UNIVERSITY OF CALICUT

B.Sc.ZOOLOGY PROGRAMME

[CBCSS UG 2019]

Lesson Plan

Ms.ANNA KURIAN

SECOND SEMESTER B. Sc. ZOOLOGY PROGRAMME

ZOOLOGY CORE COURSE- II (Theory)

ANIMAL DIVERSITY: NON-CHORDATA PART – II

Code: ZOL2B02T

[DIVERSITY, ADAPTATIONS & FUNCTIONAL ANATOMY OF COELOMATE NON-CHORDATES] [2 Credits]

Course outcomes(COs)

Course outcome statements
Explain the classification of phylum Arthropoda; elucidate the salient features of each class and describe the morphology and structural organization of *Penaeus*(11 hrs)
Describe the characteristic features of phylum Mollusca, illustrate its classification
down to classes and explain the structural organization of *Pila globosa* (8 hrs)
Explain the salient features of phylum Echinodermata and illustrate its classificationdown to classes (4 hrs)
Understand the salient features and affinities of phylum Hemichordata (1 hr)

MODULE 3. Phylum ARTHROPODA (11 hrs)

Classification down to classes (mention the five subphyla and 16 arthropod classes); salient features of the following classes:

1. Class Trilobita [brief account only]
2. Class Merostomata e.g.*Limulu*s
3. Class Arachnida e.g.*Heterometrus (Palamnaeus),Heteropoda*

(Huntsman spider, Order Araneae). Mention ticks and mites (Subclass Acari).

4. Class Chilopoda e.g.*Scolopendra, Scutigera*
5. Class Diplopoda e.g.*Spirostreptus, Julus*
6. Class Crustacea e.g.*Sacculina, Eupagurus*

7. Class Insectae.g.,*Lepisma, Mantis, Tabanus, Troidesminos* (Southern Birdwing butterfly), *Papilio buddha* (Malabar Banded Peacock),Apis.

Type*: Penaeus indicus* [Prawn]

[Morphology, digestive system, respiratory system, blood vascular system, excretory system, nervous system, sense organs (statocyst, compound eye in detail), reproductive system and development] [Details of larval stages not expected].

MODULE 4. Phylum MOLLUSCA (8 hrs)

Classification down to classes; Mention Nudibranchs and Nautilus. Salient features of the following classes:

1. Class Aplacophora e.g., *Chaetoderma*
2. Class Polyplacophora (=Amphineura) e.g., *Chiton*
3. Class Monoplacophora e.g.,*Neopilina*
4. Class Gastropoda e.g.,*Turbinella*
5. Class Bivalvia (=Pelecypoda) e.g.,*Perna*
6. Class Scaphopoda e.g.,*Dentalium*
7. Class Cephalopoda (=Siphonopoda) e.g.,*Sepia*

Type: *Pila globosa* [Apple Snail]

[Morphology, digestive system, respiratory system, blood vascular system, excretory system, nervous system, sense organs (osphradium in detail) and reproductive system].

MODULE 5. Phylum ECHINODERMATA (4 hrs)

Classification down to classes [of extant forms only]; salient features of the following classes and brief account of examples:

1. Class Crinoidea e.g.,*Antedon*
2. Class Asteroidea e.g.,*Astropecten*
3. Class Ophiuroidea e.g.,*Ophiothrix*
4. Class Holothuroidea e.g.,*Holothuria*
5. Class Echinoidea e.g.,*Echinus*

Structural peculiarities of Asterias (star fish); water vascular system in detail.

MODULE 6. Phylum HEMICHORDATA (1 hr)

Balanoglossus: Salient features and affinities

Topics for Assignments/Seminars

1] Larval forms in Crustacea and their significance.

2] Metamorphosis in insects.

3] Social organization in insects.

4] Economic importance of molluscans.

5] Insect vectors of human diseases.

REFERENCES

•Meglitsch, P.A. & Schram, F.R. (1991). Invertebrate Zoology. Oxford University Press, New York

•Russel-Hunter, W. D. (1969). A Biology of Higher Invertebrates. Collier - Macmillan Ltd., London.

•Sandhu, G.S. (2005). Textbook of Invertebrate Zoology, Volume I. University of California & Campus Books International, New Delhi.

• Sebastian, P.A. & Peter, K. V. (2009). Spiders of India. Universities Press, Hyderabad.

•Shubhalaxmi, V. & Kendrick, R. (2018). Field Guide to Indian Moths. Birdwing Publishers, Mumbai.

•Smetacek, P. (2016). A Naturalist's Guide to the Butterflies of India. Prakash Books India Pvt. Ltd., New Delhi.

•Subramanian, K. A. (2005). Dragonflies and Damselflies of Peninsular India- A Field Guide. Indian Academy of Sciences, Bangalore.

•Verma, A. (2005). Invertebrates: Protozoa to Echinodermata. Alpha Science International, Oxford.

THIRD SEMESTER B. Sc. ZOOLOGY PROGRAMME

ZOOLOGY CORE COURSE – III (Theory)

ANIMAL DIVERSITY: CHORDATA PART - I

CODE: ZOL3B03T

[TAXONOMY, DIVERSITY, STRUCTURAL ANATOMY AND ADAPTATIONS OF CHORDATES]

COURSE OUTCOMES [COs]

Elucidate the characteristic features of the class Reptilia and its classification downto orders; describe the morphology and organ systems of Calotes versicolor (15 hrs)

MODULE 7. Class REPTILIA

Type*: Calotes versicolor* (Garden Lizard)

[Morphology, body wall, skeletal system (exclude skull bones), digestive system, respiratory system, circulatory system, excretory system, sense organs and reproductive system].

REFERENCES

•Areste, M. & Cebrian, R. (2003). Snakes of the World. Sterling Publishing Company, New York.

•Barbour, T. (1926). Reptiles and Amphibians-Their Habits and Adaptations. Houghton Mifflin Co., New York.

•Boulenger, G. A. (2016). Fauna of British India, including Ceylon and Burma: Reptilia and Batrachia (illustrated reprint). Wentworth Press (Originally published by Taylor & Francis, New York, 1890).

• Das, I. (2002). A Photographic Guide to Snakes and Other Reptiles of India. Ralph Curtis Books, Florida.

FOURTH SEMESTER B. Sc. ZOOLOGY PROGRAMME

ZOOLOGY CORE COURSE-IV (Theory)

ANIMAL DIVERSITY: CHORDATA PART-II

Code: ZOