPhysics &ChemistryStream)

UnitIDifferentialequations:separableequations,firstorderdifferential equations. Secondorder differentialequationsandWronskian;equationswithconstantcoefficients,homogeneous and inhomogeneousequations.

UnitII Scalarfunctionsofseveralvariables,partial derivatives,geometricinterpretation(maxima, minima,saddlepoints),propertiesofpartialderivatives,chainrule,applications. Gradientofa function,geometricinterpretation,propertiesandapplications.

Unit III Vector functions.Derivativesof a vector function, divergenceand curl, geometric interpretation,propertiesandapplications;higherderivatives,Laplacian.

UnitIV Sphericalandcylindricalcoordinates, areaandvolumeelements,illustrations.Gradient anddivergenceinsphericalandcylindricalcoordinates.

UnitV Lineintegrals.Doubleandtripleintegrals,theirpropertiesandapplicationstoareas, volumes,etc.Gradienttheorem,divergence theorem,Stokes'theorem,applications. Illustrations fromfluidflowandelectromagnetism.

SuggestedTexts and References
1.Calculus,GilbertStrang(MITCourseware)http://ocw.mit.edu/resources/res-18-001-calculus-online-textbook-spring-2005/textbook/
2.Thomas'Calculus,11thEdition,M.Weir,J.HassandF. R.Giordano,PearsonEducation.
3.MathematicalMethodsinthePhysicalSciences,3rdEd.,MaryL.Boas,WileyStudentEd., WileyIndia(Reprint)2009(forcomplexnumbersanddifferentialequations)
4.ElementaryLinearAlgebra,10thEdition,HowardAntonandChrisRorres,WileyStudentEd., Wiley2011.
5.IntroductiontoLinearAlgebra,4thEdition,GilbertStrang,WellesleyCambridgePress,2009.

M201:Mathematics–II(ForPhysics&ChemistryStream)

UnitI Algebraofmatrices(realnumbersandotherfields),specialmatrices(scalar,diagonal, upperandlowertriangular,etc.).Linearequationsandtheirmatrixrepresentations, row-echelon form, Gauss-Jordan elimination,general and particular solutions, homogeneousequations. Invertiblematricesandelementarymatrices,computation ofinverseusingelementaryrow operations.Determinants andtheirproperties,minorsandcofactors,determinantofaproductof matrices,adjointofamatrix,invertiblematricesanddeterminants.Cramer’srule.Rankofa matrix,rankandinvertibility.Vectorspaces(realnumbersandotherfields).Examplesincluding thespaceofpolynomials,thespaceoffunctions,thesolutionspaceofasystemofhomogeneous linearequations,androwandcolumnspacesofamatrix.Span,linearindependence, basis, dimensionanditsuniqueness.

UnitII Lineartransformations, isomorphisms,kernelandimage,thedimensionformula. Eigenvaluesandeigenvectorsofasquarematrixoralinearoperator,computationofeigenvalues andeigenvectors, characteristic polynomial,sumsandproductsofeigenvalues,similarmatrices, diagonalization.

UnitIII Reviewofgeometricpropertiesofvectorsin$\mathbf{R}^2$ and$\mathbf{R}^3$,dot,crossandscalartriple products,theirpropertiesandtheirgeometricinterpretation.Vectorfields,reviewofdefinitionsand basicpropertiesofgradient,divergence, directionalderivatives, divergence, curlandtheLaplace operator.Pathsandcurvesin$\mathbf{R}^2$ and$\mathbf{R}^3$,tangent,velocity,accelerationandforcevectors,arc length.

UnitIVAbriefoverviewofdifferentials. DoubleintegralsaslimitsofRiemannsumsandas volumes,theircomputation asiteratedintegrals,elementaryregions.TripleintegralsaslimitsofRiemannsums,theircomputation asiteratedintegrals,elementaryregions.Changeofvariables, theJacobiandeterminant,sphericalandcylindricalcoordinates.

UnitV Applicationofdoubleandtripleintegralstofindingvolume,centreofmass,etc.Line integrals, their dependenceon parametrization,their computation,work done. Parametrized surfaces,normaltoasurface,surfacearea,surfaceintegralsandtheirdependence on parametrization, theircomputation.Orientedsurfaces,statementofGreen'stheoremandits applicationto computingthe area of a region, statementsof Stokes'theorem,and Gauss' divergencetheorem.Conservativevectorfields.

SuggestedTextsandReferences:

1.ACourseinLinearAlgebrawithApplications,2ndEdition,D.J.S. Robinson,WorldScientific 2006.
2.CalculusandAnalyticGeometry,9thEdition,G. B. ThomasandR.L.Finney,Pearson Education2002.
3.BasicMultivariableCalculus,J.Marsden,A. TrombaandA. Weinstein,Springer(India),2009.
4.Calculus@iitb–Concepts,ExamplesandQuizzes,InderK.Rana,Version 2, 2010(Math4all).

M201:MathematicsII(Calculus and Linear Algebra)

(For Mathematics Stream only)

UnitI Recollectionandrigoroustreatmentofcontinuityanddifferentiability ofafunctionofone variable.Riemannintegration,proofoftheFundamentalTheoremofCalculus.Functionsoftwo andthreevariables,doubleandtripleintegrals.

Unit II Line integrals.Parametrizedsurfaces,orientedsurfaces.Stokes Theorem,Gauss DivergenceTheorem(bothwithoutproof).

Unit III Recollectionofthealgebraofmatrices(mainlyoverthefieldofrealnumbers,but mentionotherfieldsalso),linearequations,row-echelonform,Gauss-Jordan elimination. Determinants,rankofamatrix,rankandinvertibility.

UnitIVVectorspaces(mainlyoverthefieldofrealnumbers,butmentionotherfieldsalso),span, linearindependence,basis,dimensionanditsuniqueness(withoutproof).

UnitVLineartransformations,kernelandimage,therank-nullityformula.Eigenvaluesand eigenvectorsofasquarematrixoralinearoperator.

References

[1]D.J.S.Robinson,ACourseinLinearAlgebrawithApplications,WorldScientific.
[2]G. B. ThomasandR.L.Finney,CalculusandAnalyticGeometry,9thed.,Addison-Wesley/Narosa,1998.
[3]J.Marsden,A. TrombaandA. Weinstein,BasicMultivariableCalculus,Springer
[4]InderK. Rana,Calculus@iitb,ConceptsandExamples,Version1.2,math4all2009.

SECONDYEAR

SEMESTER–III

M301 : Foundations

UnitILogic:Quantifiers,negations,examplesofvariousmathematical andnon-mathematical statements.Exercisesandexamples.
SetTheory: Definitions,subsets,unions,intersections,complements,symmetricdifference,De Morgan'slawsforarbitrarycollectionofsets.Powersetofaset.

UnitIIRelationsandmaps:Cartesianproductoftwosets.Relationsbetweentwosets.Examples ofrelations.Definition ofamap,injective, surjective andbijectivemaps.Amapisinvertible ifand onlyifitisbijective.Inverseimageofasetwithrespecttoamap.Relationbetweeninverse imagesandset theoretic operations.Equivalence relations(withlotsofexamples).Schroeder- Bernsteintheorem.

UnitIII FiniteandInfinitesets:Finitesets,mapsbetweenfinitesets,proofthatnumberof elementsinafinitesetiswelldefined.Definition ofacountable set(inclusive ofafiniteset). Countablyinfiniteanduncountable sets.Examples.Proofthateveryinfinitesethasaproper, countablyinfinitesubset.UncountabilityofP(N).

UnitIV PartiallyOrderedSets:Conceptofpartialorder,totalorder,examples.Chains,Zorn's Lemma.

UnitVPeano'sAxioms.Well-OrderingPrinciple.WeakandStrongPrinciplesofMathematical Induction.TransfiniteInduction.AxiomofChoice,productofanarbitraryfamilyofsets. EquivalenceofAxiomof Choice,Zorn'sLemmaandWell-orderingprinciple.

AdditionalTopics(Optional)
(i)Dedekind'sConstructionofRealNumbers.
(ii)Decimal,dyadic,triadicexpansionsofrealnumbers.
(iii)CantorSets.

References
[1]NaiveSetTheory,P. Halmos.
[2]SetTheoryandLogic,R.Stoll.
Alotofthematerialcanbefoundinthebeginningsectionsofthefollowingbooks:
[3]MethodsofRealAnalysis,R.Goldberg.
[4]Topology,J.Munkres.
[5]ElementaryNumberTheory,D. Burton.
[6]RealAnalysis,BartleandSherbert.

M302 : Analysis I

UnitIRealNumberSystem:Conceptofafield,orderedfield,examples oforderedfields, supremum,infimum.Ordercompleteness of**R,Q**isnotordercomplete.Absolutevalues, Archimedeanpropertyof**R.C**asafield, and thefactthat **C**cannotbemade intoanorderedfield. Densenessof**Q**in**R.**Everypositiverealnumberhasauniquepositiven-throot.

Unit II Sequences:Sequences,limitofasequence,basicproperties.
Boundedsequences,monotonesequences,amonotoneincreasing sequence
boundedaboveconvergestoit's
Supremum. Sandwich theorem and its applications. Using the Arithmetic mean-Geometric mean inequality like$\boldsymbol{lim\,n} \to \infty(1+1/\mathrm{n})^{\mathrm{n}}$and $\boldsymbol{lim\,n} \to \infty(1-1/n)^{n}$ are equal. Chauchy’s first theorem of limits, Chauchy’s second theorem of limits. Subsequences and Chauchy’s sequence.
Sequenceofrealnumbershasamonotone subsequence.

DefinitionofaCauchysequence.Cauchycompleteness of**R,Q**isnotCauchy complete.

Unit III Infinite Series: Basic notions on the convergenceof infinite series. Absoluteand conditionalconvergence. Comparisontest,ratiotest,roottest,alternatingseriestest,Theoremof Dirichlet,StatementofRiemann'srearrangement theorem,Cauchyproductoftwoseries.Power series,radiusofconvergenceviaexamples.

Unit IV Continuous functions: Continuity, sequential and neighbourhood definitions, basic properties such assums andproductsofcontinuousfunctionsarecontinuous.IntermediateValue Theorem,Continuous functionsonclosedandboundedintervals,Monotonecontinuous functions, inversefunctions,UniformContinuity,examplesandcounter-examples.

Differentiablefunctions: Definition:asafunctioninfinitesimallyapproximablebyalinearmap, equivalencewithNewtonratiodefinition,basicproperties.One-sidedderivatives,TheO;oand ~notationswithillustrativeexamples.Chainrulewithcompleteproof(usingabovedefinition). Localmonotonicity,relationbetweenthesignofꜦ andlocalmonotonicity.Proofsof Rolle'stheoremandtheCauchy-LagrangeMeanvaluetheorem.L'Hospital'sruleandapplications.HigherderivativesandTaylor'stheorem,estimationoftheremainderinTaylor'stheorem,example:

$$f(x) = \begin{cases} e^{-\frac{1}{x^2}} & x \neq 0 \\ 0 & x = 0 \end{cases}$$. Convex functions.

UnitV RiemannIntegration: DefinitionviaupperandlowerRiemannsums,basicproperties. Riemannintegrability,Theorem f is continuousimplies f isRiemannintegrable,examplesofRiemannintegrablefunctionswhicharenotcontinuouson[a, b]. Cauchy-Schwardz inequality. Mean value theorem for Improper integrals, power series and elementary functions : Cauchy's condition for existence ofimproper integrals, test for convergence. Power series and basicproperties,continuityofthesum,validityoftermbytermdifferentiation. Binomial theoremforarbitraryrealcoeficients.Elementarytranscendental e^x,sinx,cosxand theirinversefunctions,log x, $\tan^{-1}$ x, Gudermannianandotherexamples.

References

[1]IntroductiontoRealAnalysis: R.Bartle&D.Sherbert,Wiley.
[2]AFirstCourseinAnalysis: G. Pedrick

M303 : Algebra I (Groups, rings, fields)

UnitI Recollectionofequivalencerelationsandequivalenceclasses,congruenceclassesof integers modulon.Definitionofagroup,examplesincludingmatrices,permutation groups, groupsofsymmetry, rootsofunity.Firstpropertiesofagroup,lawsofexponents,finiteand infinitegroups.

UnitII Subgroups andcosets,orderofanelement,Lagrangetheorem,normalsubgroups, quotient groups.DetailedlookatthegroupS$_n$ofpermutations,cyclesandtranspositions, even andoddpermutations,thealternatinggroup,simplicityofA$_n$forn ≥ 5.

UnitIII Homomorphisms,kernel,image,isomorphism,the fundamentaltheoremof group Homomorphisms. Cyclicgroups,subgroupsandquotientsofcyclicgroups,finiteandinfinite cyclicgroups.

Unit IV Cayleystheoremonrepresenting agroupasapermutationgroup.Conjugacyclasses, centre,classequation,centreofa p-group.Sylowtheorems,solvableandnilpotentgroups.

Unit V Definitionof a ring, examplesincludingcongruenceclassesmodulon, ideals and

Homomorphisms, quotientrings,polynomialringinonevariableoveraring,units,fields,non-zerodivisors,integraldomains. Ringsoffractions, fieldoffractionsofanintegral domain.PID, uniquefactorizationintheringofintegersandinthepolynomialringoverafield,GaussLemma.

References

[1]M. Artin,Algebra, Prentice Hall of India, 1994.
[2]D.S. Dummit and R.M. Foote, Abstract Algebra, 2nd Ed., JohnWiley, 2002.
[3]N. Jacobson, Basic Algebra II,Hindustan Publishing Corporation, 1983.
[4]S. Lang, Algebra, 3rded. Springer (India) 2004.

M 304 : Discrete Mathematics

UnitI Combinatorics: Permutationsandcombinations.Linearequationsandtheirrelationto distributionintoboxes.Distributionswithrepetitionsandnon-repetitions.Combinatorialderivation oftheseformulae.PigeonholePrincipleandapplications.

Unit II Binomial and multinomial theorems. Inclusion-ExclusionPrinciple and Applications. Recurrence Relations andGenerating Functions.Partitionsofanumber.Numberofpartitions. Briefintroductiontothecombinatoricsof Youngtableaux.

UnitIII Graphtheory:Verticesandedges.Graphsandspecialtypeslikecompletegraph, bipartite graph. Degree of a vertex, weighted graphs. Traveling Salesman's Problem. KoenigsbergSeven-bridgepuzzle.Walks,Paths,Circuits.

UnitIV EulerGraphs,HamiltonianPathsandCircuits.Treesandalgorithmstofindtreesina given graph.PlanarGraphs.

UnitV Spaningtreesandcutsets.Minimalspanningtreesandalgorithmsfortheircomputer implementation:theKruskal'salgorithm.Coloringingraphtheory.Thefourcolourproblem.

References

[1]RichardStanley,EnumerativeCombinatorics.
[2]AlanTucker,AppliedCombinatorics.
[3]F. Harrary,GraphTheory.
[4]NarsinghDeo,GraphTheory.

M305 : Computational Mathematics I **UnitI**

BasicsofSpreadsheetProgrammes(suchasLibreoffce/gnumeric). **UnitII**

InroductiontoMathematicaincludingwritingsimpleprogrammes.

UnitIII Detailedexplorationofnotionofcalculusofonevariable,andsimplemultivariable calculususingMathematica.

UnitIV BasicLinearAlgebraUsingMathematica.

UnitV NumericalSolutionsofLinearandNon-linearequationsusingMathematica.Developing Programmesforeachofthesemethods.

References

[1]SelwynHollis,CalcLabswithMathematicaforSingleVariableCalculus,FifthEdition.
[2]SelwynHollis,CalcLabswithMathematicaforMultivariableCalculus,FifthEdition.

[3]KennethShiskowski,KarlFrinkle,PrinciplesofLinearAlgebrawithMathematica.

SEMESTER–IV

M401 : Analysis II (Multivariable Calculus)

UnitI Linearmapsfrom$\mathbf{R}^n$to$\mathbf{R}^m$, Directionalderivative,partialderivative,totalderivative,Jacobian, MeanvaluetheoremandTaylorstheoremforseveralvariables,ChainRule.

UnitII Parametrizedsurfaces,coordinatetransformations,Inversefunctiontheorem, Implicitfunction theorem,Ranktheorem.

UnitIIICriticalpoints,maximaandminima,saddlepoints,Lagrangemultipliermethod.

UnitIV Multipleintegrals,RiemannandDarbouxintegrals,Iteratedintegrals,Improperintegrals, Changeof variables.

UnitVIntegrationoncurvesandsurfaces,Greenstheorem,Differentialforms,Divergence,Stokes theorem.

References

[1]M. Spivak, Calculus on Manifolds.
[2]W. Fleming, Functions of Several Variables, 2nd Ed., Springer-Verlag, 1977.
[3]J.E.Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus.
[4]W. Rudin, Principles ofMathematicalAnalysis, 3rd ed., McGraw-Hill, 1984.
[5]A ModernApproach toClassical Theorems ofAdvanced Calculus, W. A. Benjamin, Inc., 1965.

M402 : Algebra II (Linear Algebra)

UnitI Modulesoveracommutativering,submodulesandquotientmodules, generators,homomorphisms,exactsequences,finitelygeneratedfreemodules.

UnitII Vectorspacesasmodulesoverafield,subspaces,quotientspaces.Spanandlinear independence,basis,dimension.

UnitIIILinearmapsandtheircorrrespondencewithmatriceswithrespecttogivenbases,change ofbases.

UnitIVEigenvalues,eigenvectors,eigenspaces,characteristicpolynomial,Cayley-Hamilton.

UnitV Bilinearforms,innerproductspaces,Gram-Schmidtprocess,diagonalization,spectral theorem.

Note: JordanandrationalcanonicalformstobedoneinM602inSemesterVI asanapplicationof thestructureoffinitelygeneratedmodulesoveraPID.

References

[1]M. Artin,Algebra, Prentice Hall of India, 1994.
[2]D.S. Dummit and R. M. Foote, Abstract Algebra, 2nd Ed., John Wiley, 2002.
[3]K. Ho_man and R. Kunze, Linear Algebra, Prentice Hall, 1992.
[4]N. Jacobson, Basic Algebra II,Hindustan Publishing Corporation, 1983.
[5]S. Lang, Algebra, 3rded. Springer (India) 2004.

M403 : ElementaryNumber theory

Unit I Fundamentaltheoremofarithmetic,divisibilityinintegers.Primenumbersandinfinitudeof primes.Infinitudeofprimesofspecialtypes.Specialprimes like Fermatprimes,Mersenne primes,Lucasprimesetc.Euclideanalgorithm,greatestcommondivisor,leastcommonmultiple.

UnitII Equivalencerelations andthenotionofcongruences.Wilson's theorem andFermat's little theorem.Chineseremaindertheorem.Continuedfractionsandtheirapplications. Primitiveroots, Euler'sPhifunction.Sumofdivisorsandnumberofdivisors,M□biusinversion.

UnitIIIQuadraticresiduesandnon-residueswithexamples.Euler'sCriterion,Gauss'Lemma. Quadraticreciprocityandapplications.Applicationsofquadraticreciprocitytocalculationof symbols.

UnitIV Legendresymbol:Definitionandbasicproperties.Fermat'stwosquaretheorem, Lagrange'sfoursquaretheorem.

UnitV Pythagoreantriples.DiophantineequationsandBachet'sequation.Theduplication formula.

References

[1]D. Burton, Elementary Number Theory.
[2]Kenneth H. Rosen, Elementary number theory and its applications.
[3]Niven, Ivan M.; Zuckerman, Herbert S.; Montgomery, Hugh L,An Introduction to the Theory of Numbers.

M404 : TopologyI

UnitI Recollection of some set theory, particularly the following topics:
(i) Equipotence of sets, Schroeder-Bernstein theorem,countable and uncountable sets, countability of **Q**anduncountabilityof**R**:
(ii) Equivalence relations, Zorn's lemma,axiom of choice.
Metricspaces: Definition and basic examples including the following:
(i)Thediscretemetriconanyset.
(ii)**R**and**R**^{n}withEuclideanmetrics,Cauchy-Schwarzinequality,definitionofanormonafinite dimensional**R**-vectorspaceandthemetricdefinedbyanorm.
(iii)Theset***C***[0,1]withthemetricgivenby$\sup|f(t) - g(t)|$
(iv)Metricsubspaces,examples.

Unit II Topologygeneratedby a metric: Open and closedballs, open and closedsets, complementofanopen(closed)set,arbitraryunions(intersections)ofopen(closed)sets,finite intersections(unions)ofopen(closed)sets,open(closed)ballisanopen(closed)set,asetis openif andonlyif it isaunionofopenballs,Hausdorffpropertyofametricspace.

Equivalence of metrics, examples, the metrics on $\mathbf{R}^2$ given by $|x_1 - y_1| + |x_2 - y_2|$(resp.$max\{|x_1 - y_1|, |x_2 - y_2|\}$isequivalenttotheEuclideanmetric,theshapesofopenballsunderthesemetrics.Limitpoints,isolatedpoints,interiorpoints,closure,interiorandboundaryofaset,denseandnowheredensesets.

UnitIII Continuousmaps:epsilon-deltadefinitionandcharacterizationin termsofinverseimagesofopen(resp.closed)sets,compositeofcontinuousmaps,pointwisesumsandproductsof continuousmapsinto**R**;homeomorphism,isometry,anisometryisahomeomorphismbutnot conversely,uniformlycontinuousmaps,examples.

Complete metric spaces: Cauchy sequences and convergent sequences, a subspace of a completemetricspaceiscompleteifandonlyifitisclosed,Cantorintersection theorem,Baire categorytheoremanditsapplications,completionofametricspace.

Generaltopologicalspaces,strongerandweakertopologies,continuousmaps,homeomorphisms, basesandsubbases,finiteproductsoftopologicalspaces.

UnitIV Compactness forgeneraltopologicalspaces:Finitesubcoverings ofopencoveringsand finiteintersectionproperty,continuousimageofacompactsetiscompact,compactness and Hausdorffproperty.

Compactnessformetricspaces**:**Bolzano-Weierstrassproperty,theLebesguenumber foranopen covering,sequentially compactandtotallyboundedmetricspaces,Heine-Borel theorem,compact subsetsof**R**;acontinuousmapfromacompactmetricspaceisuniformlycontinuous.

UnitVConnectedness: definition,continuousimageofaconnectedsetisconnected, characterization intermsofcontinuousmapsintothediscretespace**N**,connectedsubsetsof**R**; intermediate value theorem as a corollary, countable (arbitrary) union of connected sets, connectedcomponents,

References

[1]E. T. Copson,Metricspaces.
[2]M.Eisenberg,Topology.
[3]R.H.Kasriel,Undergraduatetopology.
[4]W.Rudin,Principlesofmathematicalanalysis. [5]G.
F. Simmons,Topologyandmodernanalysis.
[6]W.A. Sutherland,Introductiontometricandtopologicalspaces.

G401:StatisticalTechniquesandApplications

Unit-I PurposeofStatistics,EventsandProbabilities,Assignmentsofprobabilitiestoevents,Random eventsandvariables,ProbabilityAxiomsandTheorems.Probabilitydistributionsandproperties:Discrete, ContinuousandEmpiricaldistributions.

Unit-IIExpectedvalues: Mean,Variance,Skewness,Kurtosis,MomentsandCharacteristics Functions. Typesofprobabilitydistributions: Binomial,Poisson,Normal,Gamma,Exponential, Chi-squared, Log-Normal,Student'st, Fdistributions,CentralLimitTheorem.

Unit-IIIMonteCarlotechniques: Methodsofgeneratingstatisticaldistributions:Pseudorandomnumbers fromcomputersandfromprobabilitydistributions,Applications.Parameterinference:Givenpriordiscrete hypothesesandcontinuousparameters,Maximumlikelihoodmethodforparameterinference.

Unit-IVErrorAnalysis: StatisticalandSystematicErrors,Reportingandusinguncertainties,Propagation oferrors,Statisticalanalysisofrandomuncertainties, AveragingCorrelated/UncorrelatedMeasurements. Deconvolutionmethods,Deconvolutionofhistograms,binning-freemethods.Least-squaresfitting:Linear, Polynomial,arbitraryfunctions:withdescriptionsofspecific methods;Fittingcompositecurves.

Unit-VHypothesistests: Singleandcompositehypothesis,Goodnessoffittests,P-values,Chi-squared test,LikelihoodRatio,Kolmogorov- Smirnovtest,ConfidenceInterval.CovarianceandCorrelation, Analysis of Variance and Covariance. Illustration of statistical techniques through hands-on use of computerprograms.

SuggestedTextsandReferences:

1.Statistics: AGuidetotheUseofStatistical MethodsinthePhysicalSciences,R.J.Barlow,John Wiley1989
2.TheStatistical AnalysisofExperimentalData,JohnMandel,DoverPublications1984
3.DataReductionandErrorAnalysisforthePhysicalSciences,3rdEdition,PhilipBevingtonand KeithRobinson,McGrawHill 2003

THIRDYEAR

SEMESTER–V

M501 : Analysis III (Measure Theoryand Integration)

UnitI Sigmaalgebraofsets,measurespaces.Lebesguesoutermeasureontherealline. MeasurablesetinthesenseofCaratheodory.TranslationinvarianceofLebesguemeasure. Existenceofa non-Lebesguemeasurableset.Cantorset-uncountablesetwithmeasurezero.

UnitII Measurablefunctions,typesofconvergence ofmeasurablefunctions.TheLebesgue integral for simple functions, nonnegative measurable functions and Lebesgue integrable function,in general.

UnitIII Convergencetheorems-monotoneanddominatedconvergencetheorems.Comparison ofRiemannandLebesgueintegrals.Riemannstheoremonfunctionswhichare continuous almosteverywhere.

UnitI V TheproductmeasureandFubinistheorem.TheL^pspacesandthenormtopology. **Unit V**Inequalitiesof HolderandMinkowski.Completenessof L^p and L^∞ spaces.

References

[1] H.L. Royden, Real Analysis, PearsonEducation.
[2] G. DeBarra, Introduction to MeasureTheory, Van Nostrand Reinhold.
[3] I. K. Rana, An Introduction toMeasure and Integration, Narosa.
[4] H.S. Bear, A Primer onLebesgue Integration, Academic press.

M502 : Algebra III(Galois Theory)

UnitI Primeand maximalideals in acommutative ring and their elementary properties.

UnitII Fieldextensions, prime fields, characteristic ofa field, algebraic field extensions, finite field extensions, splittingfields, algebraicclosure, separable extensions,normal extensions,

UnitIIIFinite Galois extensions, Fundamental Theorem of GaloisTheory.

UnitIVSolvability by radicals.

UnitVExtensions of finite fields.

References

[1]M. Artin,Algebra, Prentice Hall of India, 1994.
[2]D. S. Dummit and R. M. Foote, Abstract Algebra, 2nd Ed., John Wiley, 2002.
[3]N. Jacobson, Basic Algebra I & II,Hindustan Publishing Corporation, 1983.
[4]S. Lang, Algebra, 3rded. Springer (India) 2004.
[5]R. Lidl and H. Niederreiter, Introduction to Finite Fields and Their Applications, CambridgeUniversity Press,1986.

M503 : TopologyII

Unit I Review of some notions from Topology I. Basic Separation axioms and first and second countability axioms.Examples.

UnitII Productsandquotients.Tychonoff'stheorem.Productofconnectedspacesisconnected.Weak topologyonXinducedbyafamilyofmap $f_\alpha\colon X \to X_\alpha$ whereeach X_α isatopological space.ThecoherenttopologyonYinducedbyafamilyofmap $g_\alpha\colon Y_\alpha \to Y$ where Y_α aregiven topologicalspaces.Examplesofquotientstoillustratetheuniversalpropertysuchas embeddingsof$\mathbf{RP}^2$ and the Klein'sbottlein$\mathbf{R}^4$.

UnitIII Completelyregularspacesandits embeddingsina productofintervals.Compactification, AlexandroffandStone-Cechcompactifications.

UnitIV NormalspacesandthetheoremsofUrysohnandTietze. ThemetrizationtheoremofUrysohn.

UnitV Localcompactness,localconnectednessandlocalpath-connectednessandtheirbasicproperties. If $q\colon X \to Y$isa quotientmapandZislocallycompactHausdorffspacethen$q \times id : X \times Z \to Y \times Z$is alsoa quotientmap.LocallyfinitefamiliesofsetsandPartitionsofunity.BaireCategorytheoremfor locallycompactHausdorffspaces.

References

[1]G. F. Simmons, Topology and modernanalysis
[2]W. A. Sutherland,Introduction to metric and topological spaces.
[3]S. Willard, General Topology, Dover,New York.

M 504 : Probability Theory

UnitI Probabilityasameasure,Probabilityspace,conditionalprobability,independence ofevents, Bayesformula.Randomvariables,distribution functions, expectedvalueandvariance.Standard Probabilitydistributions:Binomial,PoissonandNormaldistribution.

Unit II Borel-Cantellilemmas, zero-one laws. Sequences of random variables, convergence theorems,Variousmodesofconvergence.Weaklawandthestronglawoflargenumbers.

UnitIII Centrallimittheorem:DeMoivre-Laplacetheorem,weakconvergence,characteristic functions,inversionformula,momentgeneratingfunction.

UnitIVRandomwalks,MarkovChains,RecurrenceandTransience.

UnitVConditionalExpectation, Martingales.

References

[1]Marek Capinski and Tomasz Zastawniak, Probability through Problems, Springer, IndianReprint 2008.
[2]P. Billingsley, Probability and Measure,3rd ed., John Wiley & Sons, New York, 1995.
[3]J. Rosenthal, A First Look at Rigorous Probability,World Scientific, Singapore, 2000.
[4]A.N. Shiryayev, Probability,2nd ed., Springer, New York, 1995.
[5]K.L. Chung, A Course in ProbabilityTheory, Academic Press, New York, 1974.

SEMESTER–VI

M601 : Analysis IV (Complex Analysis)

UnitIComplexnumbersandRiemannsphere.Mobiustransformations.

UnitIIAnalyticfunctions.Cauchy-Riemannconditions,harmonicfunctions,Elementaryfunctions, Powerseries,Conformalmappings.

UnitIII Contourintegrals,Cauchytheoremforsimplyandmultiplyconnecteddomains.Cauchy integralformula,Windingnumber.

Unit IV Morera’stheorem.Liouville’stheorem,FundamentaltheoremofAlgebra.Zerosofan analyticfunctionandTaylorstheorem.Isolatedsingularities andresidues,Laurentseries, Evaluationofrealintegrals.

UnitV ZerosandPoles,Argumentprinciple,Rouchstheorem.

References

[1] L.Ahlfors,Complex Analysis.
[2] R.V. Churchill and J.W. Brown, ComplexVariables and Applications, International Student Edition,Mc-Graw Hill, 4th ed., 1984.
[3] B.R. Palka, An Introduction to Complex FunctionTheory, UTMSpringer-Verlag, 1991.

M602 : Algebra IV (Rings and Modules:SomeStructureTheory)

UnitI Recollectionofmodules,submodules,quotientmodules,homomorphisms.

Unit II External and internal direct sums of modules. Tensor product of modules over a commutativering.FunctorialpropertiesofandHom.

Unit III Definitionsand elementarypropertiesof projectiveand injectivemodulesover a commutativering.

UnitIV StructureoffinitelygeneratedmodulesoveraPID.Applicationstomatricesandlinear mapsoverfield:rationalandJordancanonicalforms.

UnitV Simplemodulesoveranotnecessarilycommutativering,modulesoffinitelength,Jordan-HolderTheorem,Schur'slemma.

(**Optional, if time permits**) Semisimple modules over a not necessarily commutative ring, WedderburnStructureTheoremforsemisimplerings.

References

[1]M. Artin,Algebra, Prentice Hall of India, 1994.
[2]D.S. Dummit and R. M. Foote, Abstract Algebra, 2nd Ed., John Wiley, 2002.
[3]N. Jacobson, Basic Algebra I & II,Hindustan Publishing Corporation, 1983.
[4]S. Lang, Algebra, 3rded. Springer (India) 2004.

M603 : Differential Geometry& Applications

UnitI CurvatureofcurvesinE^n:ParametrizedCurves,ExistenceofArclengthparametrization, Curvature ofplanecurves,Frennet-Serrettheoryof(arc-lengthparametrized)curvesinE^3, Curvatureof(arc-length parametrized)curvesinEn,CurvaturetheoryforparametrizedcurvesinE^n. Significanceofthesignofcurvature,Rigidityofcurvesin E^n.

UnitII Euler'sTheoryofcurvesonSurfaces**:**Surfacepatchesandlocalcoordinates,Examples ofsurfacesinE^3,curvesonasurface,tangentstothesurfaceatapoint,Vectorfieldsalong curves, Parallel vector fields, vector fields on surfaces, normal vector fields, the FirstFundamentalform,Normalcurvatureof curvesonasurface,Geodesics,geodesic Curvature,Christoffelsymbols,Gauss'formula,PrincipalCurvatures,Euler'stheorem.

UnitIII Gauss'theoryofCurvatureofSurfaces**:**TheSecondFundamentalForm,Weingarten mapandtheShapeoperator,GaussianCurvature, Gauss'Theorema Egregium, Guass-Codazzi equations,ComputationofFirst/Secondfundamentalform, curvatureetc. forsurfacesofrevolution andotherexamples.

Unit IV MoreSurfacetheory**:**IsoperimetricInequality,MeanCurvatureandMinimalSurfaces (introduction), surfacesofconstantcurvature,Geodesiccoordinates,Notionoforientation, examplesofnon-orientablesurfaces,Eulercharacteristic,statementofGauss-BonnetTheorem.

UnitVModernPerspective onSurfaces:Tangentplanes,ParallelTransport,AfineConnections, Riemannianmetricsonsurfaces.

References

[1]Elementary DifferentialGeometry : Andrew Pressley, Springer Undergraduate Mathematics Series.
[2]Elementary DifferentialGeometry : J. Thorpe, Elsevier.
[3]Differential Geometry of Curves and Surfaces : M. do Carmo.
[4]Elements of DifferentialGeometry : R. Millman & G. Parker.

M604 : Differential Equations & Dynamical Systems

UnitI Basicexistenceanduniquenessofsystemsofordinarydifferentialequationssatisfyingthe Lipschitz's condition. Examples illustrating non-uniquenesswhen Lipschitz or other relevant conditionsare dropped.Gronwall'slemmaanditsapplicationstocontinuityofthesolutionswith respecttoinitial conditions.Smoothdependenceoninitial conditionsand thevariationalequation. Maximalinterval ofexistence andglobalsolutions. Proofthatif(a,b)isthemaximalintervalof existenceanda<1then thegraph ofthesolutionmustexiteverycompactsubset ofthedomain onthedifferentialequation.

Unit II Linear systems and fundamentalsystems of solutions.Wronskiansand its basic properties. The Abel Liouville formula. The dimensionality of the space of solutions. Fundamentalmatrix.Themethodofvariationofparameters.

UnitIII Linearsystemswithconstantcoefficients andthestructureofthesolutions.Matrix exponentials and methods for computing them. Solving the in-homogeneoussystem. The Laplacetransformanditsapplications.

UnitIVSecondorderscalarlineardifferentialequations.TheSturmcomparison andseparation theoremsandregularSturm-Liouvilleproblems.

UnitV Seriessolutionsofordinarydifferentialequationsandadetailedanalyticstudyofthe differentialequationsof BesselandLegendre.Dynamicalsystemsand basic notionsofdynamical systemssuchasows,rectificationtheorem,restpointsanditsstability.Liouville'stheoremonthe preservationofphasevolume.Firstintegralsandtheirapplications.

Reference s

[1]R. Courant and D. Hilbert, Methods of Mathematical Physics,Volume - I
[2]W. Hurewicz, Lectureson ordinarydifferential equations, Dover, New York.
[3] . F. Simmons, Differential equationswith applications and historical notes, McGrawHill.

M605 : Computational Mathematics II

UnitI IntroductiontoSAGE.UsingSAGEtoexplorebasicsnotionsofLinearalgebra,Number theory,GroupTheory

UnitII Solvinglinearandnon-linearoptimizationproblemsusingMathematica.Developing programmesforvariousnumericaloptimizationtechniques.

UnitIII. ExplorationofGaloistheoryandFiniteFieldsUsingSage/Singular/Kashetc.

UnitIVBasicsofdiscretemathematicsusing Sage/Mathematica.Exploringadvancednotionsof ComplexAnalysisandDifferentialEquationsusingMathematica.

UnitV AppliedLinearAlgebrausingMathematica,variousmatrixfactorizationsandtheir applications.

<u>FOURTHYEAR</u>

SEMESTER–VII

M701 : Functional Analysis

UnitI Normedlinearspaces.Rieszlemma.Heine-Boreltheorem.Continuityoflinearmaps. Hahn-Banachextensionandseparationtheorems.

UnitII Banachspaces.Subspaces, productspacesandquotientspaces.Standardexamplesof Banachspaceslikel^p ,C([0;1])etc. .Uniformboundednessprinciple.Closedgraphtheorem.Openmappingtheorem.Boundedinversetheorem.

UnitIII Spectrumofaboundedoperator.Eigenspectrum.Gelfand-Mazurtheoremandspectral radiusformula.Dualspaces.Transposeofaboundedlinearmap.Standardexamples.

Unit IV Hilbert spaces. Bessel inequality, Riesz-Schauder theorem, Fourier expansion, Parseval'sformula.

UnitV InttheframeworkofaHilbertspace:Projectiontheorem.Rieszrepresentationtheorem. UniquenessofHahn-Banachextension.

Reference
s

[1] J.B. Conway, A course in FunctionalAnalysis, Springer-Verlag,Berlin, 1985.
[2] G. Go_man and G. Pedrick, First course in functional analysis,Prentice-Hall,1974.
[3] E.Kreyszig, Introductory FunctionalAnalysiswith applications, John Wiley & Sons, NY, 1978.
[4] B.V. Limaye, Functional Analysis, 2nd ed., New Age International, NewDelhi,1996.
[5] A. Taylorand D. Lay, Introduction tofunctional analysis, Wiley, New York, 1980.

M702 : Commutative Algebra

Unit I Primeandmaximalidealsinacommutativering,nilandJacobsonradicals,Nakayamas lemma,localrings.

UnitIIRingsandmodulesoffractions,correspondencebetweenprimeideals,localization.

UnitIII Modulesoffinitelength,NoetherianandArtinianmodules.Primarydecompositionina Noetherianmodule,associatedprimes,supportofamodule.

UnitIV Gradedringsandmodules,Artin-Rees,Krull-intersection,Hilbert-Samuelfunctionofa localring,dimensiontheory,principalidealtheorem.

UnitVIntegralextensions,Noethersnormalizationlemma,HilbertsNullstellensatz(algebraicand geometricversions).

References

[1]M.F Atiyah and I.G MacDonald, Introductionto Commutative Algebra, Addison-Wesley, 1969.
[2]D. Eisenbud, Commutative Algebrawith a viewtoward algebraic geometry, Springer-Verlag, Berlin, 2003.
[3] H. Matsumura, Commutative ring theory, Cambridge Studies in Advanced MathematicsNo. 8, Cambridge University Press, Cambridge, 1980.
[4]S. Raghavan, B. Singh and R. Sridharan, Homological methods in commutative algebra,TIFR Math. Pamphlet No.5, Oxford, 1975.
[5]B. Singh,BasicCommutative Algebra, World Scientific, 2011.

M703 : Differential Topology

UnitI Differentiable functions on $\mathbf{R}^n$: Review of differentiable functions $f: R^n \to R^m$ Implicit function and Inverse function theorems, Immersions and Submersions, critical points, criticaland regular values.

UnitIIManifolds:Level sets, sub-manifolds of$\mathbf{R}^n$, immersed andembedded sub-manifolds,tangent spaces, differentiable functions between sub-manifolds of R_n, abstract differential manifolds and tangent spaces.

UnitIIIDifferentiable functions on Manifolds: Differentiable functions$f : M \to N$, critical points, Sard's theorem, non-degeneratecritical points, MorseLemma, Manifoldswith boundary, Brouwer fixed point theorem, mod 2 degree of a mapping.

UnitIVTransversality: Orientation ofManifolds, oriented intersection number, Brouwer degree, transverse intersections.

UnitVIntegration on Manifolds: Vector field and Differential forms, integration offorms, Stokes' theorem, exact andclosed forms, Poincar Lemma, Introduction to de Rhamtheory.

References

[1] Topology from a Di_erentiable Viewpoint : J. Milnor.
[2] Di_erential Topology : V. Guellemin &A. Pollack.
[3] Di_erential Topology : M. Hirsch.

M704 : Partial Differential Equations

UnitI Generalitiesontheoriginsofpartialdifferentialequations.GeneralitiesontheCauchy problemfor a scalar linear equationof arbitraryorder. The conceptof characteristics.The Cauchy-Kowalevsky theoremandtheHolmgren'suniquenesstheorem.Thefundamental equationsofmathematicalphysicsas paradigmsforthestudyof Elliptic,HyperbolicandParabolic equations.

UnitII Quasilinear firstorderscalarpartialdifferentialequationsandthemethodof characteristics. DetaileddiscussionoftheinviscidBurger'sequationillustratingtheformationof discontinuitiesinfinite time. The fully nonlinearscalar equation and Eikonal equation.The Hamilton-Jacobiequation.

UnitIII DetailedanalysisoftheLaplaceandPoisson'sequations. Green'sfunctionforthe Laplacianandits basicproperties.Integralrepresentationofsolutionsanditsconsequencessuch astheanalyticity ofsolutions. Themeanvaluepropertyforharmonicfunctionsandmaximum principles.Harnackinequality.

Unit IV ThewaveequationandtheCauchyproblemforthewaveequation.TheEuler-Poisson- Darboux equation and integral representation for the wave equation in dimensions two and three. Properties ofsolutionssuchasfinitespeedofpropagation.Domainofdependenceanddomain ofinuence.

UnitVTheCauchyproblemfortheheatequationandtheintegralrepresentationforthesolutions ofTheCauchyproblemforCauchydatasatisfyingsuitablegrowthrestrictions. Infinitespeedof propagationofsignals.Exampleofnon-uniqueness. Fouriermethodsforsolvinginitialboundary valueproblems.

References

[1] R. Courant and D. Hilbert, Methods of Mathematical Physics, Volume - II
[2] R. C. McOwen, Partial differential equations, Pearson Education,2004.

M705 : Representation Theoryof FiniteGroups

UnitI Recollectionofleftandrightmodules,directsums,tensorproducts.

UnitII Semi-simplicityofringsandmodules,Schur0slemma,Maschke0sTheorem,

UnitIIIWedderburn0sStructureTheorem.Thegroupalgebra.

UnitIVRepresentationsofafinitegroupoverafield,inducedrepresentations,characters, orthogonalityrelations.

UnitVRepresentationsofsomespecialgroups.Burnside'sp^aq^btheorem.

References

[1]M. Artin,Algebra, Prentice Hall of India, 1994.
[2]M. Burrow, Representation Theory of Finite Groups, AcademicPress, 1965.
[3]D.S. Dummit and R. M. Foote, Abstract Algebra, 2nd Ed., John Wiley, 2002.
[4]N. Jacobson, Basic Algebra I & II,Hindustan Publishing Corporation, 1983.
[5]S. Lang, Algebra, 3rded. Springer (India) 2004.
[6] J .P. Serre, Linear Representation of Groups, Springer-Verlag,1977.

SEMESTER–VIII

M801 : Fourier Analysis

UnitI Fourierseries.DiscussionofconvergenceofFourierseries.

Unit II Uniqueness of Fourier Series, Convolutions,Cesaro and Abel Summability,Fejer`s theorem,Dirichletstheorem,PoissonKernelandsummability kernels.Exampleofacontinuous functionwithdivergentFourierseries.

UnitIII SummabilityofFourierseriesforfunctions in $L^1,, L^2 and L^p$spaces.Fourier-transformsof integrablefunctions.Basic propertiesof Fourier transforms,Poisson summationformula,Hausdorff-Younginequality,Riesz-ThorinInterpolationtheorem.

Unit IV Schwartzclassofrapidlydecreasing functions,Fouriertransforms ofrapidlydecreasing functions, RiemannLebesguelemma,FourierInversionTheorem,Fouriertransforms of Gaussians,Plancheraltheorem,Paley-Weinertheorem.

UnitVDistributionsandFourierTransforms:CalculusofDistributions,TemperedDistributions: Fouriertransformsoftempereddistributions,Convolutions,ApplicationstoPDEs.

References

[1]Y. Katznelson, Introduction to Harmonic Analysis, Dover.
[2]R. E. Edwards,FourierSeries, Academic Press.
[3]E. M. Stein and R. Shakarchi, Fourier Analysis: AnIntroduction, Princeton University Press,Princeton 2003.
[4]W. Rudin, Fourier Analysis on groups, Interscience.

M802 : Algebraic Number Theory

UnitI Fieldextensionsandexamplesoffieldextensions ofrationalnumbers,realnumbersand complexnumbers.Monicpolynomials, Integralextensions,Minimalpolynomial,Characteristic polynomial.

UnitII Integralclosureandexamples ofringswhichareintegrallyclosed.Examples ofrings whicharenotintegrally closed.Theringofintegers.TheringofGaussian integers.Quadratic extensions anddescriptionoftheringofintegersinquadraticnumberfields.Unitsinquadratic numberfieldsandrelationstocontinuedfractions.

UnitIII Noetherian rings,Ringsofdimension one.Dedekinddomains.Normsandtraces.Derive formulaerelating normsandtracesfortowersoffieldextensions.Discriminantandcalculationsof thediscriminantinthespecialcontextofquadraticnumberfields.Differentandit'sapplications.

Unit IV Cyclotomicextensionsandcalculationofthediscriminantinthiscase.Factorization of idealsintoprimeidealsanditsrelationtothediscriminant. Ramification theory,residualdegree anditsrelationtothedegreeoftheextension.Ramifiedprimesinquadraticnumberfields.

UnitV Idealclassgroup.Geometricideasinvolvingvolumes.Minkowski'stheoremandits application to proving finiteness of the ideal class group. Real and complex embeddings. Structureoffinitelygeneratedabeliangroups.Dirichlet'sUnitTheoremandtherankofthegroup ofunits.Discretevaluationrings,Localfields.

References

[1]Janusz, AlgebraicNumber Fields.
[2]Neukirch,Algebraic Number Theory.
[3]Marcus, Number Fields.

M803 : Algebraic Topology

UnitI Reviewofquotientspacesanditsuniversalproperties. Exampleson**RP^n**,Klein'sbottle, Mobius band, **CP^n**,***SO(n,R).***Connectednessandpathconnectednessofspaces suchas***SO(n, R)***and other similar examples.Topologicalgroupsand their basicproperties.Proofthat ifH isa connectedsubgroup such thatG/Hisalsoconnected(asatopologicalspace)thenGis connected.Quaternions,**S^3** and***SO(3,R).*** Connected,locallypathconnectedspaceispath connected.

UnitIIPathsandhomotopiesofpaths.Thefundamental groupanditsbasicproperties.The fundamental group of a topological group is abelian. Homotopy of maps, retraction and deformation retraction.Thefundamental groupofaproduct.Thefundamental groupofthecircle. Brouwer'sfixedpointtheorem.Degreeofamap.Applications suchasthefundamentaltheoremof algebra,Borsuk-UlamtheoremandthePerronFrobeniustheorem.

UnitV Coveringspacesanditsbasicproperties.Examplessuchasthereallineasacovering spaceofacircle,thedoublecoverη: $S^n \rightarrow RP^n$,thedoublecoverף:**S^3**→ ***SO(3,R).***Relationshipto thefundamentalgroup.LiftingcriterionandDecktransformations.Equivalence of coveringspaces.Universalcoveringspaces.Regularcoveringsanditsvariousequivalentformulationssuc hasthetransitivityoftheactionoftheDeckgroup.TheGaloistheoryofcovering spaces.

UnitIVOrbitspaces.FundamentalgroupoftheKlein'sbottleandtorus.Relationbetweencovering spacesandOrientationofsmoothmanifolds.Nonorientabiltyof**RP^2**illustratedviacoveringspaces.

UnitV Freegroupsanditsbasicproperties, freeproductswithamalgamations.Conceptofpush outsinthecontextoftopological spacesandgroups.SeifertVanKampentheoremandits applications. Basicnotionsofknottheorysuchasthegroupofaknot.Wirtinger'salgorithmfor calculatingtheGroupofaknotillustratedwithsimpleexamples.

References

[1] E. L. Lima, Fundamental groups and covering spaces, A. K. Peters, 2003. [2] W. Massey, Introduction to algebraic topology. Springer Verlag.

M804 : Stochastic Analysis

UnitI Preliminaries: Martingales andproperties.BrownianMotion-definitionandconstruction, Markovproperty,stoppingtimes,strongMarkovpropertyzerosofonedimensional Brownian motion.

UnitII Reectionprinciple,hittingtimes,higherdimensional BrownianMotion,recurrence and transience,occupationtimes,exittimes,changeoftime,Levystheorem.

UnitIII StochasticCalculus:Predictableprocesses,continuouslocalmartingales, varianceand covarianceprocesses.

UnitIV Integrationwithrespecttoboundedmartingalesandlocalmartingales,KunitaWatanabe inequality,Itosformula,stochasticintegral,changeofvariables.

UnitV Stochastic differentialequations, weaksolutions,Changeofmeasure,Changeoftime, Girsanovstheorem.

References

[1]Richard Durrett, Stochastc CalculusA Practical Introduction, CRC Press 1996.
[2]KaratzasI. and Steven Shreve, BrownianMotionand Stochastic Calculus, Springer.
[3]OksendalBernt, StochasticDifferential Equations, Springer.
[4]J.MichaelSteele, Stochastic Calculus and Financial Applications, Springer,2000

M805 : Computational Mathematics III

Unit I DifferentialGeometryofcurvesandsurfacesusingMathematica.ExploringDifferential EquationandDynamicalSystemusingXPPAUTorsomeotherspecializedsoftware.

UnitII DesignofExperimentsandStatisticsQualitycontrolusingR.Project/MathModeling problemusinganyMathematical SoftwareanddevelopingMathematica packagesforvarious specificmethods.

UnitIII ExploringsolutionsofPartialDifferentialequationsusingMathematica.Developing programmestosolveproblemsnumerically.

UnitIVExploringbasicNotionsofCommutativealgebrausingSage/Singular/Kashetc.

UnitV AdvancednotionofoptimizationtechniquesusingMathematica.Project/MathModeling problemusinganyMathematical SoftwareanddevelopingMathematica packagesforvarious specificmethods.

References

[1] Alfred Gray, Elsa Abbena, Simon Salamon, ModernDifferential Geometry of Curves and Surfaces with Mathematica, Third Edition.

FIFTHYEAR

SEMESTER–IX

Subject Code	Subject	ContactHours/ Week Theory+Tutorials	Credits
MPr901	Project		20
		Semester Credits	**20**
		Subtotal	**220**

SEMESTER–X

Subject Code	Subject	ContactHours/ Week Theory+Tutorials	Credits
ME1001	Elective 1	[3+1]	4
ME1002	Elective 2	[3+1]	4
ME1003	Elective 3	[3+1]	4
ME1004	Elective 4	[3+1]	4
ME1005	Elective 5	[3+1]	4
		Semester Credits	**20**
	Total Credits (with 5 Electives)		**240**
	Minimumrequired		**240**

Electives

In 10th semester, four subjects out of the8 Electiveswill be offered according to the availability of instructors and more than 50% of students opting for a course.

Elective-1: Integrated M.Sc. 10th Semester (Mathematics)

Dynamical Systems Using Matlab

Introduction to Matlab

Unit-I: Arithmetic Operations, built-in-MATH functions, scalar variables, creating arrays, built-in functions for handling arrays, mathematical operations with arrarys, script files, two dimensional plots, programming in MATLAB, polynomial, curve fitting, and interpolation, three-dimensional plots.

Discrete Dynamical Systems

Unit-II: One-dimensional maps, cobweb plot: graphical representation of an orbit, stability of fixed points, periodic points, the family of logistic maps, sensitive dependence on initial conditions, analysis of logistic map, Periodic Windows, Feigenbaum number, chaos in logistic map.

Unit-III: higher-dimensional maps, sinks, sources, and saddles, nonlinear maps and the jacobian matrix, stable and unstable manifolds, lyapunov exponents, Numerical Calculation of Lyapunov

Exponent, chaotic orbits. Strange Attractors, Gaussian and Hénon Maps. Julia Sets and the Mandelbrot Set.

Differential Dynamical Systems

Unit-IV: Differential dynamical systems, existence and uniqueness theorem, phase portraits, vector fields, nullclines, flows, fixed points, linearization of vector fields, planar systems, canonical forms, eigenvectors defining stable and unstable manifolds, phase portraits of linear systems in the plane, linearization and Hartman's theorem, limit cycles, existence and uniqueness of limit cycles in the plane, Lyapunov functions and stability.

Unit-V: Nonlinear systems and stability, bifurcations of nonlinear systems, normal forms, multistability and bistability, the Rössler system and chaos, the Lorenz equations, Chua's circuit, and the Belousov–Zhabotinski reaction.

Books and References:

1. Dynamical Systems with Applications using MATLAB® 2nd edition, Stephen Lynch, Springer International Publishing Switzerland 2014.
2. CHAOS: An Introduction to Dynamical Systems, Kathleen T. Alligood Tim D. Sauer James A. Yorke, Springer-Verlag .
3. Nonlinear Dynamics And Chaos**:** With Applications to Physics, Biology, Chemistry, and Engineering, Steven H. Strogatz, CRC Press Taylor & Francis Group, 2018.
4. Differential Equations, Dynamical Systems, and an Introduction to Chaos, Morris W. Hirsch , Stephen Smale , Robert L. Devaney , Elsevier, 2013.
5. Dynamical Systems with Applications using Mathematica, 2nd edition, Stephen Lynch , Springer International Publishing, 2017.

Elective-2: Integrated M.Sc. 10th Semester (Mathematics)

Mathematical Biology

Unit- I: Simple Single Species Models: **Continuous Population Models**, Exponential Growth, The Logistic Population Model, Harvesting in Population Models, Constant-Yield and Constant-Effort Harvesting, Eutrophication of a Lake: A Case Study.

Discrete–Time Metered Models, Systems of Two Difference Equations, Oscillation in Flour Beetle Populations: A Case Study.

Unit-II: Continuous Single-Species Population Models with Delays: Models with Delay in Per Capita Growth Rates, Delayed-Recruitment Models, Models with Distributed Delay, Harvesting in Delayed Recruitment Models, Nicholson's Blowflies: A Case Study.

Unit-III: Models for Interacting Species: The Lotka–Volterra Equations, The Chemostat Model, Equilibria and Linearization, Qualitative Behavior of Solutions of Linear Systems, Periodic Solutions and Limit Cycles, Species in Competition, Kolmogorov Models, Mutualism, The Spruce Budworm: A Case Study.

The Community Matrix, the Nature of Interactions Between Species, Invading Species and Coexistence.

Unit-IV: Harvesting in Two-species Models: Harvesting of Species in Competition,Harvesting of Predator–Prey Systems,Intermittent Harvesting of Predator–Prey Systems,Some Economic Aspects of Harvesting,Optimization of Harvesting Returns,A Nonlinear Optimization Problem, Economic Interpretation of the Maximum Principle.

Unit-V: Models for Populations with Age and Spatial Structure: Linear model with age structure, The Method of Characteristics, Nonlinear Continuous Models, Models with Discrete Age Groups, Some Simple Examples of Metapopulation Models, A General Metapopulation Model, A Metapopulation Model with Residence and Travel, The Diffusion Equation, Solution by Separation of Variables, Solutions in Unbounded Regions, Linear Reaction–Diffusion Equations, Nonlinear Reaction–Diffusion Equations, Diffusion in Two Dimensions.

Books and References:

1. Mathematical Models in Population Biology and Epidemiology, 2^{nd} edition, Fred Brauer, Carlos Castillo-Chavez, Texts in Applied Mathematics 40, Springer, 2012.
2. Elements of Mathematical Ecology, Mark Kot, Cambridge University Press, 2001.
3. Mathematical Biology-I: An Introduction, James D. Murray, Springer, 2002.
4. Mathematical Biology-II: Spatial Models and Biomedical Applications, James D. Murray, Springer, 2003.

Elective-3: Integrated M.Sc. 10th Semester (Mathematics)

Financial Mathematics

Unit I: Review Of probability, finite probability space.

Unit II: Derivatives security, interest rates, other financial instruments, Arbitrage and pricing, risk less issue, yield curves, mean terms matching and immunization, interest rate models.

Unit III: Dependent annual rates of return, random walk and Markov process, stochastic calculus.

Unit IV: option pricing, portfolio optimization, Fokker-plank equation, distribution and green functions.

Unit V: Feynman-kac formula options, dividends revisited. Exotic options.

Books and References:

1. Financial mathematics, Richard Brass, Springer, 2003
2. Mathematics of financial derivatives, Wilmott & Howison, Springer, 2005
3. Hand book of stochastic methods, Gardiner, Wiely, 2000
4. The Mathematics of Financial Derivatives: A Student Introduction, Wilmott, Dewynne and Howison, Cambridge University Press, 1995
5. Futures, and Other Derivatives, 5th ed, Hull, Prentice Hall, 2000

Elective-4: Integrated M.Sc. 10th Semester (Mathematics)

Non-linear Analysis

Unit-I: Calculus in Banach space

Various form of continuiuty, geometry in normed spaces and duality mappings, Gateaux and Frechet derivative, properties of derivatives, Taylor theorem, inverse function theorem and impliocit function theorem, subdeifferential of convex function.

Unit-II: Monotone operators

Monotone operators, Maximal monotone operators and its propwerties, constructive solution of operator equations, subdifferential and monotonicity, some generalization of monotone operator.

Unit-III: Fixed point theorems

Banach contraction principle and its generalizations, nonexpansive mappings, fixed point theorem of Brouwder and Schauder. Fixed point theorems for multi-functions, common fixed point theorems, sequence of contractions, generalized contractions and fixed points.

Unit-IV: Applications of monotone operators theory

Introduction, Sobolev space, differential equation, nonlinear differential equations, integral equation, Nonlinear ammerstein integral equation, Generalized Hammerstein integral equation.

Unit-V: Applications of fixed point theorems

Application to Geometry of Banach Spaces, Application to System of Linear Equations, Perron–Frobenius, Fundamental Theorem of Algebra, Game Theory and Nash Equilibria, Differential eqautions , integral equations.

Books and References:

1. Some topics in nonlinear analysis, M. C. Joshi and R. K. Bose, Wiley Eastern limited, New Delhi, 1985.
2. An introduction to nonlinear analysis and fixed point theory, H. K. Pathak, Springer, 2018.
3. Nonlinear functional analysis and its applications-I, Fixed point theorem, Zeidler, Springer, Heidelberg, 1986.
4. Nonlinear functional analysis, Akerker, Narosa publishing house, New Delhi.

Elective-5: Integrated M.Sc. 10th Semester (Mathematics)

Operations Research

Unit I Introduction, Nature and Scope of operations research. Linear Programming: Introduction, Mathematical formulation of the problem, Graphical Solution methods, Mathematical solution of linear programming problem, Slack and Surplus variables. Matrix formulation of general linear programming problems.

Unit II The Simplex Method: Simplex algorithm, Computational procedures, Artificial variables, Two phase Simplex Method, Formulation of linear programming problems and its solution by simplex method.

Unit III Unrestricted variables, problems of degeneracy, Principle of duality in simplex method, Formation of dual with mixed type of constraints, Solution of primal and dual constraints.

Unit IV Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.

Unit V Game Theory: Introduction, Two persons zero sum games, The maxmin and minimax principles. Graphical Solution: Reduction of game problem to LPP.

Books and References:

1. Introduction to Operations Research', Hillier, F.S. and G.J. Lieberman, , 9th Ed., 2010, McGraw Hill, New York.
2. Operation Research, Kanti Swarup,P K Gupta, Man Mohan, Sultanchand and Sons.
3. Operation Research, Theory and Application, J.K. Sharma, Macmillan India.
4. Linear Programming, N.P. Loomba, Tata Mc-Graw Hill.
5. Operation Research: An Introduction, H.A. Taha, Macmillan India.

Elective-6: Integrated M.Sc. 10th Semester (Mathematics)

Introduction to Cryptography

Unit-I:

Classical Cryptosystems: Some Simple Cryptosystems, Monoalphabatic and Polyalphabatic cipher, The Shift Cipher, The Substitution Cipher, The Affine Cipher, The Vigenere Cipher, The Hill Cipher, The Permutation Cipher, Cryptanalysis, Some Cryptanalytic Attacks, Stream ciphers, Synchronous Stream Cipher, Linear Feedback Shift Register (LFSR), Non-Synchronous stream Cipher, Autokey Cipher.

Unit-II:

Block Ciphers: Mode of operations in block cipher: Electronic Codebook (ECB), Ciphertext Chaining (CBC), Ciphertext FeedBack (CFB), Output FeedBack (OFB), Counter (CTR),
DES & AES: The Data Encryption Standard (DES), Feistel Ciphers, Description of DES, Security analysis of DES, Differential & Linear Cryptanalysis of DES, Triple DES, The Advanced Encryption Standard (AES), Finite field GF(28), Description of AES, analysis of AES.

Unit-III:

Shannon's Theory of Perfect Secrecy: Perfect Secrecy, Birthday Paradox, Vernam One Time Pad, Random Numbers, Pseudorandom Numbers. **Prime Number Generation:** Trial Division, Fermat Test, Carmichael Numbers, Miller Rabin Test, Random Primes.

Unit-IV: Public Key Cryptography:

Principle of Public Key Cryptography, RSA Cryptosystem, Factoring problem, Cryptanalysis of RSA, RSA-OAEP, Rabin Cryptosystem, Security of Rabin Cryptosystem, Quadratic Residue Problem, Diffie-Hellman (DH) Key Exchange Protocol, Discrete Logarithm Problem (DLP), ElGamal Cryptosystem, ElGamal& DH, Algorithms for DLP. Elliptic Curve, Elliptic Curve Cryptosystem (ECC), Elliptic Curve Discrete Logarithm Problem (ECDLP).

Unit-V: Cryptographic Hash Functions:

Hash and Compression Functions, Security of Hash Functions, Modification Detection Code (MDC0. Message Authentication Codes (MAC), Random Oracle Model, Iterated Hash Functions, Merkle-Damgard Hash Function, MD-5, SHA-1, Others Hash Functions.

Digital Signatures: Security Requirements for Signature Schemes, Signature and Hash Functions, RSA Signature, ElGamal Signature, Digital Signature Algorithm (DSA), ECDSA, Undeniable Signature, Blind Signature.

Books and References:

1. J Buchmann, Introduction to Cryptography, Springer (India) 2004
2. S. Padhye, R A Sahu, V Saraswat, Introduction to Cryptography, CRC Press, 2018
3. D R Stinson, Cryptography: Theory and Practice. CRC Press, 2000.
4. Bruce Schenier, Applied cryptography, John Wiley & Sons, 1996.
5. B Forouzan, Cryptography and Network security, Tata McGraw Hill, 2011
6. Wenbo Mao, Modern Cryptography: Theory and Practice. Pearsion Education, 2004

7. W Starling, Cryptography and Network security, Pearson Education, 2004.

Elective-7: Integrated M.Sc. 10th Semester (Mathematics)

Introduction to Nonlinear Optimization

Unit-I: Mathematical Preliminaries, the Space R^n, R^{nxm}, Inner Products and Norms, Eigen values and Eigen vectors, Basic Topological Concepts.

Unit-II: Optimality Conditions for Unconstrained Optimization: Global and Local Optima, Classification of Matrices, Second Order Optimality Conditions, Global Optimality Conditions, Quadratic Functions.

Unit-III: Least Squares: Solution of over determined Systems, Data Fitting, Regularized Least Squares, Denoising, Nonlinear Least Squares. Descent Directions Methods, The Gradient Method, The Condition Number, Diagonal Scaling, The Gauss–Newton Method, The Fermat–Weber Problem, Convergence Analysis of the Gradient Method.

Unit-IV: Newton's Method, Pure Newton's Method, Damped Newton's Method, The Cholesky Factorization. Convex Sets, Algebraic Operations with Convex Sets, The Convex Hull, Convex Cones, Topological Properties of Convex Sets, Extreme Points.

Unit-V: Convex Functions, First Order Characterizations of Convex Functions, Second Order Characterization of Convex Functions, Operations Preserving Convexity, Level Sets of Convex Functions, Maxima of Convex Functions, Convexity and Inequalities, Convex Optimization, The Orthogonal Projection Operator, Optimization over a Convex Set, Stationarity in Convex Problems, The Orthogonal Projection Revisited, The Gradient Projection Method, Sparsity Constrained Problems.

Books and References:

1. Introduction to Nonlinear Optimization Theory, Algorithms, and Applications with MATLAB, Amir Beck, Society for Industrial and Applied Mathematics, 2014.
2. Optimization Theory and Methods: Nonlinear Programming, Wenyu Sun, Ya-Xiang Yuan, Springer, 2006.
3. Nonlinear Optimization, Francisco J. Aragón, Miguel A. Goberna Marco A. López, Margarita M. L. Rodríguez, Springer Undergraduate Texts in Mathematics and Technology, 2019.
4. Nonlinear Optimization: Methods and Applications, H. A. Eiselt, Carl-Louis Sandblom, Springer 2019.

Elective-8: Integrated M.Sc. 10th Semester (Mathematics)

Complex Network

UNIT-I: Fundamentals of Graph Theory**,** Directed, Weighted and Bipartite Graphs, Trees. Complex Network, Basics, history and importance of Complex Network.

UNIT-II: Centrality Measures: The Importance of Being Central, Connected Graphs and Irreducible Matrices, Degree and Eigenvector Centrality, Measures Based on Shortest Paths, Group Centrality.

Unit –III: **Random Graphs:** Erd″os and Rényi (ER) Models, Degree Distribution, Trees, Cycles and Complete Sub-graphs, Giant Connected Component, Scientific Collaboration Networks, Characteristic Path Length.

Unit-IV: **Small-World Networks:** Six Degrees of Separation, The Brain of a Worm, Clustering Coefficient, The Watts–Strogatz (WS) Model, Variations to the Theme, Navigating Small-World Networks.

Unit-V: **Generalised Random Graphs:** The World Wide Web, Power-Law Degree Distributions, The Configuration Model, Random Graphs with Arbitrary Degree Distribution, Scale-Free Random Graphs, Probability Generating Functions. Models of Growing Graphs, Degree Correlations.

Books and References:

1. Complex Networks : Principles, Methods and Applications , Vito Latora , Vincenzo Nicosia , Giovanni Russo , Cambridge University Press, 2017
2. Graph Theory and Complex Networks: An Introduction, Maarten van Steen, Maarten van Steen, 2010.
3. Lectures on Complex Networks, S. N. Dorogovtsev, Clarendon Press Oxford, 2010.
4. The Structure Of Complex Networks: Thoery and Applications, Ernesto Estrada, Oxford University Press, 2011

SEMESTER WISE COURSE OUTCOMES:

Int. M. Sc. Mathematics program
M101: Mathematics-I (for PCM Group) • Understand the concept of co-ordinate geometry: straight line, circle etc. • Understand the complex numbers their operations and functions of complex variable. • Construct derivatives of: power, trigonometric, exponential, hyperbolic, logarithmic, and inverse trigonometric functions; products and quotients; composite functions using the chain rule. • Evaluate integrals by using substitution, partial fractions and integration by parts. • Explain the concept of a definite integral and know the basic properties of definite integrals. • State the Fundamental Theorem of Calculus and be able to use it for evaluating definite integrals and derivatives of integrals with variable limits of integration. • Understand the concept of area of regions with curvilinear boundaries and be able to find area between curves. • Understand and manipulate systems of linear equations. • Understand the basic concept of vectors, geometric interpretation of vector operations, dot product, cross product and triple products.
MB101: Mathematics-I (for PCB Group)

- Calculate limits by eliminating zero denominators and use of l'Hôpital's rule.
- To understand the concept of derivatives and its application in finding maxima, minima, curve tracing etc.
- Construct derivatives of: power, trigonometric, exponential, hyperbolic, logarithmic, and inverse trigonometric functions; products and quotients; composite functions using the chain rule.
- Evaluate integrals by using substitution, partial fractions and integration by parts.
- Explain the concept of a definite integral and know the basic properties of definite integrals.
- State the Fundamental Theorem of Calculus and be able to use it for evaluating definite integrals and derivatives of integrals with variable limits of integration.
- Understand the concept of area of regions with curvilinear boundaries and be able to find area between curves.

M201: Mathematics-II (for Physics and Chemistry Group)

Students should be able to understand

- Algebra of Matrices, Rank, Nullity, Echelon form, Normal form
- Scalar and vector valued functions of 2 and 3 variables and surfaces, and in turn the geometry of surfaces,
- Gradient vector fields and constructing potentials,
- Integral curves of vector fields and solving differential equations to find such curves,
- The differential ideas of divergence, curl, and the Laplacian along with their physical interpretations, using differential forms or tensors to represent derivative operations,
- The integral ideas of the functions defined including line, surface and volume integrals - both derivation and calculation in rectangular, cylindrical and spherical coordinate systems and understand the proofs of each instance of the fundamental theorem of calculus, and
- Examples of the fundamental theorem of calculus and see their relation to the fundamental theorems of calculus, leading to the more generalised version of Stokes' theorem in the setting of differential forms.

M201: Mathematics-II (for Mathematics Stream Only)

Students should be able to understand

- Algebra of Matrices, Rank, Nullity, Echelon form, Normal form
- Scalar and vector valued functions of 2 and 3 variables and surfaces, and in turn the geometry of surfaces,
- Vectors in R^2 and R^3, basic vector operations and their properties.
- Multiple integral, Integral as a limit of sum
- Region of Integration, change of order of integration

- Green’s Theorem and its applications

MB201: Mathematics-II (For Biology Stream Only)

- Understand basic vector linear algebra.
- Use of matrix method to solve linear equations.
- Change of Coordinate systems, Curvilinear Coordinate Systems.
- Understand Spherical and Cylindrical coordinate systems.
- Understand basic notions of vector space, sub-space, matrix representations and their properties.

M301: Foundations

- Grasp the principles and practices of their field of study.
- Recognize and construct a valid proof, and use counterexamples to disprove assertions.
- Understand the difference between necessary and sufficient conditions.
- Understand Sets, its basic operations.
- Understand and use the relation between equivalence relations and partitions.
- Perform the division and Euclidean algorithms on integers and polynomials.
- State examples of simple definitions, theorems, proofs and counterexamples.
- Define and apply the following concepts for sets: union, intersection, power set, cardinality, finite set, countable set, uncountable set.
- Determine whether a specified function is injective, surjective or bijective.
- Define what is meant by a sequence and a relation.
- Prove appropriate propositions using induction.

M302: Analysis I

- Understand limit, Continuity and Differentiability and their properties.
- Define a metric space and associated properties.
- Recognise the properties of a metric space in specific examples.
- Interpret concepts from analysis of a single real variable (convergence, uniform continuity) in the context of metric spaces.
- Define open and closed sets, and know how they relate to continuity and other simple properties.
- Define important concepts such as compactness and completeness, recognise them in concrete examples, and use them to derive conclusions.

M303: Algebra I

- define groups, homomorphisms, (normal) subgroups, quotient groups and related objects.
- Define and compute with examples, including the quaternion group, dihedral groups, the symmetric group and matrix groups.
- State and prove basic properties of groups, including Lagrange's Theorem and the Isomorphism Theorems.

- State and (with guidance) prove more advanced results concerning groups.
- Define group actions, work with examples, and prove basic results.
- Create examples to illustrate the underlying theory, and work with these examples.
- Recount and explain concepts of group theory.
- State the main definitions for rings, integral domains, and fields.
- State standard results in introductory ring theory, and be able to apply these results.
- Prove basic results in the theory of rings.
- Calculate in various types of rings, such as polynomial rings, the Gaussian integers, and certain factor rings.

M304: Discrete Mathematics

- Construct mathematical arguments using logical connectives and quantifiers.
- Validate the correctness of an argument using statement and predicate calculus.
- Understand how lattices and Boolean algebra are used as tools and mathematical models in the study of networks.
- Graph theory, various types of graph and their properties.
- learn how to work with some of the discrete structures which include sets, relations, functions, graphs and recurrence relation .

M305: Computational Mathematics I

- Use of Spreadsheet Programs
- Understand fundamentals of Mathematica and its computational efficiency
- Use of Mathematica to understand Calculus, Linear Algebra
- Use of Mathematica to solve linear and nonlinear equations.

GL301: Computation Mathematics Laboratory

- Using Programming languages to implement contents of M305

M401: Analysis II

- Know what is meant for a function of two variables to be continuous.
- Calculate partial derivatives, directional derivatives, estimate the rate of change in a given direction, and do implicit differentiation.
- Know the chain rule for functions of two and three variables and be able to use it.
- Find local extreme values and classify their type.
- Know the properties of double integrals and be able to calculate multiple integrals.
- Explain the concepts of infinite, converging and diverging for infinite sequences as well as series, and be able to test for these properties.
- Recognise and apply the concepts of power series and geometric series.
- Know the Taylor formula, and be able to apply it to obtain power series and estimate the error of approximation by using Taylor polynomials.

M402: Algebra II

- Solve linear systems and write solutions in vector form.
- Calculate the product of two matrices; calculate the transpose of a matrix; calculate the determinant, eigenvalues and eigenvectors of a square matrix; determine whether a given matrix is invertible; calculate the inverse of an invertible matrix; use algebraic equations of matrices.
- Determine whether or not a given subset of a vector space is a subspace; whether or not a given vector is in the subspace spanned by a set of vectors; and whether given vectors are linearly independent and/or form a basis for a vector space or subspace.
- Find the coordinates of a vector with respect to a given ordered basis; calculate the transition matrix corresponding to a change of basis; calculate the rank of a matrix; determine bases for the row and column spaces of a matrix.
- Verify whether a mapping between vector spaces is linear, and if so calculate the matrix of the mapping with respect to given bases.
- Calculate the scalar product of two vectors and determine whether the vectors are orthogonal and/or orthonormal; find the orthogonal projection of a vector onto a given subspace and the closest vector in a given subspace to a given vector.
- Determine the set of least-squares solutions of a given linear system.
- Apply the Gram-Schmidt process.
- Apply standard results about diagonalisation of matrices as follows: for a real square matrix $\mathbf{A}$ with distinct eigenvalues, find an invertible matrix $\mathbf{P}$ such that $\mathbf{P}^{-1}\,\mathbf{A}\,\mathbf{P}$ is diagonal; and for a real symmetric matrix $\mathbf{A}$, find an orthogonal matrix $\mathbf{Q}$ such that $\mathbf{Q}^{T}\,\mathbf{A}\,\mathbf{Q}$ is diagonal.
- Construct a mathematical argument in order to deduce or prove simple facts about vectors, matrices, vectors spaces and linear maps.

M403: Elementary Number Theory

- Use continued fractions to develop arbitrarily accurate rational approximations to rational and irrational numbers.
- Analyze Diophantine equations, i.e. polynomial equations with integer solutions.
- Know what it means to say that an integer is a quadratic reside modulo an odd prime, and calculate whether this relation is true for a given integer and prime.
- Know some of the famous classical theorems and conjectures in number theory, such as Fermat's Last Theorem and Goldbach's Conjecture, and describe some of the tools used to investigate such problems.

M404: Topology I

- Understand to construct topological spaces from metric spaces and using general properties of neighborhoods, open sets, close sets, basis and sub-basis.
- Apply the properties of open sets, close sets, interior points, accumulation points and derived sets in deriving the proofs of various theorems.
- To understand the concepts of countable spaces and separable spaces.
- Understand the concepts and properties of the compact and connected topological spaces.

G401:Statistical Techniques and Applications

- Plot one and two-dimensional data in an appropriate way and interpret such plots.
- Calculate summary statistics for a set of data.
- Explain the concepts of populations and samples and different kinds of variables.
- Explain the concepts of hypothesis testing.
- Explain concepts of estimation.
- Carry out tests and calculate confidence intervals for normal samples with known variance.
- Calculate moments of and make simple transformations of random variables.
- Calculate normal approximations to binomial and Poisson probabilities.
- Use an appropriate statistical package to perform calculations and interpret its output.
- Compute marginal and conditional probability density functions from the joint probability density function.
- Construct transformations of random variables in simple examples.
- Explain what is meant by a moment generating function and apply it appropriately.
- Explain the relationships between distributions related to the normal distribution.
- Carry out 1- and 2-sample t tests, F-tests and matched pairs t-tests.
- Carry out chi-squared goodness of fit tests for samples from specified population models.
- Carry out tests of association for contingency tables.
- State and apply Chebyshev's inequality and the weak law of large numbers.
- State and apply the Central Limit Theorem.
- State the main properties of a bivariate normal distribution.

GL401: Computational Laboratory & Numerical Methods

- Solving ODE using different method in Mathematica and Python.
- Numerical Integration using Mathematica and Python.
- Numerical Differentiation
- Interpolation

GL402: Statistical Techniques Laboratory

Using R programming language, students should be able to:

- Plot one and two-dimensional data in an appropriate way and interpret such plots.
- Calculate summary statistics for a set of data.
- Explain the concepts of populations and samples and different kinds of variables.
- Explain the concepts of hypothesis testing.
- Explain concepts of estimation.
- Carry out tests and calculate confidence intervals for normal samples with known variance.
- Calculate moments of and make simple transformations of random variables.
- Calculate normal approximations to binomial and Poisson probabilities.

M501: Analysis III • Explain the concept of length, area, volume using Lebesgue theory. • Apply the properties of integrals to the proof of completeness of certain functional spaces. • Apply the general principles of measure theory and integration in such concrete subjects as the Theory of Probability or Financial Mathematics. • Prove the Radon-Nikodym theorem and product measure space.
M502: Algebra III • Describe key advanced concepts of algebra and give precise definitions of terms used. • Describe key applications of algebra as covered in the module. • Apply the concepts learned to appropriate problems in advanced algebra. • Explain the steps of reasoning used in solving specific problems in advanced algebra.
M503: Topology II • Topological spaces, order topology and product topology • Separation axioms, countability axioms Urysohn's metrization theorem • Function spaces, pointwise and uniform convergence, Stone-Weierstrass Theorem. function
M504: Probability Theory • Write down the sample space for simple experiments, including sampling with and without replacement, and calculate probabilities in straightforward instances of these types of experiment. • State the Kolmogorov axioms for probability and make simple deductions from them. • Calculate the probability of the complement of an event and the union of two disjoint events. State and use the inclusion-exclusion formula for the probability of the union of two events. • Define and recognise independent events. Use independence to calculate probabilities. • Define conditional probability and calculate it. • Know the Theorem of Total Probability and use it in the case of a partition of the sample space into two events. • Define and use the concept of a random variable and the probability mass function of a discrete random variable. • Find the expectation and variance of discrete random variables. • Know the main properties of Bernoulli, binomial, geometric, and Poisson random variables. • Understand conditional expectations, its properties.

PM501: Numerical Analysis

- Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.
- learn how to obtain numerical solution of nonlinear equations using bisection, secant, Newton and fixed-point iterations methods and convergence analysis of these methods.
- solve linear and nonlinear systems of equations numerically.
- apply numerical methods to find eigen value and eigen vectors.
- handle the functions and data set using interpolation and least square curves.
- Evaluate the integrals numerically.
- Learn how to solve initial and boundary value problems numerically.

PML501: Numerical Methods Laboratory

- Use a programming language to perform mathematical calculations on a computer.
- Implement Euler and Runge-Kutta methods to solve ordinary differential equations.
- Generate random variables with a variety of different distributions.
- Implement Monte-Carlo methods to calculate integrals in one and higher dimensions.

M601: Analysis IV

- Find all complex solutions of a simple polynomial, indicating their position in the Argand diagram.
- Calculate the derivative of a complex function, explaining where this is well-defined.
- Explain what is meant by entire, holomorphic and harmonic functions.
- Derive the Cauchy-Riemann equations for a given function and apply this to determine the set of points in the Argand diagram for which the function is differentiable.
- Use the theory of Möbius transformations to solve simple problems.
- Calculate the Taylor and Laurent series of a function about a given point.
- Define the terms residue and pole, locate them for a given function and calculate their orders.
- Explain what is meant by a simple pole, a pole of order m and an essential singularity.
- Define the contour integral of a complex function and evaluate it along a simple contour.
- State the Residue Theorem and apply it when appropriate to calculate a contour integral.

M602: Algebra IV

- Students should become familiar with rings and fields, and understand the structure theory of modules over a Euclidean domain along with its implications.
- The material underpins many later courses in algebra and number theory, and thus should give students a good background for studying these more advanced topics

M603: Differential Geometry & Applications • Precisely define and describe basic geometric concepts, such as curves and surfaces. • Explain how geometric properties of curves and surfaces and be captured and quantified, and apply apply this knowledge in order to perform computations. • Demonstrate how ideas from differential and integral calculus can be extended to geometric settings. • Demonstrate how calculus and linear algebra can be connected to and applied to geometric concepts and questions. • Explain the main ideas behind proofs of basic results in curve and surface geometry. • Explain some ways that geometric ideas can be applied to questions in other areas of mathematics or outside of mathematics.
M604: Differential Equations & Dynamical Systems • Identify and solve first-order ordinary differential equations (ODEs) that are separable, exact or linear, or can be reduced to the above by standard methods. • Identify and solve linear second-order non-homogeneous differential equations with constant coefficients and associated initial value problems. • Identify and investigate boundary value problems for linear second-order ODEs. • Identify and solve general systems of first-order linear differential equations with constant coefficients using matrix operations. • Explain the notions of phase space, trajectories, and equilibria for autonomous systems of two first-order differential equations. • Explain the notions of stability for general systems of differential equations and apply a given Lyapunov function for investigating the stability of simple nonlinear systems of differential equations. • Find equilibria of a given autonomous system of differential equations and describe the system's behaviour and the phase portrait close to an equilibrium in linear approximation.
M605: Computational Mathematics II • Use of SAGE to solve linear algebra • Solving Optimization using Mathematica • Complex Analysis and Differential Equations using Mathematica
PML601: Numerical Methods Laboratory • Implementation of Contents of PM501 Numerical Analysis using Python.
M701: Functional Analysis • Basic idea of a normed linear spaces and operators on normed linear space.

- Open Mapping theorem, Hahn-Banach Theorem and their applications.
- To learn to recognize the fundamental properties of normed spaces and of the transformations betweenthem.
- To be acquainted with the statement of the Hahn-Banach theorem and its corollaries.
- To understand the notions of dot product and Hilbert space.
- To Understand the statements and proofs of important theorems and be able to explain the key steps inproofs, sometimes with variation.

M702: Commutative Algebra

- Knows basic definitions concerning elements in rings, classes of rings, and ideals in commutative rings.
- Know constructions like tensor product and localization, and the basic theory for this.
- Know basic theory for noetherian rings and Hilbert basis theorem.
- Know basic theory for integral dependence, and the Noether normalization lemma.
- Have insight in the correspondence between ideals in polynomial rings, and the corresponding geometric objects: affine varieties.
- Know basic theory for support and associated prime ideals of modules, and know primary decomposition of ideals in noetherian rings.
- Know the theory of Gröbner bases and Buchbergers algorithm.
- Know the theory of Hilbert series and Hilbert polynomials.
- Know dimension theory of local rings.

M703: Differential Topology

- give an account of central concepts and definitions in differential topology;
- state Sard's theorem and some of its applications;
- define and compute mapping degree and intersection number of two submanifolds;
- define index of a vector field and state the Poincaré-Hopf theorem;
- define Morse function and outline a proof of existence;
- state the classification of one- and two-dimensional manifolds.

M704: Partial Differential Equations

- Use partial differential equations to model certain physical systems.
- Choose the most appropriate method to solve a range of partial differential equations.
- Understand the limitations of analytical solution methods and understand where numerical methods are required.

M705: Representation Theory of Finite Groups

- to know in particular simple modules and semi-simple algebras and they will be familiar with examples.

- To appreciate important results in the course such as the Jordan-Hölder Theorem, Schur's Lemma, and the Wedderburn Theorem.
- To be familiar with the classification of semi-simple algebras over C and be able to apply this to representations and characters of finite groups.

M801: Fourier Analysis

- In-depth knowledge of Fourier analysis and its applications to problems in physics and electrical engineering.
- An ability to communicate reasoned arguments of a mathematical nature in both written and oral form.
- An ability to read and construct rigorous mathematical arguments.

M802: Algebraic Number Theory

- field extensions, minimum polynomial, algebraic numbers, conjugates, discriminants, Gaussian integers, algebraic integers, integral basis
- examples: quadratic fields
- norm of an algebraic number
- existence of factorisation
- factorisation in $Q(\sqrt{d})$
- ideals, Z
- -basis, maximal ideals, prime ideals
- unique factorisation theorem of ideals
- relationship between factorisation of number and of ideals
- norm of an ideal
- ideal classes
- statement of Minkowski convex body theorem
- finiteness of class number %
- statement of Dirichlet's theorem on finite generation of units
- computations of class number to go on example sheets

M803: Algebraic Topology

- Explain the fundamental concepts of algebraic topology and their role in modern mathematics and applied contexts.
- Demonstrate accurate and efficient use of algebraic topology techniques.
- Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from algebraic topology.
- Apply problem-solving using algebraic topology techniques applied to diverse situations in physics, engineering and other mathematical contexts.

M804: Stochastic Analysis

- Specify a given discrete-time Markov chain in terms of a transition matrix and a transition diagram.
- Calculate *n*-step transition probabilities.

- Apply first-step analysis to calculate absorption probabilities and mean time to absorption for a discrete-time Markov chain.
- State and apply the definition of irreducible and regular Markov chain, and calculate the equilibrium and limiting distributions as appropriate.
- Assess whether states are recurrent or transient in simple cases.
- State and apply the definition of the Poisson process, in both axiomatic and infinitesimal form.
- State and apply a number of definitions and basic results concerning the Poisson process.
- For pure Birth processes such as the Poisson process, state and use results about interarrival times.
- For a birth-death process or finite state space continuous time Markov process, derive and apply the backwards and forwards equations, and find the equilibrium distribution. State and use results about sojourn times and the jump chain.

M805: Computational Mathematics III

- Understand fundamentals of XPPAUT
- Dynamical System using XPPAUT
- Solving PDE using Mathematica
- Commutative algebra using SAGE
- Optimization Techniques using Mathematica

MPr901: Project

- Study independently towards the understanding of material from a reading list.
- Independently identify and assimilate background material from a variety of sources.
- Compose a substantial account of a mathematical topic in an appropriate style, including the selection and structuring of the material.
- Make a short seminar-level presentation of a mathematical topic, including the selection and structuring of the material.

- Connect information and ideas within their field of study.
- Use writing for learning and reflection.
- Explain and argue clearly and concisely.
- Apply different forms of communication in various social, professional and cultural settings.
- Identify information needs appropriate to different situations.
- Acquire substantial bodies of new knowledge.

ME1001:Dynamical Systems Using Matlab

- Understand basics of Matlab Software.
- Explain how ordinary differential equations (ODEs) give rise to dynamical systems.
- Define the state space, its limit sets and attractors.
- Explain how the state space dimension limits the possible dynamics.
- Sketch the limit set and, starting from this, characterize the main features in the flow of a dynamical system given by ODEs in the plane.
- Explain the concept of chaos in dynamical systems and state some properties of a chaotic

dynamical system.

ME1002:Mathematical Biology

- Develop the ability to explain mathematical results in language understandable by biologists.
- Understand and apply the concept of stability of a fixed point solution of a system of ordinary differential equations.
- Solve mathematically and interpret biologically simple problems involving one- and two-species ecosystems, epidemics and biochemical reactions.
- demonstrate ability to analyse qualitative aspects of ODEs in a biological modelling context.
- apply appropriate techniques to solve a given model of a biological problem.
- select appropriate approaches/methods and tools to generate mathematical models of aspects of biology.
- be able to formulate and critically evaluate epidemiological models.
- critically evaluate the merits and weaknesses of biological models.

ME1003:Financial Mathematics

- Describe various financial instruments.
- Explain how probability enters modern descriptions of financial instruments.
- Explain the time-value of money and use it to analyse simple cashflow models.
- Explain the notion of arbitrage and apply it to determine the fair price of various financial instruments.
- Appreciate that even the most basic of financial models requires a profound combination of techniques from various branches of mathematics.
- Calculate the no-arbitrage price of a European option using the Black-Scholes model.
- Explain several models appearing in financial mathematics, particularly those which are an extension or modification of geometric Brownian motion.
- Describe how techniques developed in differential equations and probability are applied to analysis of various financial models.
- Explain why comprehension of descriptive definitions associated with financial models is essential.
- Interpret descriptive definitions associated with financial models in terms of mathematical concepts.
- Recognize methods of measuring risk, understand the relationships between them and their relevance for particular applications.

ME1004:Non-linear Analysis

- Understanding calculus in Banach Space
- Fundamentals of Monotone operators
- Fixed point theorems
- Applications of Monotone Operators and Fixed point theory

ME1005:Operations Research

- explain the meaning of operations research
- know the various techniques of operations research
- use operations research tosolve transportation problems
- Assignment problem
- formulate operation research models to solve real life problem.
- Understand the concept of convexity and generalized convexity.
- To derive the necessary conditions (KT conditions) for constrained nonlinear optimization problems.
- To solve quadratic, goal and multi-objective programming problems.
- Use search technique to find the optimal solution of unconstrained optimization problems

ME1006:Introduction to Cryptography

- Describe basic concepts of cryptography and steganography; define plaintext, ciphertext and key.
- Describe substitution and other traditional ciphers and perform encryption/decryption with them.
- Describe stream ciphers including the Vigenère cipher, one-time pad and shift registers, explain their advantages and disadvantages, and perform encryption/decryption with them for simple situations.
- Construct the associated polynomial for a shift register and use it to determine if the shift register is primitive.
- Explain simple concepts associated with security of ciphers, including statistical attack methods; calculate the number of possible keys for simple substitution and stream ciphers.
- Define Euler's function and Carmichael's function; calculate them for small integers.
- Define a Latin square and perform actions on it such as finding the transpose or adjugate.
- State and prove Shannon's Theorem (for one-time pads).
- Describe the basic principles of public-key cryptography including complexity issues and knapsack, RSA and El-Gamal ciphers.
- Describe the basic principles of digital signatures and authentication; secret sharing.

ME1007:Introduction to Nonlinear Optimization

- demonstrate knowledge and understanding of nonlinear programming modelling techniques
- demonstrate knowledge and understanding of nonlinear programming solution algorithms
- understanding Least Square, Newton Method
- understanding convex and its role in optimization.

ME1008:Complex Network

- State the basic metrics to characterise the structure of a network.

- Calculate various centrality measures.
- Derive the degree distribution and the characteristic path length of a random graph.
- Explain what is meant by "small-world" and "scale-free" networks.
- Derive the degree distribution of the Barabasi-Albert model.
- State how to describe degree correlations in a network.
- State methods to extract motifs and community structures in networks.
- Describe the basic features of various real social, biological and man-made networks.

PT. RAVISHANKAR SHUKLA UNIVERSITY

Centre for Basic Sciences

Outcome Based Curriculum

Integrated M. Sc.: Biology Stream

[Choice and Credit Based System]

(Semester- I to X)

Semester Examination
SESSION 2015-2020

INDEX

Title of the Program: Integrated Master of Science in Biology

:Program Educational Objectives:

PEO1: To have fundamental as well as applied knowledge of the various fields of biology.

PEO2: To develop good practical handling of various basic as well as advanced instruments used in biological research.

PEO3: To orient the students to be able to work in research organizations of national and international repute and become the top future scientists of the country.

PEO3: To promote the students to explore and foster connections with other fields for interdisciplinary knowledge.

PEO4: To develop world class biology teachers who can understand their responsibilities in solving social and ethical issues with a scientific approach for the betterment of society.

:Program Learning Outcomes:

PLO1: Students will have knowledge of fundamental as well as applied aspects of various fields of biology along with the foundation of Physics Chemistry and Mathematics.

PLO2: Students will have the knowledge of Biochemistry, Microbiology, Immunology, Molecular Biology, Genetics along with the applied areas of Biotechnology, Bioinformatics as well as emerging areas of Nanobiotechnology, Biomaterials, Synthetic Biology etc.

PLO3: Students will develop skills for interdisciplinary research, critical thinking and problem solving ability.

PLO4: Students will be able to not only design and perform experiments but analyze and interpret data independently.

PLO5: Activities like reading project, review writing, presentations will inculcate the abilities of better written as well as oral expression of the scientific work.

Center for Basic Sciences
Pt. Ravishankar Shukla University, Raipur

Course structure for the M. Sc. (Integrated) Biology stream
1st July, 2015

(B: **B**iology, C: **C**hemistry, M: **M**athematics, P: **P**hysics, G: **G**eneral, H: **H**umanities,
BL: **B**iology **L**aboratory, CL: **C**hemistry **L**aboratory, PL: **P**hysics **L**aboratory,
GL: **G**eneral **L**aboratory, BE: **Biology E**lective, BPr: **Biology Pr**oject)

FIRST YEAR

SEMESTER-I

Subject	Subject	Contact hrs/per week Theory + Tutorials	Credits
B 101	Biology I (Introductory Biology)	[2 +1]	3
C 101	Chemistry I (Structures & Bonding)	[2 +1]	3
P 101	Physics I (Classical Physics)	[2 +1]	3
MB101	Mathematics I	[2 +1]	3
G 101	Computer Basics	[2 +1]	3
H 101	Communication Skills	[2 +0]	2
		Contact hrs/per week Lab	**Credits**
BL101	Biology Laboratory	[4]	2
CL 101	Chemistry Laboratory	[4]	2
PL 101	Physics Laboratory	[4]	2
GL 101	Computer Laboratory	[4]	2
			25

SEMESTER-II

Subject	Subject	Contact hrs/per week Theory + Tutorials	Credits
B 201	Biology II (Introduction to Macromolecules)	[2 +1]	3
C 201	Chemistry II (Chemical thermodynamics)	[2 +1]	3
P 201	Physics II (Electricity, Magnetism & Optics)	[2 +1]	3
MB101	Mathematics II (Linear Algebra, Calculus of several variables)	[2 +1]	3
G 201	Electronics & Instrumentation	[2 +1]	3
G 202	Glimpses of Contemporary Science	[2]	2
		Contact hrs/per week Lab	**Credits**
BL 201	Biology Laboratory	[4]	2

CL 201	Chemistry Laboratory	[4]	2
PL 201	Physics Laboratory	[4]	2
GL 201	Electronics Laboratory	[4]	2
			25

SECOND YEAR

SEMESTER-III

Subject	**Subject**	**Contact hrs/per week Theory + Tutorials**	**Credits**
CB301	Essential Mathematics for Chemistry & Biology	[3 +1]	4
CB 302	Biochemistry – I	[3 +1]	4
B 301	Cell Biology – I	[3 +1]	4
CB 303	Organic Chemistry-I	[3 +1]	4
H 301	World Literature	[2 +0]	2
H302	History & Philosophy of Science	[2 +0]	2
		Contact hrs/per week Lab	**Credits**
BL 301	Biology Laboratory	6	3
GL 301	Applied electronics laboratory	4	2
			25

SEMESTER-IV

Subject	**Subject**	**Contact hrs/per week Theory + Tutorials**	**Credits**
B 401	Cell Biology – II	[3 +1]	4
B 402	Biochemistry – II	[3 +1]	4
CB 401	Introductory Spectroscopy (UV-vis, fluorescence, IR, Raman, NMR)	[3 +1]	4
PCB 401	Physical & Chemical kinetics	[3 +1]	4
G 401	Statistical techniques and Applications	[3 +1]	4
		Contact hrs/per week Lab	**Credits**
BL 401	Biology Laboratory	6	3
GL 401	Computational laboratory and Numerical Methods	4	2
			25

THIRD YEAR [July 2017 to June 2018]

SEMESTER-V

Subject	**Subject**	**Contact hrs/per week Theory + Tutorials**	**Credits**
B 501	Genetics	[3 +1]	4
B 502	Molecular Biology	[3 +1]	4
B 503	Biodiversity	[3 +1]	4

CB 501	Analytical Chemistry	[3 +1]	4
G 501	Earth Sciences and Energy & Environmental Sciences	[3 +1]	4
		Contact hrs/per week Lab	**Credits**
BL 501	Biology Laboratory	10	5
			25

SEMESTER-VI

Subject	**Subject**	**Contact hrs/per week Theory + Tutorials**	**Credits**
B 601	Immunology	[3 +1]	4
B 602	Animal Physiology	[3 +1]	4
B 603	Plant Physiology	[3 +1]	4
B 604	Microbiology	[3 +1]	4
CB 601	Biophysical Chemistry	[3 + 0]	3
H601	Ethics of Science and IPR	[2 + 0]	2
		Contact hrs/per week Lab	**Credits**
BL 601	Biology Laboratory	8	4
			25

FOURTH YEAR

SEMESTER-VII

Subject	**Subject**	**Contact hrs/per week Theory + Tutorials**	**Credits**
B 701	Neurobiology	[3 +1]	4
B 702	Immunology – II	[3 +1]	4
B 703	Developmental Biology	[3 +1]	4
B 704	Imaging technology in biological research	[3 +1]	4
BPr 701	Reading Project	-	4
		Contact hrs/per week Lab	**Credits**
BL 701	Advanced Biology Laboratory	[5 + 5]	5
			25

SEMESTER-VIII

Subject	**Subject**	**Contact hrs/per week Theory + Tutorials**	**Credits**
B 801	Virolog	[3 + 1]	4
B 802	Biotechnology – I	[3 + 1]	4
B 803	Bioinformatics	[3 + 1]	4
B 804	Biotechnology – II	[3 + 1]	4

		Contact hrs/per week Lab	Credits
BL 801	Advanced Biology Laboratory	[5 + 5]	5
BPr 800	Project	-	4
			25

FIFTH YEAR

SEMESTER-IX

Subject	Subject	Contact hrs/per week Lab	Credits
BPr 901	Project	-	20
			20

SEMESTER-X

Subject Code	Subject	Contact hrs/per week Theory+Tutorials	Credits
E 1001	Electives I	[3 + 2]	5
E 1002	Electives II	[3 + 2]	5
E 1003	Electives III	[3 + 2]	5
E 1004	Elective IV	[3 + 2]	5
			20

Total Credits: 240

Note- Any four papers out of the available seven papers (mentioned in the syllabus) shall be in operation on availability of the instructors with more than 50% of students opting for them.

SEMESTER-WISE SYLLABUS

FIRST YEAR

Semester – I

B 101: Biology I (Introductory to Biology)

Unit-I
Life: History and origin of life, Concepts of biological evolution, natural selection, speciation. Classification of living things: Classification and domains of life, Prokaryotes and Eukaryotes, Taxonomy of plants, animals and microorganisms.

Unit-II
Ecology & Ecosystem: Concept of ecology and ecosystem, ecological succession, ecosystem dynamics, flow of ecology and matter, biogeochemical cycling, ecosystem changes, biotic and biotic factors and stresses, food web, adaptation of individual organism to the environment through genetic

changes.

Unit-III
Cell Biology: Discovery of cell, cell theory, classification of cell types, cell membrane, cell-cellinteractions, energy and metabolism, respiration, photosynthesis, sexual reproduction.

Unit-IV
Cell Division and System Development: cell cycle, mitosis, meiosis, mechanism of development (stem cells), formation of tissues.

Unit-V
Physiology- Body Systems: Digestive system, circulatory system, Lymphatic system, nervous system, respiratory system, sensory system, homeostasis.

Books Recommended:

S.No.	Author	Book
1	Neil A Campbell and JB Reece (2007)	Biology with Mastering Biology (8^{th} Edition)
2	NA Campbell, JB Reece, MR Taylor and EJ Simon (2008)	Biology: Concepts & Connections with biology (6^{th} Edition)
3	Charles Darwin (2008)	On the Origin of Species
4	B Alberts, D Bray, K Hopkin and AD Johnson (2009)	Essential Cell Biology
5	Rene Fester Kratz (2009)	Molecular and Cell Biology For Dummies
6	MJ Behe (2006)	Darwin's Black Box: The Biochemical Challenge to Evolution
7	SD Garber (2002)	Biology: A Self-Teaching Guide, (2^{nd} Edition)

C 101: Chemistry –I [Structure & Bonding]

Unit-I
Atomic spectra, Bohr's theory of atomic structure, Sommerfeld's theory for complex electron spin and magnetic quantum number, Pauli exclusion principle, Hund's rule, electron configuration of elements, Sequence of energy levels and Periodic Table.

Size of atoms and ions, ionization energy, electron affinity, electronegativity – values by Pauling, Mulliken and Allred-Rochow, Metallic character, variable valence and oxidation states, horizontal, vertical and diagonal relationships in the periodic table.
Atomic Nucleus: Fundamental particles, classification of nuclides, nuclear stability, the neutron to proton ratio N/Z, nuclear potential, binding energy, exchange force. Radioactivity and radioactive elements, radioactive decay and decay kinetics.

Unit-II
The covalent bond - the Lewis theory, Octet rule and its limitations. Shapes of the molecules –Sidgwick – powel theory. Valence shell electron pair (VSEPR) theory, effect of lone pair and electronegativity, isoelectronic principle, examples to apply VSEPR theory. Valence bond theory. Hybridization. Bond length, bond angle & dihedral angle, d-orbital participation in molecular bonding, sigma and pi bonding. Molecular orbital method – Linear combination of atomic orbitals (LCAO), MO treatment for di- and tri-atomic molecules and involving delocalized pi-bonding. Conjugation & aromaticity.

Unit-III
Metallic and organometallic bonds – general properties. Coordinate bond- coordination complexes. Physical properties and molecular structures – polaizability and dipole moments, melting point,
solubility and acid-base properties, Intermolecular forces (dipole-dipole interaction) Hydrogen bonding

and vander Waals's forces.

Unit-IV
Inductive and field effects and bond dissociation energy. pπ-dπ bonding.
Delocalization –cross conjugation, resonance. Aromaticity and Huckel's rule – systems of 4n and 4n+2 electrons, antiaromaticity . Resonance and Hyperconjugation.
Reaction mechanism: Types of mechanisms, Arhenius theory, collision theory, types of reactions, redox reactions, displacement and addition reactions, thermodynamic and kinetic requirements.

Unit-V
Hammond postulate, Curtin-Hammett principle, transition states and intermediates, carbocations, carbanions, free radicals, methods of determining mechanisms, isotopic effects.
General concepts: Oxidation number and oxidation states, Oxidation – reduction reactions and the use of reduction potential, Bronsted acids and bases, gas phase vs. solution acidity, solvent levelling effects, hardness and softness, surface acidity.

Books Recommended:

S.No.	Author	Book
1	J.D.Lee	Concise Inorganic Chemistry, 4th Edition, ELBS, 1991
2	P.W.Atkins	Physical Chemistry, Oxford University Press, 7th Edition, 2006
3	G.M.Barrow	Physical Chemistry, 5th Edition, Tata McGraw-Hill, 1992
4	R. T. Morrison, R. N. Boyd, P. Sykes	Organic Chemistry, Prentice Hall of India
5	G.W. Castellan	Physical Chemistry, 3rd Ed. Addison - 1993

P 101 Physics- I (Classical Physics)

Unit-I
Concepts of energy and mass, Linear kinematics and dynamics. Concept of force: Conservative and non-conservative forces, Friction. Conservation of momentum, energy, and angular momentum. Work-energy theorem, Centre of mass, moment of inertia.

Unit-II
Rotational kinematics and dynamics, Rigid body motion. Impulse and collisions, Central forces, Kinetic theory of gases, Equipartition of energy.

Unit-III
Free oscillations in one, two, and many degrees of freedom. Linearity and superposition principle. Normal modes; Transverse and longitudinal modes

Unit-IV
General notion of a continuous string; Resonance; Coupled pendula and oscillators, Normal coordinates.

Unit-V
Probability (chance, fluctuations, random walk, probability distribution, uncertainty principle); Curvilinear Coordinates, Vector calculus (differentiation and integration, gradient, divergence, curl, Green's theorem, Gauss' theorem, Stokes' theorem); Fourier series (an introduction).

Books Recommended:

S.No.	Author	Book
1	R. P. Feynman, R. B. Leighton, M. Sands	The Feynman lectures in Physics" Volume-1

2	D. Kleppner and R. Kolenkow	An introduction to mechanics
3	C. Kittel, W. D. Knight and M. A. Ruderman	Mechanics [Berkeley Physics CourseVol. 1]
4	F. S. Crawford	Waves [Berkeley Physics Course Volume 3]

MB 101: Mathematics – 1

Unit-I

The idea of derivative of a function, polynomials, slope and tangent line, derivatives of trigonometric functions, product and quotient rules. Notion of limits and continuous functions. Elementary results pertaining to limits of functions: product and quotient rules. Higher order derivatives, examples. Maxima and minima, curve tracing, Conic sections: circle, ellipse, hyperbola and parabola; equations, focus, directrix, latus rectum. Generalised conic section equation, exponential and logarithmic functions and their derivatives.

Unit-II

Application of derivatives to root finding: Newton's method (to be supplemented by an introduction to iterative processes). Mean value theorem of differential calculus, Rolle's theorem, applications. l'Hôpital's rule. The chain rule of differentiation, Implicit differentiation, Inverse functions and their derivatives, Inverse trigonometric functions, Applications.

Concept of infinite series, Geometric series, convergence tests; Taylor series, Maclaurin series for elementary functions, power series, simple applications.

Unit-III

Notion of an integral, integral as limit of sums; anti-derivatives, area under a curve, definite integrals, indefinite integrals. Rules of integration: integration by parts, integration by substitution. Properties of definite integrals including mean value theorem for integral calculus. Fundamental theorem of integral calculus. Integrals involving polynomial, exponential, logarithmic, trigonometric, inverse trigonometric functions. Application of integrals to areas, length of a plane curve, volumes of solids of revolution.

Unit-IV

Complex numbers: real and imaginary parts, The complex plane, Complex algebra (complex conjugate, absolute value, complex equations, graphs, physical applications). Elementary functions of complex numbers, Euler’s formula, Powers and roots of complex numbers. The exponential and trigonometric functions, Hyperbolic functions, Logarithms, Complex roots and powers, Inverse trigonometric and hyperbolic functions, Some applications.

Unit-V

Separable equations, Linear first order equations, Other methods for first order equations, Second order linear equations with constant coefficients and both zero and non-zero right hand side, Other second order equations.

Books Recommended:

S.No.	Author	Book
1	Gilbert Strang (MIT Courseware)	Calculus
2	M. Weir, J. Hass and F. R. Giordano (Pearson Education)	Calculus

H 101: Communication Skills

Unit-I

An interactive session (with examples) on what is communication, communication in the natural and civilized worlds, types of human communication: visual / non-verbal / verbal, written / spoken, etc

Unit-II

An overview of mass media; a brief discussion of their types (with examples). The concepts of facilitating factors, barriers, and filters in communication; the seven C's of effective communication.

Unit-III
Verbal communication: How to speak / listen effectively (in interpersonal communication), types of public speaking, tips for effective public speaking, how to make effective presentations. The role of written text in communication,

Unit-IV
Types of writing (academic/creative/general; formal/informal etc.) with examples of good/bad writing and their analysis.Introduction to letter writing, with stress on formal correspondence; email do's and don'ts.

Unit-V
Academic writing- an overview; explanation of various terms used in academic writing; parts of a paper/thesis; aspects such as formal language, grammatical accuracy, etc. Common grammatical/punctuation errors and how to avoid them (example-based instruction)

G101: Computer Basics

Unit-I
Introducing LINUX: getting started;

Unit-II
FORTRAN programming

Unit-III
LaTeX introduction (sufficient to make small documents); gnuplot - graph plotting and data fitting; xfig - simple drafting tool; MATHEMATICA - algebraic computations.

Unit-IV
Projects on:

Some of the projects done by the students are listed below; Predator-prey problem; Harmonic oscillator with friction Coupled pendulum

Unit-V
Projects on:

Testing random number generator; Brownian motion as a random walk problem; Sorting function and its application to making ranked lists, SUDOKU solver

BL 101 Biology laboratory

1) Introduction to Biology laboratory
2) Taxonomy
3) Methods of Classification
   Dichotomous key; Hierarchical Classification; Phylogenetic Classification
4) Natural Selection
5) Natural Selection using Daphnia
6) Concept of pH & Buffers:
   Hydrogen ion concentration in solution; Inorganic ion concentration in solutions Inorganic Buffers and Biological fluids; Henderson-Hesselbach equation
7) Media Preparation:
   Preparing and inoculating solid and liquid nutrient media for culturing microorganisms Pouring nutrient agar plates and streaking bacterial culture on solid media Inoculating nutrient broth with bacterial culture Preparing nutrient media
8) Introduction to Research Laboratory

Different kinds of microbial plates, liquid growth media for microbes, Laminar air flow system, stem cells laboratory, Centrifuges, Spectrophotometer, Sonicator, PCR and Real-time PCR, Gel Documentation system, *Chlamydomonas* and *Drosophila* incubation systems, Stereomicroscope and various Incubators

9) Growth Curve:
Generating a bacterial growth curve under various pH and environmental conditions (steady and shaking); Calculations of Growth rate constant (μ); Calculation of generation time
10) Enzyme Kinetics: To study an enzyme catalyzed reaction using hydroquinone as a substrate and peroxidase extracted from cabbage.
11) Introduction to Light Microscopy: Observing cells in a leaf peel using a compound microscope and to study the morphological characteristics of *Saccharomyces cerevesiae.*
12) Dye exclusion method of differentiating dead v/s live cells: To use a vital stain to distinguish dead and live yeast cells.
13) Staining and Observing human cheek cells: To carry out staining of epithelial cells from the mouth using acetocarmine and methylene blue stains.
14) Staining human blood cells: To observe human blood cell types by differential staining.
15) Plant anatomy: Relationship between plant anatomy and habitat.
16) Micrometry: Measuring size of a microscopic specimen.
17) Haemocytometer
18) Gram Staining: To differentiate bacteria cells by Gram staining.

CL 101: Chemistry Laboratory

Calibrations of pipette, burette, standard flasks etc., acid base titrations, recrystallization, thin layer chromatography, identification of organic functional groups, complexometric titrations based on EDTA complexation with metals, Synthesis of benzoic acid, diazotization etc.

Books Recommended:

S.No.	Author/Book
1	Vogel's Textbook of Quantitative Chemical Analysis (5th Edition; Longmann)
2	Vogel's Qualitative Inorganic Analysis (7th Edition)
3	ACS Journal of Chemical Education

PL 101: Physics Laboratory -I

Introduction to experimental physics – conceptual and procedural understanding, planning of experiments; Plots (normal, semi-log, log-log); uncertainty / error in measurements and uncertainty / error analysis.
Introduction to measuring instruments – concepts of standards and calibration; determination of time periods in simple pendulum and coupled strip oscillator system with emphasis on uncertainty in the measurements and accuracy requirements; study of projectile motion – understand the timing requirements; determination of surface tension of a liquid from the study of liquid drops formed under the surface of a glass surface; determination of Young's modulus of a strip of metal by double cantilever method (use of traveling microscope); study of combination of lenses and nodal points and correspondence to a thick lens; study of thermal expansion of metal – use of thermistor as a thermometer; measurement of small resistance of a wire using Carey-Fosterbridge and determine electrical resistivity of the wire; study of time dependence of charging and discharging of capacitor using digital multimeter –use of semi-log plot.

Books Recommended:

S.No.	Author	Book
1	Worsnop and Flint	Advanced Practical Physics for Students

GL 101 Computer Laboratory

History of computers; hardware basics. Concept of operating system; basic Unix/Linux commands; Office suite, including spreadsheets.
Flowcharts; computer arithmetic. Simple FORTRAN programming mathematical operators, input, output from keyboard, library functions.
Conditional statements - If-thenelse, Case, Go-to. Loops- Do loops, cycle, exit, nested loops.
Arrays- 1 dimensional and multidimensional.
Formatting - input and output. Input and output from file.
Functions and Subroutines.; Creating HTML pages; Plotting utilities like GNU Plot.

Semester – II [January - June 2016]

B 201: Biology –II [Introduction to Macro Molecules]

Unit-I
Cell – Overview: Cellular organization, Biomembranes, Nucleus, Cytoplasmic organelles, Bacteriophages. Nucleic Acids, Genomes and Proteomics: Building blocks- nucleotides, DNA structure, RNA structure and function, chromatin structure, genome code, genes, repetitive DNA sequences.

Unit-II
Gene Transcription: Overview of gene expression, overview of transcription, gene's regulatory elements, transcription mechanisms in prokaryotes and eukaryotes (a comparison).

Unit-III
Protein Structure and Function: Building blocks- amino acids, peptides, secondary structure, three dimensional structure, membrane proteins, miscellaneous proteins, enzymes.

Unit-IV
Cell Signaling: Overview, signaling via hydrophobic molecules, signaling via ion channels, Signaling via G-protein coupled receptors, signaling via cell surface enzymes, intracellular signaling.

Unit-V
Biotechnology: DNA cloning, Uses of recombinant DNA technology, Polymerase chain reaction (PCR), Production of recombinant proteins and SDS-PAGE.

Books Recommended:

S.No.	Author	Book
1	B Alberts, A Johnson, J Lewis, and M Raff	Molecular Biology of the Cell
2	J D. Watson, T A. Baker, S P. Bell, & A Gann	Molecular Biology of the Gene (6th Edition)
3	John Wilson and Tim Hunt (2007)	Molecular Biology of the Cell: The Problems
4	Benjamin Lewin (2007)	Genes IX (Lewin, Genes XI)

C 201: Chemistry- II [Chemical Thermodynamics]

Unit-I
Classification of system, intensive and extensive properties, equilibrium and Heat, work and energy, irreversible and reversible expansion work of an ideal First law of thermodynamics, heat content or enthalpy of a system; Thermochemistry – Enthalpy of a reaction, exothermic and endothermic

Unit -II
Second law of thermodynamics, Carnot cycle, entropy, entropy change and Free energy functions and Maxwell's relations, Gibb's Helmholtz relations, nonequilibrium states, reversible and irreversible processes. gas, internal energy in a cyclic process. heat capacities, Joule- Thomson effect, Adiabatic expansion of an

ideal gas and work done. reactions, thermochemical equation, Kirchoff's equation, heat of reaction and flame temperature, heat of combustion, heat of solution, heat of neutralization, heat of fusion, heat of vaporization, Bond energy and dissociation energy, Hess's law and its applications. irreversible processes and Clausius inequality, entropy and available work. criteria of spontaneity and conditions of equilibrium, Heat capacity relations (Cp/Cv and Cp – Cv), change of phase and Clapeyron equation, Trouton's rule.

Unit -III
Electrode potential and free energy, electrochemical series. Nernst heat Theorem and third law of thermodynamics, experimental Elements of statistical thermodynamics

Unit -IV
Chemical equilibrium and chemical potential (μ): chemical potential of an determination of entropy. ideal gas and gas mixture, Gibbs free energy and entropy of mixing, Chemical Phase equilibrium in simple systems: Equilibrium condition, stability of the Ideal solutions and colligative properties: ideal solutions, chemical potential equilibrium in a mixture of ideal gases and real gases, Equilibrium constants – Kx and Kc between ideal gases and pure condensed phase. Lechatelier principle and applications. phases of a pure substance, pressure dependence of μ vs. T curves, Clapeyron equatons.

Unit -V
Phase equilibrium: solid- liquid, liquid-gas, solid-gas, phase diagram – water, carbondioxide, sulphur, Effect of pressure on the vapour pressure, the phase rule. of a solute in a binary ideal solution – Gibbs-Duhem equation, Colligative properties – freezing pointing depression, solubility, elevation of boiling point, Osmotic pressure, Vant Hoff equation.

Books Recommended:

S.No.	Author	Book
1	P.W. Atkins	Physical Chemistry, Oxford University Press, 7th Edition, 2006
2	G.W. Castellan	Physical Chemistry, 3rd Ed. Addison - Wesley/Narosa Publishing House, 1993
3	G.N.Lewis and Randall	Thermodynamics, (Revised by K.S.Pitzer and L.Brewer), International Students Edition,
4	K. Denbigh	The principles of Chemical Equilibrium
5	B. G. Kyle	Chemical & Process Thermodynamics

P 201: Physics – II: [Electricity, Magnetism and Optics]

Unit-I
Electrostatics: Coulomb's law and Gauss' law; Electrostatic potential, uniqueness theorem, method of images; Electrostatic fields in matter; Conductors and insulators; Capacitors and capacitance; Electric current.

Unit-II
Magnetostatics: Biot – Savart law, Ampere's law; Electromagnetic induction; Mutual inductance and self inductance; Magnetic fields in matter.

Unit-III
Displacement current; Maxwell's equations; Alternating current circuits; Electric and magnetic properties of matter; Plane electromagnetic waves in vacuum; Polarisation;

Unit-IV
Energy and momentum in electromagnetic waves; electromagnetic radiation (qualitative); Dipole radiation formula; Larmor's formula for radiation due to accelerated charge (without proof); Synchrotron radiation (descriptive).

Unit-V

Optics Interference of two beams and involving multiple reflections; Young's experiment, Fresnel's biprism, Lloyd's mirror, Optical instruments; Telescope and microscopes; Magnifying power and resolving power.Sources of light and spectra; Dispersion, polarization, double refraction; Optical activity.

Books Recommended:

S.No.	Author	Book
1	Edward M. Purcell	Electricity and Magnetism Berkeley Vol. 2
2	Frank S. Crawford	Waves, Berkeley Vol. 3
3	Jenkins and White	Fundamentals of Optics
4	Feynman	Feynman Lectures Vol. 2

MB 201: Mathematics – II [Linear Algebra, Calculus of Several variables]

Unit I

Functions of several variables, partial derivatives, geometric interpretation, properties of partial derivatives, chain rule, applications. Elementary discussion on scalars and vectors, norm of a vector, dot product, projections. Linear equations and matrices, matrix operations. Concept of a determinant, its properties, evaluation of a determinant, cross product as a determinant, lines and planes. Elementary ideas of tensors.

Unit II

Vector functions. Gradient of a function, geometric interpretation, properties and applications; divergence and curl of a vector function, geometric interpretation, properties and applications; higher derivatives, Laplacian. Line integrals. Double and triple integrals, their properties and applications to areas, volumes, etc.

Unit III

Gradient theorem, Green's theorem, Stokes' theorem, divergence theorem, applications. Proofs of Stokes' and divergence theorems through physical examples (such as circulation in a 2 dimensional plane and accumulation of fluid in a given volume).

Unit IV

Curvilinear coordinate systems, spherical and cylindrical coordinates, area and volume elements, illustrations. Gradient, divergence and curl in curvilinear coordinate systems.

Unit V

Introduction to linear algebra. Vector spaces, linear dependence and independence, notion of basis, and dimension, subspaces. Examples. More on matrices: special kinds of matrices, their properties. Eignevalues and eigenvectors, secular determinant, characteristic polynomial. Eigenvalues and eigenvectors of a real symmetric matrix. Illustrative examples. Applications of linear algebra.

Books Recommended:

S.No.	Author	Book
1	Gilbert Strang (MIT Courseware)	Calculus
2	Thomas	Calculus
3	Howard Anton and Chris Rorres	Elementary Linear Algebra
4	Gilbert Strang (MIT Courseware)	Introduction to Linear Algebra
5	George B. Arfken and Hans J. Weber	Mathematical Methods for Scientists and Engineers

G201- Electronics & Instrumentation

Unit-1

Analog electronics: Introduction to passive electronic components -resistance, capacitance, inductance; Circuit theorems: Thevenin’s theorem, Norton’s theorem and Maximum power transfer theorem; basic concepts of semiconductor diode and transistor; application of Bipolar Junction Transistor (BJT) – biasing circuits: The CE configuration, fixed base bias, emitter bias, and potential-divider or voltage divider bias; CE amplifier, amplifier as a switch, concept of negative feedback.

Unit-2
Principle of DC power supply; half and full wave bridge rectifier, capacitor filter – ripple factor, concept of load and line regulation, concept of constant voltage source and constant current source; concept of short circuit protection and current limit protection; Zener regulator; concept of Switch Mode Power Supply (SMPS), power supply ICs, charge pump ICs for stepping up voltage and for bipolar supply.

Unit-3
Differential amplifier; Operational Amplifier (OPAMP): principle, basic characteristics and parameters relevant for general use; non-inverting and inverting amplifier, voltage follower, difference amplifier, summing amplifier, voltage controlled current source; OPAMP comparator, Schmidt trigger; Digital to Analog Converter (DAC) with weighted resistance and R-2R ladder network; Anlog to Digital Converter (ADC); filters: low pass, high pass; band pass; Butterworth filter.

Unit-4
Digital electronics: Review of basic logic gates; DeMorgan's theorem, Use of NAND / NOR as universal building blocks; arithmetic circuits; binary addition, half adder, full adder, binary subtraction - 1s and 2s complement, controlled inverter, adder / subtracter, parity checker; Flip-Flops (FF): RS-FF, D-FF, JK-FF; counters and shift registers: binary counter, ripple counter.

Unit-5
Basic concepts of instrumentation, generalized instrumentation systems block diagram representation; Sensing elements: electrodes and transducers. Electrode-electrolyte interface, stability of electrode potentials, circuit models, external and internal electrodes, pH, pO2 and pCO2 electrodes. Transducer, definition, types, displacement, velocity, acceleration, pressure, temperature vibration, ultrasound etc., calibration, sensitivity and resolution.
Books Recommended:

S.No.	Author	Book
1	R. L. Boylestad, L. Nashelsky, K. L. Kishore, Pearson	Electronic Devices and Circuit Theory
2	Malvino and Bates	Electronic Principles
3	Donald A. Neamen, Tata McGraw Hill	Electronic Circuit Analysis and Design
4	David A. Bell	Electronic Devices and Circuits
5	Leach, Malvino and Saha	Digital Principles and Applications
6	R.P. Jain	Modern Digital Electronics, Tata McGraw-Hill (2003)
7	M. Morris Mano, Michael D. Ciletti	Digital Design, Pearson Education Asia, (2007)
8	Thomas L. Floyd	Digital Fundamentals, Pearson Education Asia (1994)
9	DVS Murthy	Measurement & Instrumentation
10	A.K. Sawhney	Electrical Measurements & Electronic Measurements

G202- Glimpses of Contemporary Science

Unit-I
Physics in life systems: size and scale, diffusion, cell locomotion, force generated by actin growth and flagellum rotatory motion, ion channels, resting potential across the membrane, nerve conduction velocity, action potential, macromoleculaes of life, random walk model of polymer, single molecular experiments, optical tweezers, magnetic tweezers.

Unit-II
Complex systems: dynamical chaos, logistic map, bifurcation, Universality, Feigenbaum constants,

Mechanical demonstrations of chaos, Nanomechanical oscillators, Patterns, Reaction-diffusion systems, Nodal patterns, thermodynamics and human population, Falling leaves, Smoke ring physics.

Unit-III

At the turn of 1900: Silver threads, Discovery of the electron, Rutherford's nuclear atom Wien's law, Blackbody radiation and Max Planck's action.

Unit-IV

Astrophysics, Astrochemistry and Astrobiology

Unit-V

Quantum mechanics, atoms : Entanglement Light-atom interaction, Bringing atoms to rest, Laser tweezers, How bright is laser, Quantum computing.

Books Recommended:

S.No.	Author	Book
1	Darcy Wentworth Thompson	Growth and Forms
2	Rob Phillips	Physical biology of the cell
3	Harward Berg	Random walks in biology
4	L. Cooper	Physics: Structure and Meaning
5	R. P. Feynman, R. B. Leighton, and M. Sands	The Feynman Lectures on Physics vol. 3
6	S. Chandrasekhar	Introduction to the study of stellar structure

BL 201: Biology Practical

1. Observing instruments to be used in semester II, their use and maintenance: (a) micro-pipettes, (b) tissue homogenizer, (c) electrophoresis apparatus, (d) centrifuges, (e) ultraviolet and visible (uv-vis) absorption spectrophotometer
2. Centrifugation of the cell contents at varying speeds such that the subcellular fractions separate out based on their density differences
3. Photosynthesis - floating leaf disc experiment under various conditions (light, dark & light - dark)
4. Visit to TIFR
5. Nucleic acid extraction - from plant & animal tissue using ethanol precipitation
6. Agarose gel electrophoresis
7. Analysis of DNA under various conditions – pH and Temperature
8. Protein extraction & separation using polyacrylamide gel electrophoresis (PAGE)
9. Carbohydrate extraction & estimation - extraction of sugars from grapes & estimation of the same by DNSA method
10. Protein extraction & estimation determination of total protein content in microorganisms by folin- ciocaltaeu method
11. Lipid extraction & separation - Extraction of total lipids from liver tissue & separation by thin layer chromatography
12. Separation of biomolecules using:
    Adsorption chromatography; Partitioning of indicators in various solvent systems. ;
    Separation of a mixture of solutes by partitioning; Separation of leaf pigments by paper chromatograhy Separation of flower pigments by paper chromatography ; Reverse phase thin layer chromatography (PRTLC) - Separation of photosynthetic pigments

CL 201: Chemistry Laboratory

Colorimetric titrations, Beer Lambert law, Estimation of concentration by colorimetric methods, conductometric methods, estimation of concentraion of acid base bt pH meter, identification of inorganic anions and cations, finding of pka values, short project of 2 weeks based on the experiments available in Journal of Chemical Education.

Books Recommended:

S.No.	Suggested text and references:
1	Vogel's Textbook of Quantitative Chemical Analysis (5th Edition; Longmann)
2	Vogel's Qualitative Inorganic Analysis (7th Edition)
3	ACS Journal of Chemical Education

PL 201- Physics Laboratory

Review of uncertainty / error analysis; least squares fit method; introduction to sensors / transducers; determination of 'g' (acceleration due to gravity) by free fall method; study of physical pendulum using a PC interfaced apparatus – study variation of effective 'g ' with change of angle of plane of oscillation - investigation of effect of large angle of oscillation on the motion;

Study of Newton's laws of motion using a PC interfaced apparatus; study of conservation of linear and angular momentum using 'Maxwell's Wheel' apparatus; study of vibrations of soft massive spring; study of torsional oscillatory system; study of refraction in a prism - double refraction in calcite and quartz; study of equipotential surface using different electrode shapes in a minimal conducting liquid medium; determination of electrical inductance by vector method and study effect of ferromagnetic core and study the effect of non-linearity of inductance with current.

Books Recommended:

Worsnop and Flint Advanced Practical Physics for Students

GL 201 Electronics laboratory

1. To study the Half wave & Full wave rectifier and study the effect of C filter.
2. To design a Single Stage CE amplifier for a specific gain and bandwidth.
3. Study of Operational amplifier in inverting and non-inverting mode.
4. To verify and design AND, OR, NOT and XOR gates using NAND gates.
5. Measurement of pressure, strain and torque using strain gauge.

Second Year

Semester – III [July - December 2016]

CB 301- Essential Mathematics for Chemistry & Biology

Unit-I
Applications of Taylor series, Euler series

Unit-II
Review of first order ordinary differential equations, second order ODE's with constant coefficients, solutions by series expansion methods, introduction to partial differential equations,

Unit-III
Laplace's equation, separation of variables, Legendere differential equation and Legendere polynomials, important properties of Legendere poynomials, Hermite polynomials, Laguerre polynomials, Fourier series and simple applications, Laplace transforms and applications, convolution.

Unit-IV
The matrix Eigen value problems, Secular determinants, Characteristics polynomials, Eigen values and Eigen functions. Eigen values of real symmetric matrices; Eigen values and Eigen functions, important properties and examples.

Unit-V
Complex numbers, Analytic functions, Cauchy Riemann equations, Cauchy's integral formula, Residue theorem and simple applications.

Books Recommended:

S.No.	Author	Book
1	D.J.S. Robinson	A Course in Linear Algebra with Applications, World Scientific.
2	G. B. Thomas and R.L. Finney	Calculus and Analytic Geometry, 9th ed., Addison-Wesley/Narosa
3	J. Marsden, A. Tromba and A. Weinstein	Basic Multivariable Calculus, Springer
4	Inder K. Rana	Calculus@iitb, Concepts and Examples, Version 1.2

CB 302: Biochemistry-I

Unit-I
General biochemistry concepts: The concept of pH, dissociation and ionization of acids and bases, pKa, buffers and buffering mechanism, Henderson Hasselbalch equation, dissociation of amino acids and determination of pKa.

Unit-II
Chemical structure of Major: Carbohydrates, Lipids, Nucleic acids, Proteins: amino acid ; Chemical properties: molecular bond, covalent bond, ionic bond, hydrogen bond, ester, ; ethyl ; Molecular charge hydrophilic, hydrophobic, polar. pH : acid, alkaline, base. oxidation: reduction, hydrolysis Structural compounds:

In cells: flagellin, peptidoglycan, myelin, actin,
myosin In animals: chitin, keratin, collagen, silk
In plants: cellulose, lignin, cell wall

Unit-III
Enzymes and enzyme activity: enzyme kinetics , enzyme inhibition, proteolysis; ubiquitin – proteasome, kinase -- dehydrogenase

Unit-IV
Membranes : fluid mosaic model; diffusion, osmosis. Phospholipids, glycolipid, glycocalyx, antigen, isoprene ion channel; proton pump, electron transport , ion gradient, antiporter, symporter, quinine, riboflavin
Lipids, Vitamins, Hormones

Unit-V
Protein structure and function: folding, modification, enzymes, enzyme kinetics, enzyme regulation and inhibition

Books Recommended:

S.No.	Author	Book
1	D. L. Nelson & M. M. Cox	Lehninger Principles of Biochemistry,
2	Stryer L (1995	Biochemistry, 4 th edition,
3	Starzak, Michael E.	Energy and Entropy equilibrium to stationary states
4	J. McMurry (1999)	Fundamentals of General Organic & Biological Chemistry

B 301: Cell Biology -I

Unit-I
Cell biology - An Overview: Universal features of cells, Diversity of their genomes, Overview of cell chemistry (important atoms and their properties, pH, acids, bases, and buffers in cells, formation and functions of proteins, DNA, sugars, and fats in cells, Visualization of cell; Basic principles of light microscopy, Different microscopic techniques for imaging cells.

Unit-II
Membrane system: The cell membrane and its structure, Models of the biomembrane: Charles Overton's "Lipid Membrane", Lipid monolayer model of Irwing Langmuir, Lipid bilayer model by Gorter and Grendel, Protein-containing lipid bilayer model of Daveson and Danielly, David Roertson's direct observation of the membrane, Fluid Mosaic model of Singer and Nicholson, Constituents and fluidity of plasma membrane, Transport across membrane, Ion channels.

Unit-III
Cellular organelles and their functions: Mitochondria: Structure of mitochondria, Different enzymes and their location, Electron transport complexes, ATP synthase, Mitochondrial DNA, Structure of chloroplast, Protein complexes and photosynthetic electron transport chain, DNA of the chloroplast,
Bioenergetics, Structure and functions of the ribosomes, Endoplasmic reticulum, Golgi body, Lysosomes, and Nucleus. Protein sorting, Vesicular traffic inside the cells, targeting & degradation

Unit-IV
Cytoskeleton, cilia and flagella: Structure and functions of Microtubules, Actin, and Intermediate filaments. Interplay between different cytoskeletal components. Molecular motors. Cilia and flagella: structure and functions. Diseases associated with the cytoskeleton, cilia, and flagella.

Unit-V
Organization, Replication, and Maintenance of the genome: Complexity of eukaryotic genomes, Chromosomes and chromatin, DNA replication, DNA damage and repair, DNA rearrangements

Books Recommended:

S.No.	Author	Book
1	D. L. Nelson & M. M. Cox	Lehninger Principles of Biochemistry,
2	Stryer L (1995	Biochemistry,
3	Starzak, Michael E.	Energy and Entropy equilibrium to stationary states
4	J. McMurry (1999)	Fundamentals of General Organic and Biological Chemistry (Study Guide)

CB 303: Organic Chemistry –I

Unit-I
A. Basic concepts - Recapitulation
Hybridisation, formal charge, inductive and resonance effects and their effect on reactivity and acidity and basicity of organic compounds; polar & non polar covalent bonds; homolytic and heterolytic fission, types of reagents- electrophiles and nucleophiles; curly arrow notation; classification of organic reactions.

Unit -II
B. Chemistry of Aliphatic compounds
IUPAC nomenclature of aliphatic and substituted aliphatic compounds and alicyclic compounds Preparation, structure, properties and reactions of the following classes of compounds.
Hydrocarbons - a) alkanes, Methods of formation Kolbe reaction, Wurtz reaction, Corey House

reaction, decarboxylation of carboxylic acids; Mechanism of halogenation of alkanes, orientation, selectivity & reactivity, product ratio.
Cycloalkanes - Methods of formation and reactivity ; Baeyer's strain theory and its limitation; theory of strainless rings
Alkenes - Elimination reactions ; Saytzeff & Hoffman elimination; Reactions – halogenation reactionsfree radical and polar mechanisms. Markownikoff's rule, the peroxide effect, allylic halogenations using
NBS; Ozonides/Ozonolysis. epoxidation; hydroboration-oxidation;
oxymercuration-demercuration; Oxidation using KMnO4 & OsO4.; polymerization.
Dienes - Structure of butadiene and allene ; 1,2 vs 1,4 addition ; Diels Alder reaction.

Unit -III
Alkynes - Methods of formation; acidity of alkynes; electrophilic addition to alkynes; hydroboration oxidation ; metal ammonia reductions; hydrogenation using Lindlar's catalyst.
Alkyl halides - Preparation, properties and synthetic applications of alkyl halides ; SN1 & SN2 reactions (mechanism), E1 and E2 reactions(mechanism); Grignard reagent and its applications. Alcohols - Methods of formation ; acidity ; H-Bonding ; reactions of mono; di & trihydric alcohols; Diols as protecting groups

Unit -IV
Ethers and epoxides - Formation & reactions of ethers and epoxides ; ring opening reactions of epoxides under acidic and basic consitions; reaction epoxides with Grignard & organolithium reagents Aldehdyes & ketones - Methods of formation of aldehdyes and ketones; Nucleophilic addition reactions with cyanide, ammonia and derivatives of ammonia; acetal formation; oxidation reduction reactions. Meerwin-Pondroff-Verley reduction, Clemmensen reduction, Wolf-Kishner reduction, Aldol condensation reaction, Cannizzaro reaction, Tischenko reaction, haloform reaction, Baeyer-Villiger oxidation, Wittig reaction; Mannich reaction

Unit -V
Carboxylic acids - Methods of formation of mono and di carboxylic acids; acidity and factors affecting acidity; reactions of carboxylic acids :
Carboxylic acid derivatives - Methods of formation of acid chlorides, amides, anhydrides and esters and their interconversions; relative stabilities of acid derivatives; Rosenmund reaction; Hoffmann rearrangement; saponification.
Nitrogen and sulphur compounds - Nitro alkanes

Books Recommended:

S.No.	Author	Book
1	I. L. Finar	Organic Chemistry, Vol. 1 & 2, ELBS.
2	R. T. Morrison and R. N. Boyd	Organic Chemistry, Prentice Hall of India
3	L. G. Wade,	Organic Chemistry, Pearson Education
4	G. Solomons and C. Fryhle,	Organic Chemistry, John Wiley & Sons
5	W.G. Solomons	Fundamentals of Organic Chemistry,
6	J. March	Advanced Organic Chemistry, 3rd Edn.
7	F.J. Carey and R.J. Sundburg	Advanced Organic Chemistry, Part A & Part B
8	D. D. Ebbing	General Chemistry, Houghton Miffin Co
9	M. J. Sienko and R. A. Plane	Chemical Principles and Applications,

H 301: World Literature

Unit-I
What is Literature? - a discussion; Introduction to literary terms, genres, and forms of various periods, countries, languages, etc. Comprehensive idea about Sanskrit literature in relation to scientific writing: Vedic and Classical literature

Unit-II
The Novel: Class study of 'Brave New World' by Aldous Huxley; Group discussions and student presentations on other genres such as the graphic novel, detective fiction, children's literature, etc.

Unit-III
Plays: Introduction to the history of theatre, class study of (mainly) two plays: 'Pygmalion' by G. B. Shaw and 'Fire and Rain' by Girish Karnad, the setting up of play –reading group through which the students can be introduced to several other plays.

Unit-IV
Poetry: Brief introduction; Study of poetic genres, forms, topics, figures of speech, poetic language etc. by analysing various poems from around the world

Unit-V
Short stories, essays and other types of writing by various authors. Screening of films based on literary works, such as Pygmalion (My Fair Lady), Fire and Rain (Agnivarsha), Persepolis (a graphic novel) and a few others.

H302: History and Philosophy of Science

Unit-I
Brief overview of the contemporary cultural development elsewhere in the world; Indus Civilisation: progress of art, architecture, science and technology, role of geometry in art and architecture; Study of ancient Indian linguistic techniques and their relation with modern programming languages; Overview of Paninian style and techniques; Precision of Sanskrit in expressing technical terms; History of number naming and writing in India; Sulbasutra and Vedanga Jyotisha – geometrical constructions and astronomical calculations; Jain literature on mathematics and astronomy; Linguistic techniques used in Aryabhatiya; Works of Brahmagupta in opposition of Aryabhata; Contribution of Kerala school of mathematics to development of mathematical ideas.

Unit-II
Genesis of systematic ideas: Science in ancient Greece; against mythological explanations to natural phenomena; Early atomism, mathematical atomism, against atomism. Introduction to epistemology; Possible criteria of demarcation between science and folklore; Non–science and metaphysics; Introduction to logical positivism and the "standard view"; Criticism of "standard view".

Unit-III
Method of analysis and synthesis; Beginning of mathematical sciences; multicultural origins of science. Renaissance and scientific revolution:

Unit-IV
Galilean ideas; mechanisation of world picture; From alchemy to chemistry, from natural history to evolutionary history, from natural numbers to complex numbers, from physiology to cell biology.

Unit-V
Rise of experimental science: Discussion of some of the crucial experiments with an emphasis on the analysis of conceptual changes rather than the technical details.

Books Recommended:

S.No.	Author	Book
1	Colin Ronan	Cambridge Illustrated History of Science
2	Rom Harre	Great Scientific Experiments: 20 Experiments that Changed our View of the World
3	T. A. Saraswati Amma	Geometry in Ancient and Medieval India
4	Kim Plofker	Mathematics in India (Princeton Univ. Press)
5	Samir Okasha	Philosophy of Science – A Very Short Introduction

6	Henry Collins and Trevor Pinch	The Golem – What Everyone should Know about Science by (Cambridge Uni. Press, 1996)
7	Alan Chalmers	What is this thing called Science?

BL 301: Biology Laboratory (Biochemistry + Cell Biology)

1. Biochemical calculation
2. Amino acid titration:
   Determine the pka value of the provided amino acid solutions using titration curve.
   Identify the amino acids using the reference table on the basis of pka values obtained
3. Carbohydrate identification & estimation by anthrone
   method Extraction of carbohydrates from various sources.
   Identification by dichotomous key & estimation by anthrone method
4. Estimation of total free amino acids

   Extraction of total free amino acids from plant sample estimation by ninhydrin reagent
5. Acid value - Acid number is a measure of the amount of carboxylic acid groups a fatty acid
6. Iodine number

   Iodine numbers are often used to determine the amount of unsaturation in fatty acids
7. Saponification value
   Measure of the average molecular weight (or chain length) of all the fatty acids present
8. Peroxide value - Gives the evidence of rancidity in unsaturated fats and oils
9. Potato starch - isolation of starch
10. Enzyme kinetics
    Enzymatic reaction using potato starch and salivary amylase. Determine Vmax and Km for individuals salivary amylase.
11. pH and temperature effect on enzyme kinetics
    Effect of pH and temperature on salivary amylase action on starch
12. Effect of inhibitors on enzyme kinetics
13. Carbohydrate identification by thin layer chromatography
    Extraction of carbohydrates from various fruit sample and identification by separating using tlc
14. Chromatography:
    Paper chromatography, dimensional chromatography of a mixture of amino acids
    Circular chromatography, Separation utilizing gel filtration and ion-exchange chromatography, S. Russo and A. Radcliffe, *J.Chem. Educ.* **68**, 168-171 (1991).
    Isolation of lactoferrin by immobilized metal ion affinity chromatography (IMAC), A. Calvo and F. Batista-Viere, *Biochem. Educ.* **22**, 50-52 (1994).
    Rapid microscale isolation and purification of yeast alcohol dehydrogenase using Cibacron blue affinity chromatography, C. Morgan and N. Moir, *J.Chem. Educ.* **73**, 1040-1041 (1996).
    Chromatographic separation of two proteins, J. Szeberenyi, *Biochem. Mol. Biol. Educ.* **35**, 71-72 (2007).

15. Electrophoresis
    SDS-agarose gel electrophoresis in a simple procedure for determining high molecular weight protein oligomerization, M. Brownleader et al., *Biochem.Educ.* **22**, 155-158 (1994).
    Capillary electrophoresis: a fast and simple method for the determination of the amino acid composition of proteins, P. Weber and D. Buck, *J. Chem. Educ.* **71**, 609-611 (1994).
    Determination of the subunit molecular mass and composition of alcohol dehydrogenase by SDSPAGE, B. Nash, *J. Chem. Educ.* **84**, 1508-1511 (2007).
    Metal-catalyzed cleavage of tRNA-Phe, S. Kirk et al., *J. Chem. Educ.* **85**, 676-678 (2008).
    Introducing proteomics in the undergraduate curriculum: A simple 2D gel electrophoresis exercise with serum proteins, T. Kim and P. Craig, *Biochem. Mol. Biol. Educ.* **38**, 29-34 (2010).
16. Isolation and Characterization of Enzymes
    Testing the á-amylase inhibitor of the common bean, J. Moreno et al., *J. Chem. Educ.* 71, 350-

352 (1994). A rapid and inexpensive procedure for the determination of amylase activity, V. Mulimani and J. Lalitha, *Biochem. Educ.* 24, 234-235 (1996).
A rapid and inexpensive procedure for the determination of proteolytic activity, S. Castro and A. Cantera, *Biochem. Educ.* 23, 41-43 (1995).
Zymography of extracellular matrix proteases, A. Quesada et al., *Biochem. Educ.* 24, 170-171 (1996).
The thermodynamic stability and catalytic activity of yeast alcohol dehydrogenase at different pH values, R. Tabor and J. Ladwig, *Biochem. Educ.* 25, 169-170 (1997).
The competitive inhibition of yeast alcohol dehydrogenase by 2,2,2-trifluoroethanol, R. Tabor, *Biochem. Educ.* 26, 239-242 (1998).
From egg to crystal: a practical on purification, characterization, and crystallization of lysozyme for bachelor students, V. Olieric et al. *Biochem. Mol. Biol. Educ.* **35**, 280-286 (2007).
Lactate dehydrogenase kinetics and inhibition using a microplate reader, J. Powers et al. *Biochem. Mol. Biol. Educ.* **35**, 287-292 (2007).

17. Cell biology

Cell staining – i (capsule, cell wall, lipid granules)
Cell staining – ii (metachromatic granules,
endospores) Cell motility
Subcellular fractionation of mouse liver tissue, page & wester
blotting Immunoflourescence of cytoskeleton & nuclear proteins
Meiosis using lily anthers

GL 301- Applied Electronics Lab

Experiments based on:

1- Norton's theorem and Maximum power transfer theorem; basic concepts of semiconductor diode and transistor;
2-Principle of DC power supply; half and full wave bridge rectifier, capacitor filter – ripple factor, 3-Zener regulator; concept of Switch Mode Power Supply (SMPS), power supply ICs,
4- Bipolar Junction Transistor (BJT) – biasing circuits:
5- Anlog to Digital Converter (ADC); filters: low pass, high pass; band pass; Butterworth filter 6- controlled inverter, adder / subtracter, parity checker; Flip-Flops (FF):
7- RS-FF, D-FF, JK-FF; counters and shift registers: binary counter, ripple counter.

Semester – IV [January - June 2017]

B401: Cell Biology - II

Unit-I

Cell Junctions, Cell Adhesion, and the Extracellular Matrix: Introduction, Cell Junctions, Cell-Cell Adhesion, The Extracellular Matrix of Animals, Extracellular Matrix Receptors on Animal Cells. Integrins, Selectins, and other proteins involved in intercellular contacts. The Plant Cell Wall

Unit-II

Cell signaling: 1. Introduction: Components involved in signaling, Types of signaling, Three Major Classes of Signaling Receptors: Ion Channel-linked, G protein-coupled receptors (GPRs), Enzyme-linked receptors: Tyrosine-Kinase Receptors, other enzyme-linked receptors, Second Messengers: cAMP, cGMP, IP3 and DAG, Ca+2, PIP3. Signaling Cascades. Cell signaling and cancer.

Unit-III

Cell cycle and Cell division: Mechanisms and regulations of cell division, Mitosis, Meiosis, and Germ cells, Cell renewal, Uncontrolled cell division and cancer.

Unit-IV

Types of cell death: Apoptosis, Necrosis, Anoikis, Oncosis

Unit-V
Techniques in Cell biology: Cell fractionation, DNA libraries, DNA transfer into eukaryotic cells and Mammalian embryos, Nucleic acid hybridization, Purification of nucleic acid, Isolation and fractionation of proteins.

Books Recommended:

S.No.	Author	Book
1	Alberts *et al*.	Molecular biology of the Cell
2	Alberts, Bray *et al*	Essential Cell Biology Garland, Publication New York 1997
3	James E. Darnell, Harvey F. Lodish, and David Baltimore	Molecular Cell Biology
4	Geoffrey M Cooper	The Cell, 2nd edition, A Molecular Approach
5	http://publications.nigms.nih.gov/insidethecell/index.html.	Inside the Cell, an internet-based study of cells (National Institute of General Medical Sciences)

B 402: Biochemistry-II

Unit-I
Metabolism and metabolic pathways: Glycolysis, TCA cycle, Oxidative Phosphorylation, Photophosphorylation

Unit-II
Biosynthesis of macromolecules: Carbohydrate biosynthesis (Pentose phosphate pathway), Fatty acid synthesis, Cholesterol of steroid biogenesis, Amino acid biosynthesis & degradation, Nucleotide biosynthesis & degradation, Fatty acid degradation

Unit-III
Pigments : chlorophyll , carotenoids, xanthophyll , cytochrome, phycobilin, Bacteriorhodopsin, hemoglobin, myoglobin, absorption spectrum, action spectrum, fluorescence

Unit-IV
Photosynthesis : light reaction -- dark reaction. Fermentation : Acetyl-CoA -- lactic acid
Cellular respiration : Adenosine triphosphate (ATP) - NADH - pyruvate - oxalate – citrate Chemosynthesis

Unit-V
Regulation hormones : auxin signal transduction -- growth factor -- transcription factor -- protein kinase -- SH3 domain Malfunctions : tumor -- oncogene -- tumor suppressor gene Receptors : Integrin -- transmembrane receptor -- ion channel

Books Recommended:

S.No.	Author	Book
1	D. L. Nelson , M. Cox	Lehninger Principles of Biochemistry,
2	Stryer L	Biochemistry.
3	Starzak Michael E.	Energy and Entropy equilibrium to stationary states
4	J McMurry	Fundamentals of General Organic and Biological Chemistry (Study Guide)

CB 401: Introductory Spectroscopy [UV-Vis, Florescence, IR, Raman, NMR]

Unit-I
The electromagnetic spectrum: Nature of electromagnetic radiation. The electromagnetic spectrum and its regions. Frequency, waveno and wavelength: units and conversions. Absorption of electromagnetic radiation. Molecular energy states and quantisation of internal energy. Boltzmann distribution. Spectroscopic Processes: Absorption, emission, and scattering of light. Beer-Lambert Law - Quantitative absorption measurements, Jablonski diagram Fourier transformation: A mathematical tool to our advantage, basic principle and its relevance in spectroscopy.

Unit -II
UV-VIS Absorption Spectroscopy: Principles and instrumentation of spectrophotometers. UV-vis spectroscopy to determine conjugation. UV-visible spectroscopy and electronic transitions. Electronic ground states and excited states in organic molecules: pi-star and pi to pi-star transitions. band position and band intensities.
Fluorescence Spectroscopy: Principles and instrumentation of fluorimeters. Advantage of fluorimetry compared to absorption spectrophotometry. Luminescence and the fate of excited states: timescale of fluorescence and phosphorescence.Qualitative and Quantitative Fluorimetry.

Unit -III
IR - Principles and instrumentation of Infrared spectroscopy. nfrared spectroscopy and molecular vibrational transitions. Simple dispersive IR spectrometer and ovewrview of modern instrumentation. Transmittance and absorbance. Vibrational modes and selection rules. Factors governing the position and intensity of IR bands: effects of variation in reduced mass and force constant. Group frequency and fingerprint regions: use of IR for identification by presence/absence of absorptions characteristic of specific bonds/bond groupings.

Interpretation of IR spectra.
Raman Spectroscopy: Raman Effect and molecular polarizability. Technique and instrumentation.
Pure rotational Raman spectra, vibrational Rama spectra. Structure determination from Raman and IR.

Unit -IV
Nuclear Magnetic Resonance (NMR): Introduction to Nuclear Magnetic Resonance (NMR) spectroscopy. number of signals, integration, chemical shift, splitting of signals. Principles and instrumentation of NMR spectroscopy. Nuclear spin and nuclear magnetism. Energies of nuclear spin states in a magnetic field. Boltzmann population of nuclear spin states and the origin of NMR signals.. Information from: chemical shifts and delta values, peak areas and integration, splitting patterns and spin-spin coupling constants. (n+1) rule and Pascal's triangle. Interpretation of NMR spectra using

Unit -V
Examples of organic compounds. Short introduction about application of NMR for proteins.
Mass spectrometry: Introduction to mass spectroscopy (molecular mass, accurate mass and isotopes) Principles, ionisation methods (including EI, MALDI, ESI). Molecular ions and fragmentation processes under EI. Mass spectrometry for determining the molecular weight/formula of organic compounds and identify the presence of isotopes. Introduction of MS application in protein analysis.

Books Recommended:

S.No.	Author	Book
1	K Wilson and John Walker	Practical Biochemistry: Principles & Techniques
2	GR Chatwal and SK Anand	Instrumental methods of Chemical Analysis
3	S. K. Sawhney	Introductory Practical Biochemistry
4	RF Boyer	Biochemistry Laboratory: Modern Theory & Techniques
5	S Carson, H Miller and D Scott	Molecular Biology Techniques: A Classroom Laboratory Manual
6	T C Ford and J M Graham	An Introduction to Centrifugation
7	TS Work and E Work	Density Gradient Centrifugation, Vol. 6
8	David Rickwood	Centrifugation Techniques
9	A Braithwaite and FG Smith	Chromatographic Methods

10	LR Snyder, JJ Kirkland & JW Dolan	Introduction to Modern Liquid Chromatography
11	S J Pennycook and PD Nellist	Scanning Transmission Electron Microscopy
12	DJ Rawlins	Light microscopy
13	M Hoppert	Microscopic Techniques in Biotechnology
14	M Hoppert and A Holzenburg	Electron microscopy in microbiology
15	T Peng, D L Horrocks and E L Alpen	Liquid Scintillation Counting: Recent Applications and Development, Volume I
16	R Baserga and D Malamud	Autoradiography: techniques and application
17	T Chard	An Introduction to Radioimmunoassay and Related Techniques , Volume 6
18	MD Bruch	NMR Spectroscopy Techniques
19	B A Wallace and R. William	Modern Techniques for Circular Dichroism and Synchrotron Radiation ..., Volume 1

PCB 401: Physical & Chemical Kinetics

Unit -I

Basic Concepts: Rate, order and molecularity of a reaction, First, second and third order reactions – effect of concentration on reaction rate, rate expressions and integrated form, pseudo-unimolecular and second order autocatalytic reactions, nth order reaction of a single component, effect of temperature on reaction rate – Arrhenius equation and activation energy.
Complex Reactions: parallel first order reactions, series first order reactions – determination of rate constants by graphical method and the time ratio method. The stationary state, radioactive decay, general first order series and parallel reactions. Competitive, consecutive second order reactions, reversible reactions, equilibrium from the kinetic view point, complex mechanisms involving equilibria.

Unit -II

Kinetic Measurements: Experimental determination of reaction rates and order of reactions –correlation of physical properties with concentrations, reactions in the phase, reactions at constant pressure, fractional-life period method, initial rate as a function of initial concentrations.
Reactions in Solutions: General Properties, Phenomenological theory of reaction rates, Diffusion limited rate constant, Slow reactions, Effect of ionic strength on reactions between ions, Linear free energy relationships, Relaxation methods for fast reactions.

Unit -III

Catalysis: Homogeneous catalysis in gas phase, in solution, basis of catalytic action, catalysis and the equilibrium constant, acid base catalysis, The Bronsted catalysis law, linear free energy changes, general and specific catalysis. Heterogeneous catalysis. Negative catalysis and inhibition, Surface reactions – effect of temperature and nature of surface. Industrial catalysis.
Chain reactions: general treatment, activation energy, chain length, chain transfer reactions, inhibition.

Unit -4

Bond dissociation energies, branching chain reactions.
The collision theory: Dynamics of bimolecular collisions and rate and rate constant of bimolecular reaction, factors determining effectiveness of collisions, Termolecular reactions, unimolecular reactions. Relation between cross section and rate coefficients.
Potential Energy Surfaces: Long range, empirical intermolecular and molecular binding potentials, Internal coordinates and normal modes of vibration, Potential energy surfaces, ab-initio calculation of potential energy surface, experimental determination of potential energy surfaces, Details of the reactionpath, potential energy surface for electronically excited molecule. Molecular beam scattering,
Stateresolved spectroscopic technique, molecular dynamics of H_2 + H reaction, state-to-state kinetics of F +H_2 reaction.

Unit -V

Transition State Theory (TST): Motion on the potential energy surface, Basic postulates and derivation of TST, dynamical derivation of TST, Quantum mechanical effects on TST, Thermodynamic formulation of TST, Application of TST, Microcannonical TST, Variational TST, Experimental observation of TST.

Books Recommended:

S.No.	Author	Book
1	K.A. Connors	Chemical Kinetics: A Study of Reaction Rates in Solution,
2	J.I. Steinfeld, J.S. Francisco & W.L. Hase	Chemical Kinetics and Dynamics,
3	K. J. Laidler	Chemical Kinetics,
4	R. D. Levine and R. B. Bernstein	Molecular Reaction Dynamics & Chemical Reactivity
5	J.W. Moore and R.G. Pearson	Pearson, Kinetics and Mechanisms,
6	Sanjay K. Upadhay	Chemical kinetics and Reaction Dynamics,

G 401: Statistical Techniques and Applications

Unit-I
Purpose of Statistics, Events and Probabilities, Assignments of probabilities to events, Random events and variables, Probability Axioms and Theorems. Probability distributions and properties: Discrete, Continuous and Empirical distributions.

Unit-II
Expected values: Mean, Variance, Skewness, Kurtosis, Moments and Characteristics Functions. Types of probability distributions: Binomial, Poisson, Normal, Gamma, Exponential, Chi-squared, Log-Normal, Student's t, F distributions, Central Limit Theorem

Unit-III
Monte Carlo techniques: Methods of generating statistical distributions: Pseudorandom numbers from computers and from probability distributions, Applications. Parameter inference: Given prior discrete hypotheses and continuous parameters, Maximum likelihood method for parameter inference.

Unit-IV
Error Analysis: Statistical and Systematic Errors, Reporting and using uncertainties, Propagation of errors, Statistical analysis of random uncertainties, Averaging Correlated/ Uncorrelated Measurements. Deconvolution methods, Deconvolution of histograms, binning-free methods. Least-squares fitting: Linear, Polynomial, arbitrary functions: with descriptions of specific methods; Fitting composite curves.

Unit-V
Hypothesis tests: Single and composite hypothesis, Goodness of fit tests, P-values, Chi-squared test, Likelihood Ratio, Kolmogorov-Smirnov test, Confidence Interval. Covariance and Correlation, Analysis of Variance and Covariance. Illustration of statistical techniques through hands-on use of computer programs.

Books Recommended:

S.No.	Author	Book
1	R.J. Barlow	Statistics: A Guide to the Use of Statistical Methods in the Physical Sciences
2	John Mandel, Dover	The Statistical Analysis of Experimental Data
3	Philip Bevington and Keith Robinson	Data Reduction and Error Analysis for the Physical Sciences, 3rd Edition

BL401: Biology Laboratory (Biochemistry + Cell Biology)

1. Ligand Binding

a) The binding of coomassie brilliant blue to bovine serum albumin, J. Sohl and A. Splittgerber, *J. Chem. Educ.* **68**, 262-264 (1991).

b) Evaluation of the Hill coefficient from Scatchard and Klotz plots, A. Sabouri and A. Moosavi- Movahedi, *Biochem. Educ.* **22**, 48-49 (1994).

c) The shapes of Scatchard plots for systems with two sets of binding sites, A. Bordbar et al.,*Biochem. Educ.* **24**, 172-175 (1996).

2. Spectroscopy

d) Fluorescence quenching of albumin. A spectrofluorimetric experiment, M. Montero et al, *Biochem Educ.* **18**, 99-101 (1990).

e) Lactate dehydrogenase kinetics and inhibition using a microplate reader, J. Powers et al., *Biochem. Mol. Biol. Educ.* **35**, 287-292 (2007).

3. Isolation and Analysis of Biomolecules - Amino acids/peptides/proteins/antibodies

f) Application of gel filtration for fractionation and molecular weight determination of proteins, O. Malhotra and A. Kumar, *Biochem. Educ.* 17, 148-150 (1989).

g) Protein structure and chromatographic behavior: The separation and characterization of four proteins using gel filtration and ion-exchange chromatography and gel electrophoresis, M. Chakravarthy, L. Snyder, T. Vanyo, J. Holbrook, and H. Jakubowski, *J. Chem. Educ.* 73, 268-272 (1996).

4. Isolation and Analysis of Biomolecules - Carbohydrates

h) Changes in carbohydrate content during fruit ripening-a new approach of teaching carbohydrate chemistry in biochemistry course, P. Chaimanee and O. Suntornwat, *Biochem. Educ.* 22, 101-102 (1994).

i) Carbohydrate Analysis: Can we control the ripening of bananas?, S. Deal, C. Farmer, and P. Cerpovicz, *J. Chem. Educ.* **79**, 479-480 (2002).

5. Isolation and Analysis of Biomolecules - Lipids

j) Isolation and spectrophotometric characterization of photosynthetic pigments, R. Boyer, *Biochem. Educ.* **18**, 203-206 (1990), and *Modern Experimental Biochemistry,* 3rd ed., p. 333-344, (2000) Benjamin Cummings. (San Francisco).

k) An improved method for the extraction and thin-layer chromatography of chlorophyll a and b from spinach. H. Quach, R. Steeper, and G. Griffin, *J. Chem. Educ.* **81**, 385-387 (2004).

6. Metabolism/Regulation/Transport

l) The energetics of aerobic versus anaerobic respiration, T. Champion and R. Schwenz, *J. Chem. Educ.* 67, 528-530 (1990).

m) Use of DCPIP in a colorimetric method to investigate electron transport in crude heart mitochondrial extracts, A. Myers, *Journal of Biol. Educ.* 24, 123-126 (1990).

n) Mitochondria from rat liver: method for rapid preparation and study, C. Heisler, *Biochem. Educ.* 19, 35-38 (1991).

o) An experiment on glycogen biosynthesis in *E. coli,* A. Lodeiro et al, *Biochem. Educ.* 22, 213-214 (1994).

p) An experiment illustrating catabolite repression in yeast, W. Baker, *Biochem Educ.* 23, 216-217 (1995).

q) A simple experiment demonstrating the allosteric regulation of yeast pyruvate kinase, R. Taber, A. Campbell, and S. Spencer, *Biochem. Educ.* **26**, 73-76 (1998).

r) A simple laboratory exercise illustrating active transport in yeast cells, B. Stambuk, *Biochem. Mol. Biol. Educ.* **28**, 313-317 (2000).

s) The pentose phosphate pathway in the yeasts *Saccharomyces cerevisiae* and *Kloeckera apiculata,* an exercise in comparative metabolism for food and wine science students, C. Steel, P. Grbin, and A. Nichol, *Biochem. Mol. Biol. Educ.* **29**, 245-249 (2001).

t) Kinetic analysis of glucose-6-phosphatase: an investigative approach to carbohydrate metabolism, M. Wallert, J. Foster, D. Scholnick, A. Olmschenk, B. Kuehn, and J. Provost, *Biochem. Mol. Biol. Educ.* **29**, 199-203 (2001).

u) Nitrate reductase: A model system for the investigation of enzyme induction in eukaryotes, C. Pike, W. Cohen, and J. Monroe, *Biochem. Mol. Biol. Educ.* **30**, 111-116 (2002).

CELL BIOLOGY

v) Programmed Cell Death DNA Laddering and Cell death assay (quantification by Evans Blue)

w) Post-translational modification of proteins

x) Introducing undergraduate students to real-time PCR, D. Hancock et al., *Biochem. Mol. Biol. Educ.* **38**, 309-316 (2010).

y) *Caenorhabditis elegans* as an undergraduate educational tool for teaching RNAi, J. Andersen et al., *Biochem. Mol. Biol. Educ.* **36**, 417-427 (2008).

GL 401: Computational Laboratory and Numerical Methods

This course is primarily a lab course introducing computational techniques used for solving mathematics problems numerically. Vast amount of software for solving these problems exists and has been put together in general purpose packages such as MATHEMATICA, MAXIMA, MAPLE and so on.

Computing special functions (using recurrence relations, Attn: loss of accuracy and its effects), making subroutines/functions for these. Computing derivatives numerically (accuracy issues). Zeros (roots) of functions (single variable, multivariable, complex functions poles as zeros of inverse function). Solving differential equations (single variable, any order), Euler and Runge-Kutta, initial and boundary value problems. Eigenvalue problems as boundary value problems.

Numerical integration: trapizoidal and Simpson rules, Gaussian quadrature rules. Linear equations, inverse of a matrix, determinant using Gauss elimination. Matrix eigenvalue problems, Euler rotations, relaxation methods. Data fitting, χ methods, some simulations minimization. Random number generators, Monte-Carlo methods, some simulations.

Third Year

Semester – V

B501: Genetics

Unit-I

Introduction and overview of genetics: Information transfer DNA-RNA-Protein/genotype & phenotype, Eukaryotic & Prokaryotic genes, Pseudogenes. Gene regulation: λ phage, Bacterial gene regulation, Eukaryotic gene regulation, Epigenesis, Reverse genetics, genomes and genomics.

Unit-II

Mendelian inheritance (in details): *basics would have been taught*, Cell division- mitosis & meiosis *(revise: would have been taught)*, Deviation from mendelian inheritance, Linkage & Sex-linked inheritance Model genetic systems.

Unit-III

Human genome and genetics: Elements of human genetics & genetic disorders, Examples from *Drosophila*, yeast, maize and mouse, Immunogenetics.

Unit-IV

Genes and Evolution: The law of DNA constancy and C-value paradox: Numerical and structural changes in chromosomes; Molecular basis of spontaneous and induced mutations and their role in evolution; Environmental mutagenesis and toxicity testing; Population genetics.

Unit-V

Biostatistics: Principles and practice of statistical methods in biological research; samples and populations; Basic statistics – average, statistics of dispersion, coefficient of variation; Standard error; Confidence limits; Probability distributions binomial, Poisson and normal; Tests of statistical significance; Simple correlation of regression; Analysis of variance, Population genetics.

Books Recommended:

S.No.	Author	Book
1	E. J. Gardner, D.P Snustad and M. J. Simmons	Principles of Genetics
2	Leland Hartwell, Leroy Hood, Michael Goldberg, Ann Reynolds, Lee Silver, Ruth Veres.	Genetics: From genes to genomes

3	Anthony J. F. Griffiths. 2010	Introduction to genetic analysis
4	Harvey Motulsky, 2010	Intuitive Biostatistics: A Nonmathematical Guide to Statistical Thinking
5	Marcello Pagano, 2000	Principles of Biostatistics
6	Genetics for Dummies, 2005	T. R. Robinson

B 502: Molecular Biology

Unit-I
Molecular biology an overview: Concept and definition of the gene, complexity of the eukaryotic gene. Structural organization of the DNA in the nuclear material- General properties of histones, nucleosomes and solenoid structure, RNAs and their structure & function.

Unit-II
DNA synthesis: The enzymes of DNA replication in prokaryotes and eukaryotes, mechanism of replication in bacteria and viruses, reverse transcriptase, salient features of eukaryotic nuclear and mitochondrial DNA replication.
RNA synthesis: The enzymes of transcription in prokaryotes and eukaryotes, mechanism of transcription in bacteria, heteronuclear RNA, post transcriptional processing of RNA, role of ribozymes.

Unit-III
Protein synthesis: Concept of the genetic code, structure of t-RNA and t-RNA, enzymes of translation in prokaryotes and eukaryotes, mechanism of protein synthesis, post translational processing of proteins.

Unit-IV
Gene expression and its characterization: Regulation of gene expression in prokaryotes and eukaryotes, structure and mechanism of different operons, Gene regulation during development, Gene function and phenotype loss of function & gain of function, Gene interaction, suppressors & enhancers redundancy & epistasis.

Unit-V
Mutations and their consequences: Definition of mutation, mutagenesis & mutant selection, Alleles, Complementation, Recombination, recombination mapping and mechanism of recombination, Repair of DNA, Transposons & retroposons, Genomic & evolution of diversity.

Books Recommended:

S.No.	Author	Book
1	Stryer L	Biochemistry, 4 th edition,
2	Watson J. D., Hopkins, N. H., Roberts, J. W., Steitz, J. A. and Weiner, A. M.	Molecular biology of the gene, 4^{th} edition, The Benjamin/Cummings publishing companies,
3	Benjamin Lewin	Genes VII, oxford University Press, Oxford
4	Weaver R. F.	Molecular biology,
5	Brown T A	Essential molecular biology, vol. I, A practical approach, IRL press, Oxford.28
6	Cox Lynne S	Molecular Themes in DNA Replication
7	Cantor, C. R., and Schimmel, P. R.	Biophysical Chemistry.

B 503: Biodiversity of plants/animals/microbes

Unit-I
Principles of taxonomy: Concept of species and hierarchical taxa, Biological nomenclature, Taxonomical structure**,** Outline classification of animals**,** important criteria used for classification in each Taxon.**,** Classification of animals Levels of Structural organizations: Larval forms and their

evolutionary significance, Unicellular, colonial, and multicellular forms**,** Levels of organization of tissues, organs, and systems**,** Comparative anatomy

Unit-II
Classical and quantitative methods in taxonomy: Biosystematics, Interrelationship among major invertebrate phyla and minor invertebrate phyla; Evolutionary relationship among taxa, Natural History of

Indian subcontinent: Major habitat types, Geographical origin and migration of species , Common Indian mammals and birds, Seasonality and Phenology of Indian subcontinent
Deriving Solutions: Examine the concepts, benefits, and limitations of the different strategies for conserving biodiversity. a. Conservation Strategies, b. Laws and Legal Actions, c. Grassroots Action Program

Unit-III
Taxonomy of plants: Plant identification, nomenclature, collecting and documentation, plant phylogeny and systematics.
Comparative anatomy and morphology of angiosperms and gymnosperms. Angiosperms: Characteristic features, outline classification, vascular anatomy, leaves, flower, fruits and seeds. Gymnosperms: Characteristic features, outline classification, morphology and anatomy of ovules and female gametophyte, microspore and male gametophyte, seeds, stem and leaves.

Unit-IV
Concepts and characteristics of biodiversity: The concepts of biodiversity, Comparison of historical and current rate of species extinction, How genetic diversity may change between generations and within population of species, Complexity and functions of ecosystems; predictable and non-predictable features of ecosystem, Importance of preserving biodiversity, Genetic diversity

Unit-V
Causes and consequences of biodiversity loss: Address the major threats to biodiversity. The biggest threat is from habitat loss and alteration followed by the introduction of exotic species that become invasive. Chemical alteration of the environment also has a major impact on both natural and managed ecosystems.

a. Habitat Loss & Alteration b. Exotic Species c. Chemical Pollutants d. Loss of Genetic Diversity in Crops

Books Recommended:

S.No.	Author	Book
1	Cecie Starr, Ralph Taggart, Christine Evers, and Lisa Starr	Biology: The Unity and Diversity of Life
2	Hawksworth, D. L. & Bull Alan T.	Plant Conservation and Biodiversity. Series: Topics in Biodiversity and Conservation, Vol. 6 (Eds.) Reprinted from Biodiversity and Conservation, 16:6, 2007, VIII, 424 p.
3	M P Singh	Plant Biodiversity & Taxonomy
4	E.O.Wilson, *Editor.* Frances M. Peter	Biodiversity
5	Peter H. Raven, Ray F. Evert, and Susan E. Eichhorn	Biology of Plants

CB 501- Analytical Chemistry

Unit-I
Statistics in chemical analysis: Methods of sampling and associated errors, Classification of errors, Propagation of errors, treatment of errors, Normal distribution, Tests of Significance and Confidence Limits.

Unit -II
Separation techniques:

a. Solvent Extraction Technique: Conventional, Liquid Membranes – Bulk, Supported and Emulsified, Solid Phase Extraction (SPE).
b. Ion Exchange: Conventional, Membranes.
c. Chromatography: Gas chromatography (GC), High Performance Liquid Chromatography (HPLC), Ion chromatography (IC).

Unit -III
Mass Spectrometry: Mass Analysers – Magnetic, Quadrupole, Time of Flight (TOF), Ion Cyclotron Resonance, Features – Resolution, Dispersion, Abundance, Sensitivity , Detectors – Faraday Cup, Channeltron, Daly, Ion Sources –Thermal Ionisation (TI), Electron Impact, ICP, GD, Laser Ablation (LAICP), Secondary Ionisation (SI), Resonance Ionisation (RI), Matrix Assisted Laser Desorption and Ionisation (MALDI), Hyphenated Technique – IC-MS, HPLC-MS, GC-MS.

Unit -IV
Thermal Methods: Thermogravimetric Analysis (TGA), Derivative Thermogravimetric Analysis (DTG), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC), Evolved Gas Analysis (EGA).

Unit -V
Electrochemical Methods: Introduction, Potentiometry , Ion Selective Electrodes (ISE), Voltammetry & Polarography , Cyclic, Pulse and Stripping Voltammetry, Coulometry and Amperometry, AC Electrochemical Techniques, Scanning Electrochemical Microscopy.

Books Recommended:

S.No.	Author	Book
1	RA Meyers	Encyclopaedia of Analytical Chemistry: Applications, Theory and Instrumentation
2	DA Skoog, DM West, FJ Holler and SR Crouch	Fundamentals of Analytical Chemistry, 8^{th} Edition
3	DA Skoog, FJ Holler and TA Niemann	Principles of Instrumental Analysis, 5^{th} Edition, Saunders College Publishing (1998)
4	GH Jeffery, J Bassett, Mendham and RC Denney	A text book of Quantitative Analysis, 5th Edition Revised
5	AK De and SM Khopkar	Chalmers, Solvent Extraction of Metals, Van Nostrand, Reinhold
6	F Helfferich	Ion Exchangers, McGraw Hill
7	LR Snyder and JJ Kirkland	Introduction to Modern Liquid Chromatography, 2nd Edition, Wiley
8	Editors JA Marinsky, Y Marcus, Marcel Dekker	Ion Exchange and Solvent Extraction: A Series of Advances
9	ED Katz Chichester	High Performance Liquid Chromatography : Principles and Methods in Biotechnology;
10	A Metcalfe	Atomic Absorption and Emission Spectroscopy,
11	K Jose and AC Broekaert	Analytical Atomic Spectrometry with flames and Plasmas, Wiley-VCH
12	lJ Sneddon	Advances in Atomic Spectroscopy, Jai Press
13	M John Roboz	Introduction to Mass Spectrometry: Instrumentation and Techniques, Interscience
14	Steve J Hill	Inductively Coupled Plasma Spectrometry and its Application, Sheffield Academic Press
15	WW Wendlandt	Thermal Methods of Analysis, 2nd Edition, Wiley
16	T Daniels, Kogan Page	Thermal Analysis
17	AJ Bard and LR Faulkner	Electrochemical Methods, 2nd Edition, Wiley
18	SP Kruger	Principles of Activation Analysis, Wiley Interscience

19	LC Feldman and JW Meyer	Fundamentals of Surface and Thin Film Analysis, North Holland
20	JC Miller and JN Miller	Statistics for Analytical Chemistry, 2nd Edition, Wiley

G 501: Earth Science and Energy & Environmental Sciences

Unit –I

Origin of the earth, type of rocks in different layers, their physical and chemical properties.
Mechanism of their formation and destruction. Radioactivity and its role in geochronology, Plate tectonics and geodynamics and the role of mantle plumes in sustaining these processes.
Gravity, electrical, seismic and magnetic properties of the different layers in the earth.
Their variations in different geological terrains. Instrumentation, field procedures used in these studies.
Response of the earth to the elastic (Seismic) and electromagnetic waves, use of this phenomena to study the earth's interior.

Unit-II

Geodynamo and the internal magnetic field of the earth.
Paleomagnetic studies, Polar wandering and reversal, possible theoretical arguments for understanding the phenomena.
Seismology and its use in understanding of the different layers in the earth's interior.
Utility of the different geophysical techniques (discussed above) in exploration for academic as well as for harnessing resources.

Unit-III

Introduction to Environmental Science. Natural Environments: Ecosystems and ecology, biodiversity. Socio-cultural environments: demography, population density, human organizations.
Land use and its planning.
Global climate change and effects on environment.
Carbon cycle from human activity, calculation of carbon budgets.

Unit-IV

Water harvesting, storage and treatment.
Natural calamities, hazards, and effects of human activity: Chemical and other technological hazards. Introduction to energy Sources - evolution of energy sources with time. Power production, per capita consumption in the world, and relation to development index. Energy scenario in India: Various issues related to consumption and demands -energy crisis issues in India.
Renewable and non-renewable energy sources - technology and commercialization of energy sources, local (decentralized) versus centralized energy production, constraints and opportunities of renewable energy (hydrocarbon and coal based energy sources).

Unit-V

Energy conservation – calculation of energy requirements for typical and home and industrial applications. Alternative to fossil fuels - solar, wind, tidal, geothermal.
Bio-based fuels. Hydrogen as a fuel.
Energy transport and storages, comparison of energy sources - passage from source to delivery (source, production, transport, delivery) - efficiencies, losses and wastes.
Nuclear energy: Power production: Components of a reactor and its working, types of reactors and comparison. India's three stage nuclear program. Nuclear fuel cycle. Thorium based reactors. Regulations on nuclear energy.

Books Recommended:

S.No.	Author	Book
1	Merill RT, McElhinny MW and McFadden PL	The magnetic field of the Earth: International Geophysical Series
2	Edward J, Tarbuck EJ and Lutgens FK	Earth Science
3	HR Sheehan *et al.*,	Introduction to Applied Geophysics: Exploring the Shallow Subsurface Burger

4	Condie KC	Mantle Plumes and Their Record in Earth History; Cambridge University Press, Cambridge, UK
5	WM Telford, Robert E Sheriff and LP Geldart	Applied Geophysics (Paperback)
6	JB Marion	Energy in Perspective, University of Maryland, Academic Press
7	Robert A Ristinen and Jack J Kraushaar	Energy and Environment, , 2nd Edn., John Wiley and Sons, Inc.
8	Boyle Godfrey	Renewable Energy, Oxford University Press
9	D.K.Asthana and Meera Asthana	Environment, Problems and Solutions, S. Chand and Company
10	Balaram Pani IK	Text Book on Environmental Chemistry, International Publishing House

BL 501: Biology Laboratory (Molecular Biology + Biodiversity + Genetics)

1. BACTERIAL GENETICS

a) *E. coli* Transformation
b) *E. coli* Conjugation
c) *E. coli* Transduction
d) Phage Titration
e) Transposition
f) α- Complementation

2. EUKARYOTIC GENETICS

g) To Study the model organism, *Drosophila Melanogaster*
h) Concept of Crossing: - Monohybrid and Dihybrid crosses using *Drosophila Melanogaster*
i) Drosophila Genetics:
To Observe & Study the Mutants of *Drosophila Melanogaster*
Concept of Mutation - Lethal Mutations
j) Karyotyping

3. BIODIVERSITY

k) Setting up biodiversity niches in the lab & Hospital :fish-tank & Winogradsky column
l) Biodiversity in soil, air & Winogradsky's Column – Plating , Colony Characterization & Gram Staining
m) Field Trips - SEWRI MUD FLATS – ½ DAY, COLABA WOODS - ½ DAY, THANE BUTTERFLY PARK - ½ DAY, KARNALA BIRD SANCTUARY - ½ DAY, MAHIM NATURE PARK - ½ DAY

4. MOLECULAR BIOLOGY

n) General Laboratory Procedures
Pouring Nutrient Agar Plates; Preparation of Solutions;
Bacterial Culturing Techniqueso) Designing of Primers for PCR procedure
p) Extraction and Isolation of genomic DNA Using Kit method By conventional Ethanol Precipitation method
q) Detection of Nucleic acids (AGE)
r) Polymerase Chain Reaction (PCR) & Detection of the PCR product and its purification
s) Blunt-end cloning (after Ligation)
t) Preparation of competent cells & Transformation of E. coli cells with plasmid
u) Plasmid Purification, RE Digestion & Detection of the RE-digested product
v) Overexpression & Detection by PAGE
w) Using restriction mapping to teach basic skills in the molecular biology lab, L. Walsh et al., *Biochem. Mol. Biol. Educ.* **35**, 199-205 (2007).
x) Western blot analysis to illustrate relative control levels of the *lac* and *ara* promoters in *E. coli*, B. Nielsen et al., *Biochem. Mol. Biol. Educ.* **35**, 133- 137 (2007).

Semester – VI [January - June 2018]

B601: Immunology

Unit-I
Overview of the Immune system: Types of immunity, innate, acquired, passive and active, self vs nonself discrimination, Adaptive immune response, Autoimmunity

Unit-II
Cells and organs of the immune system: T cell receptors, T cell receptor genes & gene rearrangements, T cell maturation, activation & differentiation, B cell generation, activation & development

Unit-III
Antigens and Antibodies: Immunoglobulins- structure and function, Immunoglobulin genes-Organization and rearrangement, Antibody diversity, Antigen antibody reactions, MHC (antigens and genes), Antigen processing & presentation

Unit-IV
Immune response: Self Non-self discrimination (mechanism), Clonal selection theory & idiotypic network hypothesis, Cytokines, The complement system, Cell mediated effector response, Leukocyte
migration and inflammation, Hypersensitive reactions, Immune regulation, Immune response to infectious organisms, Vaccines, Immunodeficiency diseases (AIDS)

Unit-V
Immunology & applications: Transplantation immunology, Tumour immunology, Immunotechnology, Animal models. Plant immunity

Books Recommended:

S.No.	Author	Book
1	Goldsby, Kindt, and Osborne	Immunology
2	Janice Kuby	Immunology
3	Ivan Roitt	Essential Immunology, 8th Edition
4	Cellular and Molecular Immunology	Kathyrn Austyn
5	David	Biology of Immunological Diseases
6	Richard Burry	Immunocytochemistry: A practical guide for Biomedical Research

B 602: Animal Physiology

Unit-I
Cell Structure & Metabolism: Homeostasis, Mechanisms of Cellular Control, Membrane Transport, Membrane Potentials (a review). Body Control: Hypothalamic/Pituitary Axis, Mystic Rhythms

Unit-II
Neurons and the Nervous system: Synapses, Sense Perception, Special Senses, CNS Design: Autonomic Nervous System, Action Potential, - Basic structures of neurons and glia, Neurotransmission: Ion channels, Membrane potentials, Resting potential – Depolarization, repolarization and hyperpolarization. Electrotonic and Action potential, Mechanism of neurotransmission. Membrane channels –voltage gated, ligand gated, mechanically gated. Basics of a synapse (electrical and chemical). Introduction to central nervous system design: Structural and functional outline of the brain and the spinal cord, Hypothalamus: Osmoregulation, temperature control, and role in neuroendocrine system: Hypothalamo-hypophyseal portal system, Autonomic Nervous System (sympathetic and parasympathetic pathways). Reflex action.
Unit-III
Muscular system: Skeletal Muscle, Muscle Characteristics, Muscle Control, Muscle Exercise, Smooth Muscle. Cardiovascular Systems: Cardiac Muscle, Heartbeat , Cardiac Control, Blood: Hemostasis,

Temperature Control, Vessels, Tissue Exchange, EKGs and Blood Pressure. Digestion: Absorption

Unit-IV
Respiratory Systems: Respiration, Respiratory Control. Energy Balance and Metabolism: Fuel Metabolism (both plants and Animals)

Unit-V
Processes: Excretion Control Salt & Water Balance, An example of a process going wrong. Diabetes. Comparative Physiology

Books Recommended:

S.No.	Author	Book
1	Linda S. Costanzo	Physiology: Board Review Series
2	William Ganong	Review of Medical Physiology (Lange Basic Science)
3	Guyton and Hall	Physiology Review
4	Appleton and Lange	Review of Physiology
5	Linardakis	Illustrated review of Physiology
6	C Guyton	Textbook of Medical Physiology

B 603: Plant Physiology

Unit-I
Plant Cells - Model Organisms, The Plant Kingdom, Flower Structure and the Angiosperm Life Cycle, Plant Tissue Systems: Dermal, Ground, and Vascular
The Structures of Chloroplast
Glycosylglycerides A Model for the Structure of Nuclear Pores
The Proteins Involved in Nuclear Import and Export
Protein Signals Used to Sort Proteins to their Destinations
SNAREs, Rabs, and Coat Proteins Mediate Vesicle Formation, Fission, and Fusion ER Exit Sites (ERES) and Golgi Bodies Are Interconnected
Specialized Vacuoles in Plant Cells
Actin-Binding Proteins Regulate Microfilament Growth
Kinesins Are Associated with Other Microtubules and Chromatin Water and Plant Cells
Calculating Capillary Rise, Calculating Half-Times of Diffusion Alternative Conventions for Components of Water Potential
Temperature and Water Potential, Can Negative Turgor Pressures Exist in Living Cells? Measuring Water Potential, The Matric Potential, Wilting and Plasmolysis
Understanding Hydraulic Conductivity
Water Balance of Plants
Irrigation, Physical Properties of Soils, Leaf Transpiration and Water Vapor Gradients Calculating Velocities of Water Movement in the Xylem and in Living Cells
Mineral Nutrition
Symptoms of Deficiency in Essential Minerals - Wade Berry, UCLA Observing Roots below Ground
Solute Transport
Relating the Membrane Potential to the Distribution of Several Ions across the Membrane: The

Unit-II
Photosynthesis: The Light Reactions
Principles of Spectrophotometry, Quantum Yield
The Distribution of Chlorophylls and Other Photosynthetic Pigments Antagonistic Effects of Light on Cytochrome Oxidation

Structures of Two Bacterial Reaction Centers
Midpoint Potentials and Redox Reactions
Oxygen Evolution, Photosystem I, ATP
Synthase
Mode of Action of Some Herbicides, Chlorophyll Biosynthesis
Photosynthesis: The Carbon Reactions
Inorganic Carbon-Concentrating Mechanisms: CO2 and HCO3 –
Pumps How the Calvin–Benson Cycle Was Elucidated
Rubisco: A Model Enzyme for Studying Structure and
Function Energy Demands for Photosynthesis in Land
Plants
Rubisco Activase, Thioredoxins, Operation of the C2 Oxidative Photosynthetic Carbon
Cycle Carbon Dioxide: Some Important Physicochemical Properties
Three Variations of C4 Metabolism
Single-Cell C4 Photosynthesis, Photorespiration in CAM
plants Glossary of Carbohydrate Biochemistry, Starch
Architecture Fructans, Chloroplast Phosphate Translocators

Photosynthesis: Physiological and Ecological Considerations
Working with Light, Heat Dissipation from Leaves: The Bowen
Ratio The Geographic Distributions of C3 and C4 Plants
Calculating Important Parameters in Leaf Gas
Exchange Prehistoric Changes in Atmospheric CO2
Projected Future Increases in Atmospheric CO2
Using Carbon Isotopes to Detect Adulteration in
Foods Reconstruction of the Expansion of C4 Taxa

Translocation in the Phloem
Sieve Elements as the Transport Cells between Sources and Sinks
An Additional Mechanism for Blocking Wounded Sieve Elements in the Legume
Family Sampling Phloem Sap, Nitrogen Transport in the Phloem
Monitoring Traffic on the Sugar Freeway: Sugar Transport Rates in the Phloem
Alternative Views of Pressure Gradient in Sieve Elements: Large or Small
Gradients? Experiments on Phloem Loading, Experiments on Phloem Unloading
Allocation in Source Leaves: The Balance between Starch and Sucrose
Synthesis Partitioning: The Role of Sucrose-Metabolizing Enzymes in Sinks
Possible Mechanisms Linking Sink Demand and Photosynthetic Rate in Starch
Storers Proteins and RNAs: Signal Molecules in the Phloem

Unit-III
Respiration and Lipid Metabolism
The Q-Cycle Explains How Complex III Pumps Protons across the Inner Mitochondrial
Membrane, Multiple Energy Conservation Bypasses in Oxidative Phosphorylation of
Plant Mitochondria, FoF1-ATP Synthases: The World′s Smallest Rotary Motors
Transport Into and Out of Plant Mitochondria, The Genetic System in Plant Mitochondria
Has Several Special Features, Does Respiration Reduce Crop Yields?
The Lipid Composition of Membranes Affects the Cell Biology and Physiology of
Plants Utilization of Oil Reserves in Cotyledons

Assimilation of Mineral Nutrients
Development of a Root Nodule, Measurement of Nitrogen
Fixation The Synthesis of Methionine, Oxygenases

Secondary Metabolites and Plant Defense
Goldman Equation, Patch Clamp Studies in Plant Cells, Chemiosmosis in Action
Kinetic Analysis of Multiple Transporter Systems, ABC Transporters in
Plants Transport Studies with Isolated Vacuoles and Membrane Vesicle

Cutin, Waxes, and Suberin, Structure of Various Triterpenes
The Shikimic Acid Pathway, Detailed Chemical Structure of a Portion of a Lignin Molecules

Cell Walls: Structure, Biogenesis, and Expansion
Plant Cell Walls Play a Major Role in Carbon Flow through
Ecosystems Terminology for Polysaccharide Chemistry
Molecular Model for the Synthesis of Cellulose and Other Wall Polysaccharides That Consist
of a Disaccharide Repeat, Matrix Components of the Cell Wall
The Mechanical Properties of Cell Walls: Studies With *Nitella*
Wall Degradation and Plant Defense, Structure of Biologically Active
Oligosaccharins Glucanases and Other Hydrolytic Enzymes May Modify the
Matrix

Unit-IV
Growth and Development
Embryonic Dormancy, Rice Embryogenesis
Polarity of *Fucus* Zygotes, *Azolla* Root Development
Class III HD-Zip Transcription Factors Promote Adaxial Development through a micro RNASensitive
Mechanism During Senescence Photoactive Chlorophyllide Is Converted into a Colorless Chlorophyll
Catabolite Phytochrome and Light Control of Plant Development
Mougeotia: A Chloroplast with a Twist, Phytochrome and High-Irradiance
Responses The Origins of Phytochrome as a Bacterial Two-Component Receptor
Profiling Gene Expression in Plants, Two-Hybrid Screens and
Co-immunoprecipitation Phytochrome Effects on Ion Fluxes, Microarray Analysis
of Shade Avoidance Blue-Light Responses: Morphogenesis and Stomatal
Movements
Blue-Light Sensing and Light Gradients, Guard Cell Osmoregulation and a Blue
Light-Activated Metabolic Switch
The Coleoptile Chloroplast, Phytochrome-Mediated Responses in
Stomata Gibberellins: Regulators of Plant Height and Seed Germination
Structures of Some Important Gibberellins and Their Precursors, Derivatives, and Inhibitors
of Gibberellin Biosynthesis
Commercial Uses of Gibberellins, Gibberellin Biosynthesis
Environmental Control of Gibberellin Biosynthesis, Auxin Can Regulate
Gibberellin Biosynthesis
Negative Regulators of GA Response, Effects of GAs on
Flowering DELLA Proteins as Integrators of Multiple Signals
Cytokinins: Regulators of Cell Division
Cultured Cells Can Acquire the Ability to Synthesize
Cytokinins Structures of Some Naturally Occurring
Cytokinins
Various Methods Are Used to Detect and Identify
Cytokinins The Biologically Active Form of Cytokinin Is
the Free Base
Cytokinins Are Also Present in Some tRNAs in Animal and Plant
Cells The Structures of Opines, The Ti Plasmid and Plant Genetic
Engineering Phylogenetic Tree of *IPT* genes
A Root-Derived Hormone, Strigolactone, Is Involved in the Suppression of Branching in
Shoots Cytokinin Can Promote Light-Mediated Development
Cytokinins Promote Cell Expansion and Greening in
Cotyledons Cytokinins Interact with Elements of the
Circadian Clock Ethylene: The Gaseous Hormone
Ethylene in the Environment Arises Biotically and
Abiotically Ethylene Readily Undergoes Oxidation
Ethylene Can Be Measured by Gas
Chromatography Cloning of the Gene That
Encodes ACC Synthase Cloning of the Gene
That Encodes ACC Oxidase
Ethylene Binding to ETR1 and Seedling Response to Ethylene
Conservation of Ethylene Signaling Components in Other Plant

Species ACC Synthase Gene Expression and Biotechnology
The *hookless* Mutation Alters the Pattern of Auxin Gene Expression
Ethylene Inhibits the Formation of Nitrogen-Fixing Root Nodules in
Legumes
Ethylene Biosynthesis Can Be Blocked with Anti-Sense
DNA Abscission and the Dawn of Agriculture
Specific Inhibitors of Ethylene Biosynthesis Are Used Commercially to Preserve Cut
Flowers Abscisic Acid: A Seed Maturation and Stress-Response Hormone
The Structure of Lunularic Acid from
Liverworts ABA May Be an Ancient Stress
Signal
Structural Requirements for Biological Activity of Abscisic Acid, The Bioassay
of ABA Evidence for Both Extracellular and Intracellular ABA Receptors
The Existence of G Protein-Coupled ABA Receptors Is Still
Unresolved The Yeast Two-Hybrid System
Yellow Cameleon: A Noninvasive Tool for Measuring Intracellular
Calcium Phosphatidic Acid May Stimulate Sphingosine-1-Phosphate
Production The ABA Signal Transduction Pathway Includes Several
Protein Kinases
The *ERA*1 and *ABH* Genes Code for Negative Regulators of the The ABA
Response Promoter Elements That Regulate ABA Induction of Gene
Expression
Regulatory Proteins Implicated in ABA-Stimulated Gene Transcription
ABA Gene Expression Can Also Be Regulated by mRNA Processing and
Stability ABA May Play a Role in Plant Pathogen Responses
Proteins Required for Desiccation Tolerance, The Types of Coat-Imposed Seed
Dormancy Types of Seed Dormancy and the Roles of Environmental Factors
The Longevity of Seeds, Genetic Mapping Of Dormancy: Quantitative Trait Locus
(QTL) Scoring of Vegetative Dormancy Combined with a Candidate Gene
Approach ABA-Induced Senescence and Ethylene

Unit-V
The Control of Flowering
Contrasting the Characteristics of Juvenile and Adult Phases of English Ivy (*Hedera helix*)
and Maize (*Zea mays*), Regulation of Juvenility by the *TEOPOD* (*TP*) Genes in Maize
Flowering of Juvenile Meristems Grafted to Adult Plants
Characteristics of the Phase-Shifting Response in Circadian
Rhythms Support for the Role of Blue-Light Regulation of
Circadian Rhythms
Genes That Control Flowering Time, Regulation of Flowering in Canterbury Bells by
Both Photoperiod and Vernalization, The Self-Propagating Nature of the Floral Stimulus
Examples of Floral Induction by Gibberellins in Plants with Different Environmental
Requirements for Flowering, The Effects of Two Different Gibberellins on Flowering
(Spike
Length) and Elongation (Stem Length), The Contrasting Effects of Phytochromes A and B on
Flowering A Gene That Regulates the Floral Stimulus in Maize
Responses and Adaptations to Abiotic Stress
Stomatal Conductance and Yields of Irrigated Crops, Membrane Lipids and Low
Temperatures Ice Formation in Higher-Plant Cells, Water-Deficit-Regulated ABA Signaling
and Stomatal Closure, Genetic and Physiological Adaptations Required for Zinc
Hyperaccumulation
Cellular and Whole Plant Responses to Salinity Stress
Signaling during Cold Acclimation Regulates Genes That Are Expressed in Response to
Low Temperature and Enhances Freezing Tolerance

Books Recommended:

S.No.	Author	Book
1	Hans Mohr, Peter Schopfer	Plant Physiology; Springer, 629 pages

2	Taiz and Zeiger	Plant Physiology; 4th Edition. Sinauer
3	Hopkins WG	Introduction to Plant Physiology. 2nd or 3rd Edition
4	Stern KR	Introductory Plant Biology. 7th Ed. Wm C Brown Publishers
5	Fosket	Plant Growth and Development: A molecular approach. Acad. Press. More details on how plants grow and develop.
6	Buchanan R, Gruissem W and	Biochemistry and Molecular Biology of
	Jones R	Plants
7	Chrispeels MJ and DE Sadava	Plants, Genes and Crop Biotechnology. 2nd Ed. Jones and
8	Bartlett	Understanding plant biology and the potential of agricultural biotechnology

B 604: Microbiology

Unit-I

General Microbiology - Introduction to Microscopy, Prokaryotic Structure & Function, Microbial Nutrition, Microbial Growth, Control of Microbes, From Taxonomy through the *Archaea*: Gram Negative Bacteria, Gram Positive Bacteria, metabolism, microbial genetics, and the role of microorganisms in disease, immunity, and other selected applied areas.
Fundamentals of General Microbiology - Isolation of a broad range of nonpathogenic bacteria from natural sources, using selective and enrichment techniques, with microscopic, biochemical, and molecular identification. Related exercises include genetics, physiology, quantitation, and growth energetics. Survey of the microbial world, metabolism, biosynthesis, regulation, growth, structure, and function.

Unit-II

Microbes and Society Focuses on activities of bacteria, viruses, and other microorganisms, and their influence on humans. Microbe-related topics include disease, bioterrorism, food, biotechnology, and ecology. Examine the nature of scientific inquiry, along with major biological concepts.
Bacterial Genetics - Molecular genetics: description of fundamental genetic processes such as mutation, repair, genetic exchange, recombination, and gene expression. Use of genetic strategies to analyze complex biological processes. Focuses on prokaryotic organisms. Signal transduction in bacteria

Unit-III

Evolution of Prokaryotic Diversity - Evolution, diversity, and genomics of prokaryotic microorganisms, Enrichment, isolation, and molecular phylogenetic characterization of selected
prokaryotic organisms. Prokaryotic Diversity - Structure, biochemical properties, and genetics of the major groups of prokaryotes.
Microbial Ecology - Consideration of the various roles that microorganisms, particularly bacteria and cyanobacteria, play in environmental processes. The interrelationships among microorganisms and the effects of the physical, chemical, and biological properties of their environment are discussed and assessed. Microbial ecology; food, industrial and medical microbiology Symbiosis Aquatic Ecology, Terrestrial Ecology, Industrial Microbiology, Food Microbiology

Unit-IV

Medical Bacteriology - Medically important bacterial pathogens in terms of the clinical, therapeutic, and epidemiological aspects of diseases caused by them, molecular mechanisms of pathogenesis and their identification in the clinical laboratory, procedures for isolation and identification of pathogenic bacteria, testing their susceptibility to antibiotics. Bacterial Pathogenesis: Introduction, Genetic tools used for bacterial pathogenesis study; Bacterial cell-cell communications and biofilm formation, Bacterial genomics, lateral transfer, phage, Vertebrate microbial communities in health and disease, Strategies for bacterial adhesion and invasion

Medical Mycology and Parasitology - Consideration of medically important fungi and parasites, with emphasis on their biology in relation to disease and its laboratory diagnosis.

Unit-V
Molecular Mechanisms of Bacterial Pathogenesis Mechanisms of bacterial pathogenesis explored at the molecular, genetic, and cellular levels through selected models as presented in the current scientific literature. Molecular and Medical Microbiology recent advances in molecular biology of microbial pathogenesis or the current research of the participants is presented and discussed critically.

Protozoan infections: Introduction to protozoa, A survey of the major protozoan infections of humans including a brief description of the parasite life cycles and a brief discussion of the clinical diseases seen during these infections.

Biology and pathogenesis of Plasmodium. life cycle Plasmodium parasites and pathology of human malaria, biochemical and cell biological similarities and differences with other apicomplexa (Babesia, Cryptosporidium, Toxoplasma, etc.), and implications for therapeutic development. Biology and pathogenesis of Toxoplasma, Leishmania, Trypanosoma.

Books Recommended:

S.No.	Author	Book
1	Thomas D Brock	Brock's Biology of Microorganisms
2	Patrick R Murray	Medical Microbiology: with STUDENT CONSULT Access
3	John M Barry	The Great Influenza: The Story of the Deadliest Pandemic in History
4	Alfred E Brown	Benson's Microbiological Applications: Laboratory Manual in General Microbiology (Spiral-bound)
5	Ananthanarayan and Paniker Orient Blackswan	Textbook of Microbiology: Medical microbiology

CB601: Biophysical Chemistry

Unit-I
Physical properties of water: Structure, water as solvent, The hydrophobic effect, osmosis and Diffusion. Introduction to Biomolecules: Nucleic Acid, Protein - Polymer Description of Macromolecular Structure, Intermolecular and Intramolecular forces, Non Covalent Interaction

Unit -II
Hydrodynamic properties: Diffusion and sedimentation, determination of molecular weight from sedimentation and diffusion; Introduction of Ultra Centrifugation, Dynamic Light Scattering and Electrophoresis.
Spectroscopic properties of proteins and nucleic acid: UV/Vis, Intrinsic fluorescence, Circular Dichroism

Unit -III
The concept and application of Chemical and Physical equilibria in Biological system, The equilibrium constant and Standard Gibbs Free energies of reactants and products, Temperature dependence of the equilibrium constant, Double Strand formation in nucleic acid, Ligand-protein binding, Protein denaturation and stability, Introduction of DSC and ITC

Unit -IV
Protein folding kinetics and Biophysical methods, Misfolding and aggregation ; Physical basis of conformation diseases, Therapeutic approaches to protein misfolding diseases.

Unit -V
Introduction to basic principles of protein X-ray crystallography, protein NMR, Small Angle X-ray scattering (SAXS), and Electron microscopy (EM).

Books Recommended:

S.No.	Author	Book
1	Tinoco, Sauer, Wang & Puglisi	Physical Chemistry: Principles and Applications in the Biological Sciences
2	Peter Atkins and Julio de Paula	Physical Chemistry for the Life Sciences

H 601 Ethics of Science and IPR

Unit-I

Introduction – causes of unethical acts, ignorance of laws, codes, policies and Procedures, recognition, friendship, personal gains; Bioethics: Definition – moral, values, ethics; Role and importance of ethics in biology; Professional ethics – professional conduct

Ethical decision making, ethical dilemmas; Teaching ethical values to scientists, good laboratory practices, good manufacturing practices, laboratory

Basic Approaches to Ethics; Posthumanism and Anti-Posthumanism; Bioethics: legal and regulatory issues;

Unit-II

Bioethics in healthcare, agriculture, modern biology, biotechnology, animal welfare & right / animals in research, wildlife conservation and management, commercialism in scientific research

Bioethics and cross-cultural bioethics – Autonomy, Rights, Beneficience, Do No Harm, Justice, Confidentiality, Animal Rights, Environmental ethics, Decision-Making Perceptions of Ethical Biotechnology 'Moral' is not the same as Ethical, Mixed Perception of Benefit & Risk, Reasoning behind Acceptance or Rejection of Genetic Manipulation, Concerns about Consuming products of GMOs.

Past and Present 'Bioethical Conflicts' in Biotechnology- Interference with Nature , Fear of Unknown, Regulatory Concerns, Human Misuse Future 'Bioethical Conflicts' in Biotechnology - Changing perception of Nature, Human Genetic Engineering

Unit-III

Ethical issues related to Synthetic biology:

Engineering DNA-based biological circuits, including but not limited to standardized biological parts;

Defining a minimal genome/minimal life (top-down); Constructing protocells, i.e. living cells, from scratch (bottom-up), Creating orthogonal biological systems based on a biochemistry, e.g. non-ATGC DNA bases or non-DNA non-RNA nucleic acids, so called XNA

Unit-IV

Introduction to IPR; Types of Intellectual property – Patents, Trademarks

Copyrights and related rights; Traditional vs. Novelty; Importance of intellectual property rights in the modern global economic environment, Importance of intellectual property rights in India; IPR and its relevance in biology and environmental sciences;

Case studies and agreements - Evolution of GATT and WTO and IPR provisions under TRIPS; Madrid agreement; Hague agreement; WIPO treaties; Budapest treaty; Indian Patent Act (1970)

Unit-V

Patents: Definition, patentable and non patentable inventions; types of patent application – Ordinary, Conventional, PCT, Divisional, and Patent of addition; Concept of Prior Art; Precautions while patenting disclosure / nondisclosure; Time frame and cost; Patent databases, Searching International databases; Patent licensing and agreement; Patent infringement – meaning, scope, litigation, case studies. Patenting rules – European Scenario, US Scenario, Australia Scenario, Indian Scenario, Non Patentable IP and Patentable IP in Indian Patent Act

Rights of patents – Infringement of patent rights Remedies for infringement of patent rights; Patentability and emerging issues

Books Recommended:

S.No.	Author	Book

1	Lesk	Introduction to Bio Informatics, OUP
2	Cynthia Gibas and Per Jambeck,	Developing Bioinformatics Computer Skills
3	Atwood, Pearson Education	Introduction to Bioinformatics
4	Tisdall, SPD	Beginning Perl for Bio-informatics
5	Smith, D.W., 1994	Biocomputing: Informatics and Genome Project
6	Baxevanis, A.D., Quellette, B.F.F.,	Bioinformatics: A practical Guide to the Analysis of Genes and Proteins

BL 601: Biology Laboratory
(Animal Physiology + Plant Physiology +Immunology + Microbiology+ Bioinformatics)

1. ANIMAL PHYSIOLOGY

a) Animal cell culture and microscopy
b) Gross anatomy of the animal brain & Staining of mouse brain sections
c) Wound Healing Assay

2. IMMUNOLOGY

d) Isolations of monocytes/macrophages- properties; Isolation of Lymphocytes- T and B cell identification & Lymphocyte Activity.
e) Separation of WBC & RBC; counting by Haemocytometer
f) Serum Electrophoresis
g) ELISA - direct & indirect
h) Ag detection & Ab detection
i) Widal – Tube & Slide
j) VDRL
k) Blood typing & Pregnancy hCG Ag
l) Double diffusion
m) Immunoelectrophoresis
n) Radial Immunodiffusion

3. PLANT PHYSIOLOGY

p) *Arabidopsis thaliana* - model organism and its development
q) *Funaria hygrometrica* - differentiation from chloronema to caulonema to bud formation
r) Callus formation from carrot cells

4. Bioinformatics:

DNA sequence analysis using BLAST; sequence pattern, motifs and profiles. Prediction of secondary structure of proteins
Prediction of tertiary structure of (fold recognition, homology search)
Molecular modeling and dynamics: using small oligonucleofides and small protein with known crystal structure (available from data bank)
Drug designing – using available data Applications of bio informatics – open ended / small project.

FOURTH YEAR
Semester – VII [July – December 2018]

B 701: Neurobiology

Unit-I

The glial system: Generation of Astrocytes, Oligodendrocytes, and Schwan cells. Function of glia in normal brain and in neuroprotection.
Chemical composition of the brain: metabolism (utilization and uptake of glucose and amino acids). Blood-Brain barrier.

Unit-II

Neurotransmitters: Synthesis, storage, release, uptake, degradation and action of neurotransmitters, Acetyl choline, GABA, Serotonin, Dopamine, Glutamate, Nitrous oxide, etc. Receptors: different subtypes (cholinergic, dopaminergic, adrenergic, and glutamatergic), mechanism of action, Agonists and Antagonists – their mode of action and effects. Exocytosis of neurotransmitter – Role of synapsins, synaptogamins, SNAP, SNARE and other proteins in docking, exocyotosis and

recycling of vesicles.
Unit-III
Sleep and Learning and memory: Mechanism of short-term memory and Long-term memory (longterm potentiation). Role of sleep in memory consolidation. Electroencephalogram. Role of second messenger pathways in learning and memory process. Role of synaptic plasticity.

Unit-IV
Sensory organs:
Vision: Biochemistry of vision: Rod and cone cells, mechanism and regulation of vision, color vision, visual field, visual acuity. Visual pathway and topographic mapping.
Audition: functional anatomy of the middle and inner ear. Amplification of sound. Functional anatomy and mechanism of detection of specific sound frequency in the inner ear. Mechanism of action of the mechanosensory receptors in the inner ear.

Unit-V
Chemical senses:
Olfaction: The olfactory pathway, mechanism and the combinatorial code of detecting a smell. Taste: Mechanism of taste perception.
Touch/pain: The touch/pain/temperature pathway (ascending and descending). Higher order integration in the brain.
Pathologies of the nervous system: Molecular basis of Parkinson's disease, Alzheimer's disease, Schizophrenia, Myasthenia gravis and Multiple sclerosis, stress and antidepressants.

Books Recommended:

S.No.	Author	Book
1	Ferdinand Hucho	Neurochemistry
2	MP Spiegel	Basic Neurochemistry
3	Koenig and Edward	Cell Biology of the Axon, Series: Results & Problems in Cell Differentiation, Vol. 48
4	Eric Kendel, JH Schwartz, T Jessel	Principles of neural Sciences
5	A Guyton and J Hall	Textbook of medical Medical physiology

B 702: Immunology-II (Immunity and Disease)

Unit-I
Host-Pathogen relationship
Diseases caused by Viruses and the immune response to them- HIV and AIDS-immune responses

Unit-II
Bacterial diseases – and the immune response to bacteria Vaccines- mechanisms, types of vaccines

Unit-III
Parasites – protozoan parasites, parasitic worms and the immune response to them- eg malaria, leishmaniasis, worm infestations

Unit-IV
Immediate Hypersensitivity and allergy, anaphylaxis
Hypersensitivity and chronic inflammatory diseases- tuberculosis and leprosy Cancer immunology

Unit-V
Autoimmune diseases- generalized- SLE, Rheumatoid arthritis; localized- multiple sclerosis Diseases due to immune cross reactivity- Rh incompatibility, transfusion, transplantation Inherited immune diseases
Books Recommended:

S.No.	Author	Book
1	Charles A Janeway, JP Travers, Mark Walport and Mark J Shlomchik	Immunobiology, 5th edition; The Immune System in Health and Disease
2	Baron S, Galveston	Medical Microbiology; 4th Edition; University of Texas Medical Branch at Galveston
3	RA Goldsby *et al.*	Kuby's Immunology
4	E Benjamini, R Coico and G Sunshine	Immunology- A short Course
5	Roitt, Brostoff and Male	Immunology
6	William Paul	Fundamentals of Immunology
7	Tizard	Immunology
8	Abbas *et al.*	Immunology

B 703: Developmental Biology

Unit-I

Basic concepts of molecular regulation of development: Transcription factors in differential gene expression; morphogens and axis formation; autocrine and paracrine regulation. How cell proliferation, apoptosis, and fate specification determine developmental processes.
Fertilization: Structure of oocytes and spermatocytes. The process of fertilization.

Unit-II

Comparative study of early embryonic development: (*Caenorhabditis elegans*, amphibians, birds, and mammals), Cleavage formation, Gastrulation
Axis formation: Signaling cascades and molecular understanding of anteroposterior, mediolateral, and dorsoventral axes development.

Unit-III

Organogenesis in vertebrates: Germ layer formation. Regulation of formation of the somites, heart, kidney, blood vessels, and limb. Changes in circulation pattern between fetus and newborn.
Metamorphosis and regeneration process: Hormonal control of metamorphosis in amphibians and insects; wing imaginal disc formation in *drosophila*. Regeneration in planeria and that of vertebrate limb.

Unit-IV

Stem cells: Concepts of totipotent, pluripotent, and multipotent cells. Factors regulating "stemness" of a cell. Embryonic vs. adult stem cells. Sources of stem cells in vertebrates and their applications.
Developmental disorders and aging: Regulatory role of genetic and environmental factors. Role of carcinogens and teratogens.

Unit-V

Development processes in plants: How are the mechanisms different from that of animal development? Gametogenesis, pollination, and fertilization processes in angiosperms. Hormonal regulation of seed dormancy and the process of germination. Root and shoot development mechanisms. Reproductive phase: photoperiod sensitivity and molecular regulation of flowering process.
Epigenetic and environmental control of development: Sexual dimorphism, sex determination, X inactivation. Environ-elicited phenotypic changes. Defense mechanism-related changes.

Books Recommended:

S. No.	Author	Book
1	Alberts *et al.*	Molecular Biology of the Cell
2	SF Gilbert	Developmental Biology
3	Lewin Benjamin	Gene VIII
4	PO Moody	Introduction to Evolution, 1970,

5	Dobzhansky et al.	Evolution, W. H. Freeman. New York
6	SW Fox and K Dose	Molecular Evolution and the Origin of Life,
7	FJ Ayala and JW Valentine	Evolving: The theory and processes of Organic evolution
8	EO Dodson	Evolution: Process and Product
9	MW Strickberger	Evolution, 1979, James and Barlett International

B 704: Imaging Technology in Biological Research

Unit-I

The power of ten (understanding how small cells and the sub-cellular contents are)
An introduction to light and optics, exploring with lenses (what are lenses, looking through them, understanding the concept of magnification, mirrors, angles of reflection, refraction, prisms and colors)

Unit-II

Fundamentals of illumination (ray diagrams, types of light sources, LEDs, power levels, coherence of light, elliptical reflectors)
Exploring microscopes (short history, magnifying glass, simple and compound microscopes, electron Microscopes, stereomicroscope)

Unit-III

Fluorescence microscopy (Understanding fluorescence, Fluorescence protein technology, GFP, YFP) two-photon fluorescence microscopy, matrix-assisted laser desorption/ionization mass spectrometry (MALDI- MS) imaging

Unit-IV

Live cell imaging (confocal microscopes), Differential interference contrast (DIC)
images Comparing Confocal and Widefield Fluorescence Micro scopy
Atomic force microscopy and optical tweezers force spectroscopy

Unit-V

NMR Imaging

Spatially nonresolved NMR spectroscopy; low-field NMR instruments; ^{1}H-nuclear magnetic resonance (NMR) microimaging ; ^{1}H-magic angle spinning NMR spectroscopy; MAS-^{13}C NMR spectroscopy
Spectral-resolution enhancement using magic angle spinning

Books Recommended:

S.No.	Author	Book
1	Ulf Grenander, Y Chow and Daniel M Keenan	Hands: A Pattern Theoretic Study of Biological Shapes (Research Notes in Neural Computing) (Volume-2)
2	Valery V Tuchin, Lihong Wang and Dmitry A Zimnyakov	Optical Polarization in Biomedical Applications (Biological and Medical Physics, Biomedical Engineering)
3	RM Lambrecht	Biological Models in Radiopharmaceutical Development (Developments in Nuclear Medicine)
4	Michael D Powers and Janet Poland	Asperger Syndrome and Your Child: A Parent's Guide
5	Philippe Sansonetti	Bacterial Virulence: Basic Principles, Models and Global Approaches (Infection Biology (VCH)
6	Richard Nuccitelli, Leslie Wilson and Paul T Matsudaira	A Practical Guide to the Study of Calcium in Living Cells, Volume 40 (Methods in Cell Biology)

7	Warren CW Chan	Bio-Applications of Nanoparticles (Advances in Experimental Medicine and Biology)
8	Bertram Manz, Kerstin Mu¨ ller,	Water Uptake and Distribution in Germinating
	Birgit Kucera, Frank Volke, and Gerhard Leubner-Metzger	Tobacco Seeds Investigated in Vivo by Nuclear Magnetic Resonance Imaging. Plant Physiology, July 2005, Vol. 138, pp. 1538–1551

Semester – VIII [January – June 2019]

B 801: Virology

Unit-I
Introduction to Virology: definition, properties and origin of
viruses Virus architecture and nomenclature
Virus replication cycle
Basic virological
methods
Basics of virus entry, spread and transmission

Unit-II
Host resistance to viral infection: immune responses
Vaccines and antiviral chemotherapy: the prevention and treatment of viral
diseases Epidemiology
Exploiting viruses as gene therapy and vaccine vectors

Unit-III
Viruses and cancer: oncoviruses and oncolytic viruses
Polioviruses and other single-stranded positive-strand RNA
viruses Rabies and other single-stranded nonsegmented
negative-strand
Influenza viruse and ther single-stranded segmented negative-strand RNA viruses.

Unit-IV
Evolution of viruses: new and reemerging viruses
Herpesviruses (nuclear large double-stranded DNA
viruses) Poxviruses (cytoplasmic large double-stranded
DNA viruses) HIV and other retroviruses

Unit-V
Hepatitis B virus (reverse-transcribing DNA virus) and other viruses causing
hepatitis Prion diseases
Plant viruses
Bacteriopha
ges

Books Recommended:

S.No.	Author	Book
1	L Collier, J Oxford and Paul Kellam	Human Virology (4^{th} edition),
2	SJ Flint, LW Enquist, VR Racaniello and AM Skalka	Principles of Virology (3^{rd} edition) 2009
3	AJ Cann	Principles of Molecular Virology,
4	Teri Shors, Jones and Bartlett	Understanding Viruses
5	NJ Dimmock, A Easton, K Leppard	Introduction to Modern Virology 6th edition,

6	David M Knipe, Peter M Howley, MD Diane E Griffin, Robert A Lamb, Malcolm A Martin, Bernard Roizman, Stephen E Straus	Field's Virology. 6th edition
7	AJ Zuckerman, JE Banatvala, P Griffiths, B Schoub and P Mortimer	Principles and Practice of Clinical Virology (6th edition)
8	G Kudesia and T Wreghitt: Cambridge Clinical Guide	Clinical and Diagnostic Virology
9	L. Sompayrac	How Pathogenic Viruses Work;

B 802: Biotechnology-I

Unit-I
Basic principles of genetic engineering:
Methods of creating recombinant DNA molecule, splicing, properties of restriction endonucleases and their mode of action. Cloning vectors (lambda phage plasmid, M-13 phage, cosmid, shuttle vectors, yeast and viral vectors, expression vectors), construction of DNA library, Subtraction cDNA cloning, genomic vs cDNA library - Expression libraries and vectors for protein synthesis, protein purification, protein solubilization, protein export, RNA probes, BACs, PACs and cosmid vectors, Yeast vectors and YACs

Unit-II
Transgenic animals [Selectable markers for animal cells eg HAT, methotrexate Reporter genes for promoter analysis (Lac Z, GFP) vectors (Baculoviruses) microinjection, retroviruses, Embryonic stem cells), Transgenic mouse / Super mouse – (MT promoter fused to human growth hormone) (isolation of cloned proteins from goat milk). Viruses as gene-transfer Methods for production of transgenic mice
(Pronuclear Transgenic Goats Whole animal cloning eg Dolly, Knock-out, knock-down, knock-in technology, Site-specific recombination using Cre-recombinase LOX system, Gene therapy eg SCID]

Unit-III
Transgenic plants [Agrobacterium mediated transformation, Ti plamid, Transgenic tobacco expressing luciferase gene, Bt Cotton, Herbicide-resistant plants, Plant viruses as vectors (eg CaMV virus)]. Application of genetic engineering in medicine and agriculture, vaccine production.

Unit-IV
Chemical synthesis of gene and engineering artificial life . Selection/screening: Analysis of genomic DNA by Southern hybridization, Northern and Western blotting techniques, Restriction mapping: Restriction fragment length polymorphism (RFLP). DNA sequencing and analyses techniques: plus and minus, dideoxynucleotide, Maxam and Gilbert, deep sequencing and next gen sequencing, microarray technology and hybridisations.

Unit-V
DNA manipulation techniques:
Preparation of radiolabelled and synthetic probes, Amplification of DNA by polymerase chain reaction (PCR), Site directed mutagenesis, Gene transfer methods for animals and plants; Agrobacterium mediated
gene transfer, electroporation and particle gun. Cell and tissue culture in plants and animals: Primary culture; Cell line; Cell clones; Callus cultures; Somaclonal variation; Micropropagation; Somatic embryogenesis; Haploidy; Protoplast fusion and somatic hydridization; Cybrides; Gene transfer methods in plants and in animals; Transgenic biology; Allopheny; Artificial seeds; Hybridoma technology.

B 804: Biotechnology-II

Unit-I
Principles of plant breeding: Important conventional methods of breeding self and cross pollinated and vegetatively propagated crops; Non-conventional methods; Polyploidy: Genetic variability; Plant diseases and defensive mechanisms. Ethics of GM crops and animal cloning . Model organisms - S.

cereviceae, Dictostylium, Caenorhabditis elegans, Arabidopsis, Zebra Fish, Mouse, Drosophila

Unit-II

Industrial Biotechnology-I

Bioprocess Technology [basics of bioreactor kinetics and mathematical equations regarding bioreactors, scale-up and aeration of bioreactors in detail, Kinetics of microbial growth, substrate utilization and product formation: Batch, Fed- Batch and continuous processes, Scale up concepts with
respect to fermenter design and product formation, Gas exchange and mass transfer: O2 transfer, critical oxygen concentration, determining the oxygen uptake rate, Solid state fermentation. Common examples: Biopolymers: Xanthan , melanin , adhesive proteins , rubber, poly hydroxyl alkaloids

Unit-III

Industrial Biotechnology-II

Downstream Processing - Flocculation and floatation, Filtration, Centrifugation, Cell disruption, Liquid extraction, Precipitation, Adsorption, Dialysis, Reverse osmosis, Chromatography, Crystallization and drying, Biodegradation of xenobiotic compounds:Remediation and Biotechnology - Priority pollutants and their health effects, Microbial basis of biodegradation, Bioremediation (phyto and metal), Environmental and industrial pollution control, Biopesticides, Microbial plastics, Solid waste management

Unit-IV

Medical Biotechnology -

a. Small Biological Molecules: - ascorbic acid, indigo, amino acids, lycopene, succinic acid production, Antibiotics, Tissue Engineering - Growth Factors and morphogens: signals for tissue engineering and whole organ development, extracellular Matrix: structure, function and applications to tissue engineering, Cell adhesion and migration, Inflammatory and Immune responses to tissue engineered devices

b. Biomaterials - Polymeric scaffolds, Calcium Phosphate Ceramics for bone tissue engineering, Bio mimetic materials, Nanocomposite scaffolds

Unit-V

Nanotechnology-

a. Introduction to nanotechnology and nano-biotechnology, Nanomaterials and their uses.

b. Nanoparticles derived from biological molecules, Synthesis of nanoparticles: strategies, biological methods, general properties and characterization methods

c. Applications of nanotechnology: Nanosensors, Carbon nanotubes and their applications in biology

d. Environmental and safety issues with nanoparticles.

Books Recommended:

S.No.	Author	Book
1	Benjamin Lewin	Gene VII, Oxford Publishers
2	T A Brown	Genome, Second edition,
3	Old and Primrose	Principles of Gene Manipulation;
4	Simmons and Gardner	Principles of genetics;
5	Donald Voet and Judith Voet	Biochemistry 3rd Edition,
6	T D.Watson and others	Molecular Biology of the Gene , 6th Edition
7	GM Cooper	The Cell: A molecular approach: Library of Congress cataloging in publication data.
8	Griffiths A and Miller J	An introduction to genetic analysis; Freeman
9	Lodish H and Berk	A Molecular cell biology;
10	Sambrook J, Russell	Molecular cloning:- Vol I, II , III; CSHL Press
11	TA Brown	Gene cloning and DNA analysis;
12	B Glick, J Pasternak & C Patten	Molecular Biotechnology- principles and applications of Recombinant DNA, 4th
13	K. Deb and Satish Totey	Stem Cells Basics and Applications;
14	Gary Stein and Maria B et al.	Human Stem Cell Technology and Biology;

15	R. Ian Freshney, Glyn N. Stacey, Jonathan M. Auerbach	Culture of Human Stem Cells. John Wiley & Sons
16	Bernard R Glick, Jack J Pasternak, Cheryl L Patten	Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press
17	Robert Lanza, Robert Langer, Joseph P Vacanti	Principles of Tissue Engineering
18	Inderbir Singh and GP Pal	Human Embryology; MacMillan Publishers
19	Thomas W Sadler	Langman's Medical Embryology;
20	F Gilbert	Developmental Biology; 6th Edition;
21	Gordana Vunjak-Novakovic, R Ian Freshney	Culture of Cells for Tissue Engineering;
22	SB Primrose and Twyman	Principles of gene manipulation
23	RW Old and SB Primrose	Principles of gene manipulation
24	Watson	Recombinant DNA
25	TA Brown	Gene cloning and DNA analysis
26	SC Rastogi *et al.,*	Bioinformatics-Methods and Applications
27	A Caldwell et al.,	Integrated Genomics; Wiley Publishers
29	D Clark, N Pazdernik	Bioprocess Technology- Biotechnology-Applying the genetics to revolution
30	Wulf Crueger and Anneliese Crueger	Biotechnology: A Textbook of Industrial Microbiology; Panima Publishers, New Delhi
31	Michael L Shuler, Fikret Kargi	Bioprocess Engineering: Basic concepts
32	Stanbury PF, Whitaker A, Hall SJ	Principles of Fermentation Technology; Butterworth-Heinemann
33	Glazer AN and Nikaido H	Microbial Biotechnology: Fundamentals of Applied Microbiology
34	Sulabha Kulkarni	Nanotechnology principles and practices;
35	David S Goodsell	Bionanotechnology: Lessons from Nature;
36	James A Schwarz, Cristian I Contescu and Karol Putyera	Dekker Encyclopaedia of Nanoscience and nanotechnology;

B 803: Bioinformatics

Unit-I

Computer related introductory topics: History of development of computers, Basic components of computers, Hardware; CPU, input, output, storage devices. Software; operating systems, Programming languages (Machine, Assembly and Higher level)

Application software: Introduction to MSEXCEL-Use of worksheet to enter data, edit data, copy data, move data. Use of in-built statistical functions for computations of Mean, S.D., Correlation, regression coefficients etc. Use of bar diagram, histogram, scatter plots, etc. graphical tools in EXCEL for presentation of data. Introduction to MSWORD word process or editing, copying, moving, formatting, Table insertion, drawing flow charts etc.

Unit-II

Bioinformatics core topics: Introduction to Internet and use of the same for communication, searching of database, literature, references etc. Introduction to Bioinformatics, Databank search- Data mining, Data management and interpretation, BLAST, Multiple sequence alignment, Protein Modeling, Protein structure Analysis, Docking, Ligplot interactions, Genes, Primer designing, Phylogenetic Analysis, Genomics and Proteomics.

Unit-III

Biological databases**:** Introduction to variety of data sources. Population, sample, Classification and modeling of Data. Quality of data, Private and public data sources.

Example Databases:

(a) Nucleic acid databases (NCBI, DDBJ, and EMBL). (b) Protein databases (Primary, Composite, and Secondary)

(c) Specialized Genome databases: (SGD, TIGR, and ACeDB) (d) Structure databases (CATH, SCOP, & PDBsum)

Unit-IV

Alignment: Basics and techniques, Local alignment and Global alignment Pairwise sequence alignment: NEEDLEMAN and Wunsch algorithm, Smith and Waterman algorithm, The Dot Plot, Dynamic Programming Algorithm. Multiple Sequence Alignment (MSA): Definition, Objective, Consensus, Methods for MSA: Heuristic approach, Dynamic programming approach and their combinations. Complexity analysis. Phylogenetic Analysis: Molecular-Phylogenetics, Phylogenetic-trees, Terminology of tree-reconstruction, rooted and un-rooted trees, gene vs species trees and their properties. Algorithms /methods of phylogenetic analysis: UPGMA, Neighbor-Joining Method.

Unit-V

Protein structure analysis and prediction: Identification/assignment of secondary structural elements from the knowledge of 3-D structure of macromolecule using DSSP and STRIDE methods , Prediction of secondary structure: PHD and PSI-PRED method Tertiary (3-D) Structure prediction: Fundamentals of the methods for 3D structure prediction (sequence similarity/identity of target proteins of known structure, fundamental principles of protein folding etc.) Homology Modeling, fold recognition, threading approaches, and ab-initio structure prediction methods. Genomics: Basic concepts on identification of disease genes, role of bioinformatics-OMIM database, reference genome sequence, integrated genomic maps, gene expression profiling; identification of SNPs, SNP
database (DbSNP). Role of SNP in Pharmacogenomics, SNP arrays
Drug discovery and Development : - Introduction to Drug Design and Development, Drug targets, Lead Identification and Modification, Computer-Aided Drug Design, Drug Delivery, Pre-clinical and Clinical Testing Applications of Bioinformatics: Pharmaceutical industries, immunology, agriculture, forestry; Legal, ethical and commercial ramifications of bioinformatics; Bio-sensing

Books Recommended:

S.No.	Author	Book
1	E Wayne W Daniel	Biostatistics: A foundation for Analysis in the Health Sciences
2	Prem S Mann	Introductory Statistics. 5^{th} Edition;
3	Olive Jean Dunn	Basic Statistics: A primer for Biomedical Sciences
4	Auram Gold Stein	Biostatistics: An introductory text
5	Taro Yamane	Statistics: An Introductory Analysis;
6	C Stan Tsai	Computational Biochemistry;

FIFTH YEAR

Semester – IX [July – December 2019] BPr 901 Research Project*

Note: Project Work*

The project has to be carried out in recognized national laboratories or UGC-recognized universities. No student will be allowed to carry out project work in private laboratories/ college/ institutions, excluding the colleges recognized as research centers by the RDC of Pt. Ravishankar Shukla University, Raipur.

Electives for X Semester-Biology Stream

1. Proteomics and Genomics

Unit-I

Introduction and scope of proteomics; Protein separation techniques: ion exchange, size-exclusion and affinity chromatography techniques; Polyacrylamide gel electrophoresis; Isoelectric focusing (IEF); Two dimensional PAGE for proteome analysis; Image analysis of 2D gels.

Unit-II

Introduction to mass spectrometry; Strategies for protein identification; Protein sequencing; Protein modifications and proteomics; Applications of proteome analysis to drug.

Unit-III

Protein-protein interaction (Two hybrid interaction screening); Protein engineering; Protein chips and functional proteomics; Clinical and biomedical application of proteomics; Proteome database; Proteomics industry.

Unit-IV

Introduction and Classification of genomics; Methods of preparing genomic DNA; Genome sequencing methods (next-generation sequencing); Databases of genomes; Genetic mapping; Mapping of human genome; Human genome project; HapMap Project, The 1000 genome project, and The ENCODE Project.

Unit-V

Gene variation and Single Nucleotide Polymorphisms (SNPs); Expressed sequenced tags (ESTs); Gene disease association; DNA fingerprinting; Microarray based techniques for RNA analysis; metagenomics.

Suggested readings:

1. Cantor and Smith, Genomics. John Wiley & Sons, 1999.
2. Introduction to Genomics - Arthur M Lesk, Oxford University Press, 2007.
3. R.M.Twyman, Principles of Proteomics, BIOS Scientific Publishers, 2004.
4. P.Michael Conn, Handbook of Proteomic Method. Humana Press, Totowa, Ne Jersay, USA, 2003.
5. L.Stryer, Biochemistry, W. H. Freeman and Co., New York, 2007.

2. Nanobiotechnology

Unit-I

The nanoscale dimension and paradigm, Various definitions and Concept of Nano- biotechnology, Historical background, Development. Fundamental sciences and broad areas of Nanobiotechnology.

Unit-II

Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires etc. Cell – Nanostructure interactions. Protein-based Nanostructures, Cell as Nanobio-machine, DNA-Protein Nanostructures-Overview and introduction, DNA- Protein conjugates in microarray technology.

Unit-III

Biosensors; molecular recognition elements, transducing elements. Applications of molecular recognition elements in nanosensing of different analytes, Application of various transducing elements as part of nanobiosensors.

Unit-IV

Miniaturized devices in nanobiotechnology - types and applications, lab on a chip concept. Biological nanoparticles production - plants and microbial, methods, Properties, Characterization and applications.

Unit-V

Nanobiotechnological applications in health and disease - infectious and chronic. Nanobiotechnological applications in Environment and food - detection and mitigation.

Suggested readings:

1. Nanobiotechnology: Concepts,Applications and Perspectives (2004), Christof M.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
2. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
3. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications.

4. Plants for Human Welfare

Unit-I
A general overview of economically important plants and their role in human welfare as food, oil, drugs, nutraceuticals, fuel. Food crops: Cereals; Spices and condiments; Alcoholic and non-alcoholic beverages.

Unit-II
Medicinal: Traditional plants as source of drugs against several diseases such as cancer, diabetes, malaria, dengue, psoriasis,etc. Plant secondary metabolites; classification, knowledge of extraction, isolation, characterization and elicitation of bioactive metabolites.

Unit-III
Nutraceuticals and functional foods; Important plants such as Aloe vera, Piper, Withania, Ginseng, Amaranthus etc. yielding antioxidants and nutraceutical compounds. Edible and non-edible oils: Oil yielding plants, transgenic approaches and constraints for improvement in different oils. Essential oils.

Unit-IV
Plant-based biofuels e.g., Difference between first and 2nd generation biofuels, Jatropha, Pongamia, Zea mays, Madhuca, etc. Extraction and economic viability; application as alternate source of diesels, Bioelectricity.

Unit-V
Plants as a source of timber: e.g., Tectona grandis, Salix sp., Dalbergia sisso, Fibre yielding plants: Cotton (Gossypium sp.), Jute (Corchorus sp.) with special reference to their improvement through breeding and genetic transformation e.g., Bt cotton.

Suggested readings:

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors.
3. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
4. Acharya, Deepak; Anshu, Shrivastava (2008). Indigenous Herbal Medicines: Tribal Formulations and Traditional Herbal Practices. Jaipur, India: Aavishkar Publishers
5. Raven, Peter H.; Evert, Ray F.; Eichhorn, Susan E. (2005). Biology of Plants (7th ed.). New York: W. H. Freeman and Company

4. Plant Genetic Engineering

Unit-I
Plant transformation vectors and methods: T-DNA and viral vectors; Selectable marker and reporter genes, Plant transformation by Agrobacterium sp., Molecular mechanism of T-DNA transfer; in planta transformation; Direct gene transfer methods in plants.

Unit-II
Genetic engineering for increasing crop productivity by manipulation of

Photosynthesis, Nitrogen fixation, Nutrient uptake efficiency. Genetic engineering for biotic stress tolerance (Insects, fungi, bacteria, viruses, weeds). Genetic engineering for abiotic stress (drought, flooding, salt, metal and temperature)

Unit-III
Genetic engineering for quality improvement of Protein, lipids, carbohydrates, vitamins & mineral nutrients, Plants as bioreactor, Marker-assisted selection of qualitative and quantitative traits. Concept of gene synteny, Concept of map-based cloning and their use in transgenics.

Unit-IV

Chloroplast transformation; Transgene analysis, silencing and targeting; Marker-free and novel selection strategies; Multigene engineering; Gene knock-down by ribozymes, antisense RNA and RNA interference.

Unit-V

Plant Metabolic Engineering. The concept of secondary metabolites, Historical and current views, Importance of secondary metabolites in medicine and agriculture, Introduction to various pathways, Flavanoid pathway, Terpenoid pathway, Polyketoid pathway, Plant vaccine.

Suggested readings:

1. Plant Tissue Culture: Theory and Practice Bhojwani S. S. & Razdan M. K. Elsevier
2. Plant Biotechnology: The Genetic Manipulation of Plants Slater A. Scott N. & Fowler M. Oxford University Press Inc.
3. Plants, Genes and Crop Biotechnology Chrispeels M. J. & Sadava D. E. Jones and Barlett Publishers
4 Principles of Gene Manipulation and Genomics Primrose S. B. & Twyman R. M. Blackwell Publishing.
5. Plant Cell, Tissue and Organ Culture: Fundamental Methods. (Eds). Gamborg O. L & Phillips G. C. Springer-Verlag.

5. Evolutionary Biology

Unit- I

Origin of life: Historical theories and background information, Experimental approaches, Chemogeny, Biogeny, RNA and DNA world, evolution of proteins, origin of photosynthesis, evolution of eukaryotes. Lamarckism, Darwinism, pre-Darwinian and post-Darwinian period, Neo-Darwinism. Theories of organic evolution. Evidences of Evolution.

Unit- II

Sources of variations: Heritable variations and their role in evolution. Natural selection: types of natural selection (Directional, stabilizing and disruptive) and examples (Industrial melanism, Australian rabbits, resistant to pestiscides, heavy metal resistance in plants), Sexual selection, group and kin selection.

Unit- III

Polpulation genetics and evolution: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H -W equilibrium. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon); Role of Migration and Mutation in changing allele frequencies.

Unit-IV

Evolution above species level: Adaptation, adaptive radiation, microevolution, macroevolution, megaevolution, punctured equilibria and related phenomenon. Isolation: Introduction and types of isolation. Speciation: species concept, modes of speciation: allopatric, sympatric

Unit-V

Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from Dryopithecus leading to Homo sapiens, Phylogenetic trees, Multiple sequence alignment, construction of phylogenetic trees.

Suggested readings:

1. S. Freeman and J. C. Herron, Evolutionary Analysis, 4th Edn., Benjamin-Cummings (2007).
2. D. J. Futuyma, Evolution, 2nd Edn., Sinauer Associates Inc. (2009)

6. Plant-Microbe Interaction

Unit-I
History of Plant pathology and recent developments: Significance of plant diseases, and pathology, types of plant-microbe associations (pathogenic– bacteria, virus, fungi, and symbiotic).

Unit-II
Beneficial Plant - Microbe interactions (molecular aspects): a. Nitrogen fixing bacteria and blue green algae b. Mycorrhizal association c. Phytohormones and Biocontrol antibiotics

Unit-III
Parasitism and disease development: Pathogenecity, host range of pathogens, disease cycle and epidemics.

Unit-IV
Molecular biology of pathogenicity: Mechanisms of variability in pathogens, pathogenicity genes and mechanisms in pathogenic bacteria, biotrophic and necrotrophic fungi, Virus and Viroid genes involved in pathogenicity, Agrobacterium and plant interaction-a model system.

Unit-V
Molecular genetics of plant disease susceptibility and resistance: Types of plant resistance to pathogens (R gene resistance, quantitative and monogenic), basal and induced defense mechanisms, pre-formed inhibitors of pathogens, gene for gene interaction in plant defense, Systemic Acquired Resistance (SAR) and Induced Systemic Resistance (ISR), Recognition mechanism and signal transduction during plant - pathogen interaction.

Suggested readings:

1. Plant Pathology Agrios G. N. Academic Press
2. Molecular Plant pathology Dickinson M. BIOS Scientific Press
3. Plant Pathogenesis and Resistance: Biochemistry and Physiology of Plant- Microbe Interactions Jeng-Sheng H. T Kluwer Academic Pubs.T Gen 904(ii)- MEDICA

7.Animal Tissue Culture

Unit-I
Introduction and significance of Animal cell culture, historical background of cell culture. Types of cell culture: Primary and secondary cell culture.
Laboratory requirements for animal cell culture: Sterile handling area. Sterilization of different materials used in animal cell culture, Aseptic concepts. Instrumentation and equipments for animal cell culture.

Unit-II
Culture requirements and reagents: Culture media, properties of media, Types of cell culture media, Ingredients of media, Physiochemical properties, Antibiotics, growth supplements, Foetal bovine serum; Serum free media, Trypsin solution, Selection of medium and serum, Conditioned media, Other cell culture reagents, Preparation and sterilization of cell culture media, different types of serum and other reagents.

Unit-III
Types of cell culture: Different types of cell cultures, Trypsinization, Cell separation,Continuous cell lines, Suspension culture, Organ culture.
Cell lines: Introduction, development of cell lines, c, stem cells, Cryopreservation, Common cell culture contaminants.

Unit-IV
Stem cell research: Stem cell types, properties and biological significance, Current status and application in medicine. Application of animal cell culture for in vitro testing of drugs; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins. Production of different recombinant proteins. General account of in vitro regulation of blood cells production.

Unit-V

Gene transfer technology in animals: Different method in gene transfer technology in animals, viral and non-viral methods, Production of transgenic animals, current status in the field of transgenic animals. Animal cloning: Techniques, relevance and ethical issues.

Suggested readings:

1. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005
2. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach, 3rd Edition, Oxford University Press, 2000.
3. Ed. Martin Clynes, Animal Cell Culture Techniques, Springer, 1998. B.Hafez, E.S.E Hafez, Reproduction in Farm Animals, 7th Edition, Wiley- Blackwell, 2000.
4. Louis-Marie Houdebine, Transgenic Animals: Generation and Use, 1st Edition, CRC Press, 1999.

:SEMESTER WISE COURSE OUTCOMES:

B 101: Biology I (Introductory to Biology)
With this introductory paper students will be able to comprehend • General biological processes which are essential for students of all the streams Physics, Chemistry or mathematics. • Theories of origin of life, evolution and process of development on earth. • Identification of the levels of biological organization. • Cellular mechanism which will further improve the understanding of processes of living beings. • Physiology of different organ systems of the human body.
ES101: Environmental Science
Students will have knowledge of • Concepts of ecology and environment which are important for the student of any stream. • Environmental issues, measures to deal with them. • Owns' role as a responsible citizen.
B201: Biology II (Introduction to Macromolecules)
Students will be able to exhibit a knowledge base in • Cell structure, function and role of biological molecules in regulating the basic mechanism of a cell. • Process of Cell Signaling. • Fundamentals of biotechnology and recombinant DNA technology.
B301: Cell Biology – I

Students will gain clear understanding of

- Cell structure, organelles and their roles.
- Biomolecules, and different imaging techniques.
- Organization of DNA, its replication, damage and repair processes.

CB302 Biochemistry – I

This Paper is common for biology and chemistry students. It will be able to exhibit a knowledge base of

- Concepts of biochemistry
- Concepts of enzymes and enzyme kinetics
- Protein structure, folding, and modification processes.

CB402 Biochemistry – II

Students will have a knowledge base of

- Different metabolic pathways related to synthesis and degradation of the major macromolecules.
- Structure and role of different pigments and electron carriers.
- Basics of photosynthesis process and electron carriers involved.

B401: Cell Biology – II

Students will gain in- depth understanding of

- Cell-Cell communication and cell junctions present between the cells.
- Cell division and regulation mechanisms.
- Process of apoptosis and other types of cell death.
- Concepts of techniques used in the study of cell biology.

B501: Genetics

Students will be able to exhibit a knowledge base of

- General principle, importance of genetics and interpretation of the various laws of genetic
- Hereditary nature of the gene and how it codes different proteins of the cells.
- Genetic diseases linked to gene/DNA.
- Relationship between gene and evolution.
- Biostatics and its significance in biology.

B502: Molecular Biology

Students will gain in-depth understanding of

- **B**asic concept of molecular biology.
- Central dogma and molecular mechanism in prokaryotes and eukaryotes.
- Synthesis and control the proteins synthesis,
- Gene expression in prokaryotes and eukaryotes.
- Mutation, its types, causes, and consequences.

B503: Biodiversity
Students will have a knowledge base in • Taxonomy of plants and animals. • Distribution and diversity of plants and animals. • Biodiversity, threats and conservation need.
B601: Immunology
Students will develop knowledge base in • Concepts of immune system and types of immunity. • Mechanism of activation of immune system components. • Concepts of immunodeficiency, allergies, autoimmune disorders, transplant immunology, immunotherapy, development of vaccines etc.
B 602: Animal Physiology
Students will be able to comprehend the basics of • Organization and mechanism of working of various organ systems of the human body like nervous system, muscular system, and respiratory system. • Process of nerve stimulation, neurotransmission, cardiac control, temperature control, blood pressure etc.
B603: Plant Physiology
Students will gain in-depth understanding of • Fundamentals of Plant morphology, plant ecology • Phytochemistry including the plant growth regulators • Phenomenon like photoperiodism, photomorphogenesis, circadian rhythms.
B604 Microbiology
Students will able to gain in –depth understanding of • Microscopic organisms unicellular, multicellular or acellular. • Concepts of mycology, parasitology and bacteriology. • Diseases mechanism associated with these microorganisms.
H 601: Ethics of Science and IPR
Students will gain understanding of • Ethics, Bioethics and its approaches • Bioethics in modern biology • Ethical issues related to Synthetic biology • Intellectual property rights • Patents and emerging issues
B701: Neurobiology

Students will be able to comprehend the basics of • Neurobiology, brain and its components. • Biochemical mechanism, neurotransmitters, mechanism of sleep, learning, and memory. • Sensory organs of the body and neurobiology related diseases.
B702: Immunology
Students will able to gain in –depth understanding of • Concepts of host-pathogen relationships and hypersensitivity. • Application of concepts of immunology for the disease prevention. • Mechanism of vaccines action. • Concepts of various autoimmune diseases.
B703: Developmental Biology
Students will be able to comprehend • Developmental procesess in animals and plants. • Biochemical and molecular regulation of development. • Concepts of epigenetics and how environmental factors influence the development of plants and animals.
B704: Imaging Technology in Biological Research
This is a very crucial paper which will be going to benefit students in further research in biological sciences. It will give in –depth understanding and knowledge base of • Imaging techniques and instruments sample preparation procedure, operation of instruments, and data interpretation of different instruments in biological research. • Concept of the lights, different types of microscopes including confocal and atomic force microscopy, optical tweezers. • Advanced and sophisticated instruments NMR technique.
BPr701: Reading project
• Project is kept in curriculum to give training to students and motivate to pursue research as a career. • This is the first phase where the students are made familiar to preliminary aspect of research which starts with reading and understanding a research problem through review articles / research articles.
B801: Virology
Students will be able to comprehend the various concepts regarding • Structure and classification of animal, plant viruses and bacteriophages. • Replication mechanism and diseases caused by them. • Development of vaccines for the viral epidemics and also about antiviral chemotherapy.

B802: Biotechnology I

Students will have in –depth understanding of

- Basic principles of genetic engineering.
- Transgenic animals, cloning and applications
- Development of transgenic plants and their applications.

B803: Bioinformatics

Students will have in –depth understanding of

- Biological databases and alignment techniques.
- Construction of phylogenetic tree and 3D structure of proteins.
- Various bioinformatics tools for the study of whole genome sequencing and making phylogenetic tree.

B804: Biotechnology II

Students will have in –depth understanding of

- Principles of plant breeding
- Bioprocess technology and industrial application of biotechnology in the production of various biopolymers.
- Biotechnological ways for environmental and industrial pollution control.
- Medical biotechnology applications like tissue engineering.
- Synthesis and application of nanoparticles.

BPr801: Project

- The main objective of such projects is to develop research aptitude in students at early stage.
- This is the second phase where the students will undertake some research problem and solve it through experiments.
- Further a report is submitted and presented for discussion.

BPr901: Six-Months Project

- This whole semester is fully dedicated to research.
- Students will undertake six month research training from any of the recognized premier institute or university.
- The course aims to provide a full fledged exposure to students to experience fully devoted research environment, learn techniques and develop writing skills too.

BE01: Proteomics and Genomics

Students will have in –depth understanding of

- Protein separation and identification techniques.
- Protein and Genome sequencing methods.
- Functional proteomics and its applications.
- Human genome, Gene disease association and metagenomics.

BE02: Nanobiotechnology
Students will be able to comprehend various concepts • Nanotechnology in biology • Nanomaterial and Nanostructures • Biosensors and nanobiosensors. • Nanobiotechnological applications in health and disease and environment.
BE03: Plants for Human Welfare
Students will develop understanding about • Economically important plants and their role in human. • Food crops Medicinal: Plant secondary metabolites. • Knowledge of extraction, isolation, characterization and elicitation of bioactive metabolites. • Nutraceuticals and functional foods. • Plant-based biofuels.
BE04: Plant Genetic Engineering
Students will have in –depth understanding of • Plant transformation techniques. • Transgenics for increasing crop productivity. • Transgenics for quality improvement. • Chloroplast transformation. • Plant Metabolic Engineering, Plant vaccines.
BE05: Evolutionary Biology
Students will be able to comprehend various concepts • Theories and evidences of organic evolution. • Sources of variations and role in evolution. • Polpulation genetics, Evolution of man. • construction of phylogenetic trees, Multiple sequence alignment.
BE06: Plant Microbe Interaction
Students will have in –depth understanding of • Plant pathology and plant-microbe associations. • Molecular biology of pathogenicity. • Systemic Acquired Resistance and Induced Systemic Resistance.
BE07: Animal Tissue Culture .
Students will have in –depth understanding • Animal cell culture. • Types of cell culture media. • Cell lines, Stem cell research and gene transfer technology in animals

PT. RAVISHANKAR SHUKLA UNIVERSITY

Centre for Basic Sciences

Outcome Based Curriculum

Integrated M. Sc.: All Stream

[Choice and Credit Based System]

(Semester- I to IV)

INDEX

Program Learning Outcomes: हिंदी–भाषा

स्नातकस्तरपरमूलविज्ञानकेंदमेंहिंदीभाषा एवंसाहित्य के अध्ययन–अध्यापन के निम्नलिखितउद्देश्य हैं–

- भाषा के माध्यम से विद्यार्थियोंमेंकौशल–क्षमता, व्यक्तित्वविकास, संप्रेषणकौशलतथाआत्मविश्वासजागृतकरना।
- भाषा की शुद्धतातथाव्याकरण के नियमों से परिचितकराना।
- हिंदीतथामातृभाषाओंमेंचिंतन, मनन की प्रवृत्तिविकसितकरनातथाराष्ट्रीय एकता एवंवसुधैवकुटुंबकम् पर बल देना।
- रचनात्मकहिंदीमेंसम्मिलितपाठों के माध्यम से समाज, राष्ट्र एवंविश्व के यथार्थ से परिचितकरानातथाश्रेष्ठव्यक्ति का निर्माणकरना।
- सबकाहिततथासांप्रदायिकसद्भाव का निर्माणकरना।
- प्रयोजनमूलकहिंदीपाठ्यक्रम द्वाराछात्र हिंदीपत्राचार, शब्दावली से परिचितहोकरआत्मविश्वास के साथसमाजमेंकार्यकरसकताहै।
- भाषाज्ञान एवंसाहित्य ज्ञान से विद्यार्थीमेंसमाज, संस्कृति, औरज्ञान–विज्ञान के क्षेत्र में समझविकसितहोतीहै।

Pt. Ravishankar Shukla University, Raipur

Center for Basic Sciences

Scheme of Examination

CBS Semester-I Examination

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	B 101	Biology I (Introductory Biology)	3
2.	C 101	Chemistry I (Structures & Bonding)	3
3.	P 101	(A) Physics I (PCM Stream)	3
		(B) Physics I (Biology Stream)	
4.	M 101	Mathematics I (For Physics, Mathematics & Chemistry Stream)	3
	MB 101	Mathematics I (For Biology Stream)	
5.	G101	Computer Basics	3
6.	H101	Communication Skills	2
Practical Paper			
1.	BL101	Biology Laboratory	2
2.	CL 101	Chemistry Laboratory	2
3.	PL 101	Physics Laboratory	2
4.	GL 101	Computer Laboratory	2
Total			**25**

Additional Papers

S.No.	Paper Code	Paper Title	Credits
1.	CH101	Creative Hindi	2
2.	ES101	Environmentel Studies	3

Pt. Ravishankar Shukla University, Raipur
Center for Basic Sciences
Scheme of Examination
CBS Semester-II Examination

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	B 201	Biology II	3
2.	C 201	Chemistry II	3
3.	P 201	Physics II (Optics, Electricity & Magnetism)	3
4.	M 201	Mathematics II (For Physics & Chemistry Stream)	3
	M201	Mathematics II (Calculus and Linear Algebra)	
	MB201	Mathematics II (For Biology Stream)	
5.	G201	Electronics and Instrumentation	3
6.	G202	Glimpses of Contemporary Science	2
Practical Paper			
1.	BL201	Biology Laboratory	2
2.	CL 201	Chemistry Laboratory	2
3.	PL 201	Physics Laboratory	2
4.	GL 201	Electronics Laboratory	2
Total			**25**

Additional Papers

S.No.	Paper Code	Paper Title	Credits
1.	ES201	Environmentel Studies	2
2.	H201	Communication Skills Lab	2

Pt. Ravishankar Shukla University, Raipur
Center for Basic Sciences
Scheme of Examination
CBS Semester-III

BiologyStream

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	CB301	Essential Mathematics for Chemistry & Biology	4
2.	CB 302	Biochemistry – I	4
3.	B 301	Cell Biology – I	4
4.	CB 303 (B)	Organic Chemistry-I	4
5.	H301	World Literature	2
6.	H302 (B)	History and Philosophy of Science (Biology Group)	2
Practical Paper			
1.	BL 301	Biology Laboratory	3
2.	GL 301	Applied electronics laboratory (Bio. & Chemistry)	2
Total			**25**

Additional Papers

S.No.	Paper Code	Paper Title	Credits
1.	FH301	Functional Hindi	2

ChemistryStream

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	CB301	Essential Mathematics for Chemistry & Biology	4
2.	CB 302	Biochemistry – I	4
3.	CB 303(A)	Organic Chemistry-I	4
4.	C301	Inorganic Chemistry-I	4
5.	H301	World Literature	2

6.	H302(A)	History and Philosophy of Science (PCM Group)	2
Practical Paper			
1.	CL301	Chemistry Laboratory	3
2.	GL 301	Applied electronics laboratory (Bio. & Chemistry)	2
Total			**25**

Additional Papers

S.No.	Paper Code	Paper Title	Credits
1.	FH301	Functional Hindi	2

Mathematics Stream

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	M301	Foundations	4
2.	M302	Analysis I	4
3.	M303	Algebra I	4
4.	M304	Discrete Mathematics	4
5.	M305	Computational Mathematics I	4
6.	H301	World Literature	2
7.	H302 (A)	History and Philosophy of Science (PCM Group)	2
Practical Paper			
1.	GL301	Computation Mathematics Laboratory	1
Total			**25**

Additional Papers

S.No.	Paper Code	Paper Title	Credits

1.	FH301	Functional Hindi	2

Pt. Ravishankar Shukla University, Raipur

Center for Basic Sciences

Scheme of Examination

CBS Semester-IV Examination

BiologyStream

S.No.	Paper Code	Paper Title	Contact hrs/per week Theory + Tutorials	Credits
Theory Paper				
1.	B 401	Cell Biology – II	[3 +1]	4
2.	B 402	Biochemistry – II	[3 +1]	4
3.	CB 401	Introductory Spectroscopy (UV-vis,fluorescence, IR, Raman, NMR)	[3 +1]	4
4.	PCB 401(B)	Physical & Chemical kinetics	[3 +1]	4
5.	G 401	Statistical techniques and Applications	[3 +1]	4
Practical Paper				
1.	BL 401	Biology Laboratory	6	3
2.	GL 401	Computational laboratory and Numerical Methods	4	2
Total				**25**

Additional Papers

S.No.	Paper Code	Paper Title	Contact hrs/per week Theory + Tutorials	Credits
1.	H401	Communication Skills Lab-II	4	2

Chemistry Stream

S.No.	Paper Code	Paper Title	Contact hrs/per week Theory + Tutorials	Credits

Theory Paper				
1.	PCB401(A)	Physical and Chemical kinetics	[3+1]	4
2.	CB401	Introductory Spectroscopy (UV-vis, fluorescence, IR, Raman, NMR)	[3+1]	4
3.	C401	Properties of Matter	[3+1]	4
4.	C402	Group theory	[3+1]	4
5.	G401	Statistical Techniques and Applications	[3+1]	4
Practical Paper				
1.	CL 401	Chemistry Laboratory	6	3
2.	GL 401	Computational laboratory and Numerical Methods	4	2
Total				**25**

Additional Papers

S.No.	Paper Code	Paper Title	Contact hrs/per week Theory + Tutorials	Credits
1.	H401	Communication Skills Lab-II	4	2

Syllabus

CH101:रचनात्मकहिंदीभाषा

इकाईI–(1) मानकहिंदीभाषा ,वर्तनीलेखनमेंअशुद्धियॉ , शब्द शुद्धि, वाक्य शुद्धि,

हिंदीभाषा के विकासमेंहिंदीतर एवंविदेशीविद्वानों का योगदान,

(2) उसनेकहाथा , कहानी–चंद्रधर शर्मागुलेरी ।

इकाईII– (1) पत्राचारऔपचारिक व अनौपचारिकपत्र एवंसंप्रेषणकौशल ।

(2) मनुष्य हीसाहित्य का लक्ष्य है । (हजारी प्रसाद द्विवेदी)

इकाईIII– (1) पारिभाषिक शब्दावली की परिभाषा एवंस्वरुपतथानिर्माण की प्रक्रिया (विज्ञान –तकनीकी), शब्दभंडार ।

(2) सादगी, सत्य औरअहिंसा–मोहनदासकरमचंदगांधी (आत्मकथांश)

इकाईIV— (1) देवनागरी लिपि, वाग्यंत्र और ध्वनिउत्पादनमेंउनकीभूमिका , स्वरव्यंजन का वर्गीकरण,IPAअंतरराष्ट्रीय ध्वनि लिपि ।

(2) नमामिछत्तीसगढ. (छत्तीसगढ. का सांस्कृतिक वैभव) : डॉहीरालाल शुक्ल (आलेख) ।

इकाईV— (1) अनुवाद ,परिभाषा ,प्रक्रिया , अनुवादक के गुण , सफलअनुवाद, हिंदी से अंग्रेजीअनुवाद ।

(2) योग की शक्ति—डॉ. हरिवंशराय बच्चन (डायरी) ।

(3) पृथकछत्तीसगढ. राज्य —विष्णु खरे (कविता) ।

Suggested Texts and References:

Sr.No.	Author	Title	Publisher
1.	तिवारीभोलानाथ	हिन्दीभाषा की संरचना	पाण्डूलिपिप्रकाशन ,दिल्ली
2.	प्रसादवासुदेवनंदन	आधुनिकहिंदीव्याकरणऔररचना	भारतीभवनप्रकाशन ,पटना
3.	बाहरीहरदेव	पारिभाषिक शब्दावलीकोश	राजकमलप्रकाशनदिल्ली
4.	वधानअमरसिंह	भाषाऔरसूचनाप्रौद्योगिकी	भावनाप्रकाशन,दिल्ली
5.	गुरु कामताप्रसाद	हिंदीव्याकरण	लोकभारतीप्रकाशन ,इलाहाबाद

Sem.II (2018-19)

H 201: Communication Skills (Lab)

Unit 1
Elementary Phonetics (Speech Mechanism. The Description of Speech Sounds, The Phoneme the syllable; Intonation and Word Accent)
Formal (Extempore and Mock Interviews) and Informal Speaking(Situational Dialogues and Role play), Telephoning (Telephonic Conversations)

Unit 2
Paralinguistic features of speaking (voice modulation, pitch, tone, etc.)
Paper Presentation (Non-Technical & current Affairs), Use of Audio-Visual aids: Preparation slides, power point presentation etc.

Unit 3
Body Language(Gestures / Postures during Role Play/Speaking and JAM (Just-a-Minute) Session and Group Discussion

Unit 4
Listening and Comprehending spokenmaterial in Standard Indian English, British English and American English;Exercises on Listening Comprehension,Exercises on Reading Comprehension

Effective Writing (Business Letters, Covering Letter, Resume on Word Document. Translation and Precis Writing)

Unit 5

Grammar:(English/ Hindi)

Grammar in use: Errors of Accidence and syntax with reference to Parts of Speech; Agreement of Subject and Verb; Tense and Concord; Use of connectives, Question tags. Voice and Narration.

Indianism in English: Punctuation and Vocabulary, Building (Antonym, Synonym, Verbal Analogy and One Word Substitution).

Books Recommended:

S.No.	Author	Book	Publication
1.	W. Stannard Allen,	Living English Structure	Orient Longman Pvt. Ltd. (New Delhi) 2002
2	Bansal, R.K. and J.B. Harrison,	Spoken English: A Manual of Speech and Phonetics	Orient Longman Pvt. Ltd.(Mumbai) 2005.
3	Brown, Gillian	Listening to Spoken English	Longman.(Hong Kong)1983
4	Gimson, A.C.	An Introduction to the Pronunciation of English	Edward Arnold (London) 1980.
5	Kachru, Braj B	The Indianization of English: The English Language in India	Oxford University Press(Delhi) 1983
6	Suresh Kumar,	A Handbook for English Language Laboratories	E. &Sreehari, P. Foundation. (New Delhi) 2009
7	SasiKumar , V & Dhamija, P.V,	How to Prepare for Group Discussion and Interviews.	Tata McGraw Hill
8.		Spoken English (CIEFL) in 3 volumes with 6 cassettes	OUP
9.	Murphy Raymond	Essential English Grammar	Cambridge University Press. (1992).

मूलविज्ञानकेंद्र, पं. रविशंकर शुक्लविश्वविद्यालय, रायपुर (छ.ग.)

एम.एस–सी. (इंटीग्रेटेड) तृतीय सेमेस्टर

प्रयोजनमूलकहिंदी (FH301)

Functional Hindi

इकाईI- (1) प्रयोजनमूलकहिंदी का स्वरूप एवंमहत्व

(2) भाषा के विविध रूप–बोली, उपभाषा, राजभाषा, राष्ट्रभाषा, संपर्कभाषा, साहित्यिकभाषा।

इकाईII- (1) मीडिया की भाषा–समाचारपत्र, विज्ञापन

(2) श्रव्य माध्यम, दृश्य–श्रव्य माध्यम

इकाईIII- (1) पल्लवन–परिभाषा, पल्लवन एवंव्याख्या, आशय कुशलविस्तारक के गुण, सूक्तिपरकवाक्यों का पल्लवन

(2) झलमलापदुमलालपुन्नालालबख्शीकहानी

इकाईIV- (1) शब्दरचना–उपसर्गसंस्कृत, हिंदी, उर्दू के उपसर्गों का परिचय

(2) प्रत्यय–परिभाषा, प्रत्यय के भेद

इकाईV- (1) चीफ की दावत–भीष्मसाहनीकहानी

(2) मजदूरीऔरप्रेम–सरदारपूर्ण सिंह

संदर्भग्रंथ–

1. प्रयोजनमूलकहिंदी की नयीभूमिकाकैलाशनाथपाण्डेय, लोकभारतीप्रकाशन, इलाहाबाद।
2. प्रयोजनमूलकव्यावहारिकहिंदीभाषाकैलाशचंद्रभाटिया, तक्षशिलाप्रकाशन, जयपुर।
3. भाषाप्रौद्योगिकी एवंभाषाप्रबंधनसूर्यप्रसाददीक्षित, किताबघर, नईदिल्ली
4. हिंदीभाषाऔरसंस्कृति म.प्र. हिंदीग्रंथअकादमी, भोपाल सं. राजेन्द्रमिश्र
5. कार्यालयीहिंदी, श्रीप्रकाशन, रायपुर, प्रो. केशरीलालवर्मा
6. अच्छीहिंदी, रामचंद्रवर्मा, लोकभारतीप्रकाशन, इलाहाबाद (उ.प्र.)
7. अच्छीहिंदी, किशोरीदासवाजपेयी, मीनाक्षीप्रकाशनमेरठ (उ.प्र.)
8. भारतीयता के अमरस्वरप्रधान सं. डॉ. घनंजय वर्मा, म.प्र. हिंदीग्रंथअकादमीभोपाल।
9. प्रयोजनमूलकहिंदीडॉ. चितरंजनकरवैभवप्रकाशनरायपुर (छ.ग.)

Sem.IV (2018-19)

H 401: Communication Skills (Lab)

Unit 1

Elementary Phonetics (Speech Mechanism. The Description of Speech Sounds, The Phoneme the syllable; Intonation and Word Accent)

Formal (Extempore and Mock Interviews) and Informal Speaking(Situational Dialogues and Role play), Telephoning (Telephonic Conversations)

Unit 2

Paralinguistic features of speaking (voice modulation, pitch, tone, etc.)
Paper Presentation (Non-Technical & current Affairs), Use of Audio-Visual aids: Preparation slides, power point presentation etc.

Unit 3
Body Language(Gestures / Postures during Role Play/Speaking and JAM (Just-a-Minute) Session and Group Discussion

Unit 4
Listening and Comprehending spokenmaterial in Standard Indian English, British English and American English;Exercises on Listening Comprehension,Exercises on Reading Comprehension
Effective Writing (Business Letters, Covering Letter, Resume on Word Document. Translation and Precis Writing)

Unit 5
Grammar:(English/ Hindi)
Grammar in use: Errors of Accidence and syntax with reference to Parts of Speech; Agreement of Subject and Verb; Tense and Concord; Use of connectives, Question tags. Voice and Narration.
Indianism in English: Punctuation and Vocabulary, Building (Antonym, Synonym, Verbal Analogy and One Word Substitution).

Books Recommended:

S.No.	Author	Book	Publication
1.	W. Stannard Allen,	Living English Structure	Orient Longman Pvt. Ltd. (New Delhi) 2002
2	Bansal, R.K. and J.B. Harrison,	Spoken English: A Manual of Speech and Phonetics	Orient Longman Pvt. Ltd.(Mumbai) 2005.
3	Brown, Gillian	Listening to Spoken English	Longman.(Hong Kong)1983
4	Gimson, A.C.	An Introduction to the Pronunciation of English	Edward Arnold (London) 1980.
5	Kachru, Braj B	The Indianization of English: The English Language in India	Oxford University Press(Delhi) 1983
6	Suresh Kumar,	A Handbook for English Language Laboratories	E. &Sreehari, P. Foundation. (New Delhi) 2009
7	SasiKumar , V & Dhamija, P.V,	How to Prepare for Group Discussion and Interviews.	Tata McGraw Hill
8.		Spoken English (CIEFL) in 3 volumes with 6 cassettes	OUP

9.	Murphy Raymond	Essential English Grammar	Cambridge University Press. (1992).

SEMESTER WISE COURSE OUTCOMES:

Int. M. Sc. Program

CH101: रचनात्मक हिन्दी भाषा

- रचनात्मकहिंदीमेंसम्मिलितपाठों के माध्यम से समाज, राष्ट्र एवंविश्व के यथार्थ से परिचितकरानातथाश्रेष्ठव्यक्ति का निर्माणकरसकेंगे।

H 201: Communication Skills (Lab)

After learning the course the students should be able to

- To know the process of communication and its components.
- To improve the language skills i.e. Listening Skills, Speaking Skills, Reading Skills and Writing Skills (LSRW).
- Construct basic and intermediate skills in English / Hindi language.
- To enhance phonetic competence, comprehension skills, presentation skills, group discussion skills etc.
- To build confidence for communicating in English /Hindi and create interest for the life-long learning of English/Hindi language.

FH-301: प्रयोजन मूलक हिन्दी

- विद्यार्थियोंकोभारत की राष्ट्रभाषा, संपर्कभाषातथाराजभाषाहिंदी के इतिहास, व्याकरण एवंप्रयोजनीयता से परिचितकरातेहुए उन्हेंभाषायी रूप से दक्ष तथासमर्थ बनसकेंगे।

H 401: Communication Skills (Lab)

After learning the course the students should be able to

- To know the process of communication and its components.
- To improve the language skills i.e. Listening Skills, Speaking Skills, Reading Skills and Writing Skills (LSRW).
- Construct basic and intermediate skills in English / Hindi language.
- To enhance phonetic competence, comprehension skills, presentation skills, group discussion skills etc.
- To build confidence for communicating in English /Hindi and create interest for the life-long learning of English/Hindi language.

PT. RAVISHANKAR SHUKLA UNIVERSITY

Centre for Basic Sciences

Outcome Based Curriculum

Integrated M. Sc.: All Stream

[Choice and Credit Based System]

(Semester- I to VI)

INDEX

Program Learning Outcomes: English Language

1. After studying this course, you should be able to:
2. recognize the importance of interpersonal skills
3. describe how good communication with other can influence our working relationships
4. demonstrate critical and innovative thinking.
5. display competence in oral, written, and visual communication.
6. apply communication theories.
7. show an understanding of opportunities in the field of communication.
8. use current technology related to the communication field.
9. respond effectively to cultural communication differences.
10. communicate ethically.
11. demonstrate positive group communication exchanges.
12. generate a close reading of a text: recognize, understand, and explain a text's elements—for example, word choice, imagery, form, and connotations.
13. research and write focused, convincing analytical essays in clear, grammatical prose.
14. participate in discussions by listening to others' perspectives, asking productive questions, and articulating original ideas.

Pt. Ravishankar Shukla University, Raipur
Center for Basic Sciences
Scheme of Examination
CBS Semester-I Examination

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	B 101	Biology I (Introductory Biology)	3
2.	C 101	Chemistry I (Structures & Bonding)	3
3.	P 101	(A) Physics I (PCM Stream)	3
		(B) Physics I (Biology Stream)	
4.	M 101	Mathematics I (For Physics, Mathematics & Chemistry Stream)	3
	MB 101	Mathematics I (For Biology Stream)	
5.	G101	Computer Basics	3
6.	H101	Communication Skills	2
Practical Paper			
1.	BL101	Biology Laboratory	2
2.	CL 101	Chemistry Laboratory	2
3.	PL 101	Physics Laboratory	2
4.	GL 101	Computer Laboratory	2
Total			**25**

Additional Papers

S.No.	Paper Code	Paper Title	Credits
1.	CH101	Creative Hindi	2
2.	ES101	Environmentel Studies	3

Pt. Ravishankar Shukla University, Raipur

Center for Basic Sciences
Scheme of Examination
CBS Semester-II Examination

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	B 201	Biology II	3
2.	C 201	Chemistry II	3
3.	P 201	Physics II (Optics, Electricity & Magnetism)	3
4.	M 201	Mathematics II (For Physics & Chemistry Stream)	3
	M201	Mathematics II (Calculus and Linear Algebra)	
	MB201	Mathematics II (For Biology Stream)	
5.	G201	Electronics and Instrumentation	3
6.	G202	Glimpses of Contemporary Science	2
Practical Paper			
1.	BL201	Biology Laboratory	2
2.	CL 201	Chemistry Laboratory	2
3.	PL 201	Physics Laboratory	2
4.	GL 201	Electronics Laboratory	2
Total			**25**

Additional Papers

S.No.	Paper Code	Paper Title	Credits
1.	ES201	Environmentel Studies	2
2.	H201	Communication Skills Lab	2

Pt. Ravishankar Shukla University, Raipur
Center for Basic Sciences
Scheme of Examination
CBS Semester-III

BiologyStream

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	CB301	Essential Mathematics for Chemistry & Biology	4
2.	CB 302	Biochemistry – I	4
3.	B 301	Cell Biology – I	4
4.	CB 303 (B)	Organic Chemistry-I	4
5.	H301	World Literature	2
6.	H302 (B)	History and Philosophy of Science (Biology Group)	2
Practical Paper			
1.	BL 301	Biology Laboratory	3
2.	GL 301	Applied electronics laboratory (Bio. & Chemistry)	2
Total			**25**

Additional Papers

S.No.	Paper Code	Paper Title	Credits
1.	FH301	Functional Hindi	2

ChemistryStream

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	CB301	Essential Mathematics for Chemistry & Biology	4
2.	CB 302	Biochemistry – I	4
3.	CB 303(A)	Organic Chemistry-I	4

4.	C301	Inorganic Chemistry-I	4
5.	H301	World Literature	2
6.	H302(A)	History and Philosophy of Science (PCM Group)	2
Practical Paper			
1.	CL301	Chemistry Laboratory	3
2.	GL 301	Applied electronics laboratory (Bio. & Chemistry)	2
Total			**25**

Additional Papers

S.No.	Paper Code	Paper Title	Credits
1.	FH301	Functional Hindi	2

Mathematics Stream

S.No.	Paper Code	Paper Title	Credits
Theory Paper			
1.	M301	Foundations	4
2.	M302	Analysis I	4
3.	M303	Algebra I	4
4.	M304	Discrete Mathematics	4
5.	M305	Computational Mathematics I	4
6.	H301	World Literature	2
7.	H302 (A)	History and Philosophy of Science (PCM Group)	2
Practical Paper			
1.	GL301	Computation Mathematics Laboratory	1

Total	25

Additional Papers

S.No.	Paper Code	Paper Title	Credits
1.	FH301	Functional Hindi	2

Pt. Ravishankar Shukla University, Raipur

Center for Basic Sciences

Scheme of Examination

CBS Semester-IV Examination

BiologyStream

S.No.	Paper Code	Paper Title	Contact hrs/per week Theory + Tutorials	Credits
Theory Paper				
1.	B 401	Cell Biology – II	[3 +1]	4
2.	B 402	Biochemistry – II	[3 +1]	4
3.	CB 401	Introductory Spectroscopy (UV-vis,fluorescence, IR, Raman, NMR)	[3 +1]	4
4.	PCB 401(B)	Physical & Chemical kinetics	[3 +1]	4
5.	G 401	Statistical techniques and Applications	[3 +1]	4
Practical Paper				
1.	BL 401	Biology Laboratory	6	3
2.	GL 401	Computational laboratory and Numerical Methods	4	2
Total				**25**

Additional Papers

S.No.	Paper Code	Paper Title	Contact hrs/per week Theory + Tutorials	Credits

1.	H401	Communication Skills Lab-II	4	2

Chemistry Stream

S.No.	Paper Code	Paper Title	Contact hrs/per week Theory + Tutorials	Credits
Theory Paper				
1.	PCB401(A)	Physical and Chemical kinetics	[3+1]	4
2.	CB401	Introductory Spectroscopy (UV-vis, fluorescence, IR, Raman, NMR)	[3+1]	4
3.	C401	Properties of Matter	[3+1]	4
4.	C402	Group theory	[3+1]	4
5.	G401	Statistical Techniques and Applications	[3+1]	4
Practical Paper				
1.	CL 401	Chemistry Laboratory	6	3
2.	GL 401	Computational laboratory and Numerical Methods	4	2
Total				**25**

Additional Papers

S.No.	Paper Code	Paper Title	Contact hrs/per week Theory + Tutorials	Credits
1.	H401	Communication Skills Lab-II	4	2

Pt. Ravishankar Shukla University, Raipur
Center for Basic Sciences
Scheme of Examination
CBS Semester-V Examination

Chemistry Stream:

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
CB501	Analytical Chemistry	[3 + 1]	4
C501	Quantum Chemistry	[3+ 1]	4
C502	Inorganic Chemistry II	[3 + 1]	4
C503	Organic Chemistry II	[3 + 1]	4
G501	Earth Science and Energy & Environmental Sciences	[3 + 1]	4
		Lab contact hrs	**Credits**
CL501	Chemistry Laboratory	[8]	4

24
(124 of 240 credits)

Additional Papers

S.No.	Paper Code	Paper Title	Contact hrs/per week Theory + Tutorials	Credits
1.	H 501	Scientific Writing	4	2

Pt. Ravishankar Shukla University, Raipur
Center for Basic Sciences
Scheme of Examination
CBS Semester-VI Examination

Chemistry Stream:

Subject Code	Subject	Contact Hours / Week Theory+Tutorials	Credits
CB601	Biophysical Chemistry	[3 + 1]	4
C601	Atomic and molecular spectroscopy	[3+ 1]	4
C602	Inorganic Chemistry III	[3 + 1]	4
C603	Organic Chemistry III	[3 + 1]	4
C604	Nuclear Chemistry	[3 + 1]	4
H601	Ethics in Science and IPR	[2 + 0]	2
		Lab contact hrs	**Credits**
CL601	Chemistry Laboratory	[8]	4

26
(150 of 24credits)

Additional Papers

S.No.	Paper Code	Paper Title	Contact hrs/per week Theory + Tutorials	Credits
1.	H 602	Applications of Scientific Writing	4	2

Syllabus

Semester I

H 101: Communication Skills (COMMON TO ALL BRANCHES)

Unit-I

An interactive session (with examples) on what is communication, communication in the natural and civilized worlds, types of human communication: visual / non-verbal / verbal, written / spoken, etc

Unit-II

An overview of mass media; a brief discussion of their types (with examples). The concepts of facilitating factors, barriers, and filters in communication; the seven C's of effective communication.

Unit-III

Verbal communication: How to speak / listen effectively (in interpersonal communication), types of publicspeaking, tips for effective public speaking, how to make effective presentations. The role of written text in communication,

Unit-IV

Types of writing (academic/creative/general; formal/informal etc.) with examples of good/bad writing and their analysis. Introduction to letter writing, with stress on formal correspondence; email do's and don'ts.

Unit-V

Academic writing- an overview; explanation of various terms used in academic writing; parts of a paper/thesis;aspects such as formal language, grammatical accuracy, etc. Common grammatical/punctuation errors andhow to avoid them (example-based instruction)

Books Recommended:

S.No	**Author**	Book	Publication
1.	Rajendra Pal and JS Kurlahalli,	Essentials of Business Communication	S.Chand& Sons,
2	Michael Alley,	The Craft of Scientific Writing (3rd Edition),	Springer, ,New York, 1996.
3	Philip Reubens (General editor),	Science and Technical Writing – A Manual of Style (2nd Edition),	Routledge, New York,2001.
4	Edmond H. Weiss	Writing Remedies – Practical Exercises for Technical Writing	Universities Press (India) Ltd. , Hyderabad,2000.
5	M. Ashraf Rizvi,	Effective Technical Communication	Tata Mc Graw – Hill , New Delhi ,2005.
6	DH Menzel, HM Jones& LGBoyd	Writing Technical Papers	Mc Graw Hill ,1961
7	KL Turbian	A Manual for Writers of Term Papers, Thesis and Dissertation	University of Chicago press ,1973.

Semester II

H 201: Communication Skills (Lab) (COMMON TO ALL BRANCHES)

Unit 1

Elementary Phonetics (Speech Mechanism. The Description of Speech Sounds, The Phoneme the syllable; Intonation and Word Accent)

Formal (Extempore and Mock Interviews) and Informal Speaking(Situational Dialogues and Role play), Telephoning (Telephonic Conversations)

Unit 2

Paralinguistic features of speaking (voice modulation, pitch, tone, etc.)

Paper Presentation (Non-Technical & current Affairs), Use of Audio-Visual aids: Preparation slides, power point presentation etc.

Unit 3

Body Language(Gestures / Postures during Role Play/Speaking and JAM (Just-a-Minute) Session and Group Discussion

Unit 4

Listening and Comprehending spokenmaterial in Standard Indian English, British English and American English;Exercises on Listening Comprehension,Exercises on Reading Comprehension

Effective Writing (Business Letters, Covering Letter, Resume on Word Document. Translation and Precis Writing)

Unit 5

Grammar:(English/ Hindi)

Grammar in use: Errors of Accidence and syntax with reference to Parts of Speech; Agreement of Subject and Verb; Tense and Concord; Use of connectives, Question tags. Voice and Narration.

Indianism in English: Punctuation and Vocabulary, Building (Antonym, Synonym, Verbal Analogy and One Word Substitution).

Books Recommended:

S.No.	Author	Book	Publication
1.	W. Stannard Allen,	Living English Structure	Orient Longman Pvt. Ltd. (New Delhi) 2002
2	Bansal, R.K. and J.B. Harrison,	Spoken English: A Manual of Speech and Phonetics	Orient Longman Pvt. Ltd.(Mumbai) 2005.
3	Brown, Gillian	Listening to Spoken English	Longman.(Hong Kong)1983
4	Gimson, A.C.	An Introduction to the Pronunciation of English	Edward Arnold (London) 1980.
5	Kachru, Braj B	The Indianization of English: The English	Oxford University Press(Delhi) 1983

		Language in India	
6	Suresh Kumar,	A Handbook for English Language Laboratories	E. &Sreehari, P. Foundation. (New Delhi) 2009
7	SasiKumar , V & Dhamija, P.V,	How to Prepare for Group Discussion and Interviews.	Tata McGraw Hill
8.		Spoken English (CIEFL) in 3 volumes with 6 cassettes	OUP
9.	Murphy Raymond	Essential English Grammar	Cambridge University Press. (1992).

Semester III

H301: World Literature (COMMON TO ALL RANCHES)

Unit-I

What is Literature? - a discussion; Introduction to literary terms, genres, and forms of various periods, countries, languages, etc.

Unit-II

The Novel: Class study of 'Brave New World' by Aldous Huxley; Group discussions and student presentations on other genres such as the graphic novel, detective fiction, children's literature, etc.

Unit-III

Plays: Introduction to the history of theatre, class study of (mainly) two plays: 'Pygmalion' by G. B. Shaw and 'Fire and Rain' by Girish Karnad, the setting up of play –reading group through which the students can be introduced to several other plays.

Unit-IV

Poetry: Brief introduction; Study of poetic genres, forms, topics, figures of speech, poetic language etc. by analysing various poems from around the world

Unit-V

Short stories, essays and other types of writing by various authors. Screening of films based on literary works, such as Pygmalion (My Fair Lady), Fire and Rain (Agnivarsha), Persepolis (a graphic novel) and a few others.

Books Recommended:

S.No	Author	Book	
1	IforIvans	A Short History of English Literature	London: Penguin Books, 1976
2	Kettle Arnold	An Introduction to English Novel Vol. I, Vol. II	New. Delhi: Universal Book store, 1993.
3	Eagleton, Terry.	The English Novel: An Introduction	Oxford: Basil Blackwell. 1983
4	M.H. Abrams	A Glossary of Literary Terms	Wadsworth Publishing; 10th edition (January 10, 2011)
5	J.A. Cuddon	Dictionary of Literary Terms and Literary	(London: Penguin, 2004)
6	Girish Karnad	The Fire and the Rain	New Delhi, Oxford University Press, 1998
7	Aldous Huxley	'Brave New World'	New York: Harper Perennial, 1989
8	G. B. Shaw	Pygmalion	Longman Literature. Harlow: Longman, 1991

Semester IV

H 401: Communication Skills (Lab) (COMMON TO ALL BRANCHES)

Unit 1
Elementary Phonetics (Speech Mechanism. The Description of Speech Sounds, The Phoneme the syllable; Intonation and Word Accent)
Formal (Extempore and Mock Interviews) and Informal Speaking(Situational Dialogues and Role play), Telephoning (Telephonic Conversations)

Unit 2
Paralinguistic features of speaking (voice modulation, pitch, tone, etc.)
Paper Presentation (Non-Technical & current Affairs), Use of Audio-Visual aids: Preparation slides, power point presentation etc.

Unit 3
Body Language(Gestures / Postures during Role Play/Speaking and JAM (Just-a-Minute) Session and Group Discussion

Unit 4
Listening and Comprehending spokenmaterial in Standard Indian English, British English and American English;Exercises on Listening Comprehension,Exercises on Reading Comprehension

Effective Writing (Business Letters, Covering Letter, Resume on Word Document. Translation and Precis Writing)

Unit 5

Grammar:(English/ Hindi)

Grammar in use: Errors of Accidence and syntax with reference to Parts of Speech; Agreement of Subject and Verb; Tense and Concord; Use of connectives, Question tags. Voice and Narration.

Indianism in English: Punctuation and Vocabulary, Building (Antonym, Synonym, Verbal Analogy and One Word Substitution).

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5	Kachru, Braj B	The Indianization of English: The English Language in India	Oxford University Press(Delhi) 1983
6	Suresh Kumar,	A Handbook for English Language Laboratories	E. &Sreehari, P. Foundation. (New Delhi) 2009
7	SasiKumar , V & Dhamija, P.V,	How to Prepare for Group Discussion and Interviews.	Tata McGraw Hill
8.		Spoken English (CIEFL) in 3 volumes with 6 cassettes	OUP
9.	Murphy Raymond	Essential English Grammar	Cambridge University Press. (1992).

Semester V

H501: Scientific Writing (COMMON TO ALL BRANCHES)

Unit 1

Introduction: What is Scientific Writing; Needs and importance, main features and elements of scientific writing. Tools and types of Scientific Writing , Scientific writing Vs other forms of writing, Different methods of Research, Types of Research.

Unit 2

Scientific Writing in Research: Mechanics of writing. How to write a Research Paper, Project Proposal components of a full length research paper, Research/ Project Report writing, Formulation of Hypothesis, Do's and Don'ts of writing a Research Paper.

Unit 3

Technical Writing:

Types of technical documents: Full length research paper, Letters to editor, Book chapter, Review, Conference report, Title/Thesis statement, Abstract/key words, Aims and objectives, Rationale of the paper, Work plan, Materials and methodology, Results and discussion, Key issues and arguments, Acknowledgement, Conflict of interest statement, Reference and Bibliography.

Unit 4

Scientometrics: How to cite and how to do Referencing, Literature Search Technique: using SCOPUS, Google Scholar, PUBMED, Web of Science, Indian Citation Index, and RG Styles of referencing: APA, MLA, Oxford, Harvard, Chicago Annotated bibliography Tools for citing and referencing: Footnote, Endnote etc.

Unit 5

Research Paper and Thesis Designing: Components, Types and Importance Research ethics, Institutional ethics committee, Proof Reading, Studying Peer Review and Impact Factor of Journals, Synopsis Designing, Writing Preface, Acknowledgements, Plagiarism – Pitfall (software to check plagiarism).

Book Recommended :

S. No.	Author	Book	Publication
1	Various	The Oxford Book of Modern Science writing	Oxford University Press
2	Robert A. Day and Barbara	How to write and Publish a Scientific paper	Cambridge University Press
3	Angelika Hofmann	Scientific Writing and Communication: Papers	Oxford University Press

		Proposals and Presentations	
4	Jennifer Peat, Elizabeth-Elliott, Louise Baur and Victoria Keena	Scientific Writing: Easy when you know how	BMJ Books
5	Hans F. Ebel, Claus Bliefert, William E. Russey	The Art of Scientific Writing	WILEY-VCH Publishers

Semester VI

H602: Applications of Scientific Writing (COMMON TO ALL BRANCHES)

Effective Writing skills: Structuring Scientific Paper for Journals (Category A, B, C and D) Tables, Figures, Equations and Pictures using Excel, Improving Writing Style, Punctuation, Mechanism of Scientific Writing, Capitalization and Spelling, Collecting, organizing and evaluating data, Making deductions and reading conclusions.

Project writing: Technical Resumes & Cover Letters Components of a research proposal: Project summary, Key words, Origin of the proposal, Major Objectives, Methodology, Instrument facility available in the PI's department, Overview of status of Research and Development in the subject, Importance of the proposed project in the context of current status, Bibliography, Making Report of a Project / Research Paper

Formulation of projects, Funding Agencies: their Templates and Assignments on Project Submission.

Presentations:_Oral, and Power Point Presentation of Scientific Research Paper in Seminars, Conferences, Research Meetings and gatherings, Audience Analysis in Presentation, Conducting Seminars and Conferences etc.

Book Recommended:

S. No.	Author	Book	Publication
1	Various	The Oxford Book of Modern Science writing	Oxford University Press
2	Robert A. Day and Barbara	How to write and Publish a Scientific paper	Cambridge University Press
3	Angelika Hofmann	Scientific Writing and Communication: Papers Proposals and Presentations	Oxford University Press

4	Jennifer Peat, Elizabeth-Elliott, Louise Baur and Victoria Keena	Scientific Writing: Easy when you know how	BMJ Books
5	Hans F. Ebel, Claus Bliefert, William E. Russey	The Art of Scientific Writing	WILEY-VCH Publishers

SEMESTER WISE COURSE OUTCOMES

Int. M. Sc.

H 101: Communication Skills
Student will gain understanding of-

1. communication theories.
2. opportunities in the field of communication.
3. using current technologies related to the communication field.

H 201: Communication Skills Lab
Student will learn to:

1. recognize and analyze different communication styles across cultures and the various values that structure different communication styles across cultures.
2. recognize elements of communication apprehension that may be present during intercultural encounters and identify the skills necessary to reduce this discomfort.

H 301: The World Literature
Student will learn to:

- be able to communicate extensive independent work in a way that is acceptable to the scholarly community, masters the specialized language and terminology specific to the academic fields of literary, cultural and historical studies and has a high level of proficiency in reading, writing and speaking formal, academic English.

H 401: Communication Skills Lab
Student will learn to:

1. recognize and analyze different communication styles across cultures and the various values that structure different communication styles across cultures.
2. recognize elements of communication apprehension that may be present during intercultural encounters and identify the skills necessary to reduce this discomfort.

H 501: Scientific Writing
Student will learn to:

1. appreciate the benefits of exercise science.

2. understand the scientific method. 3. become familiar with correct grammar and literary devices.
H 602: Scientific Writing Lab **Students will learn to:** 1. apply the scientific method in writing a research paper. 2. demonstrate the use of correct grammar and various literary devices.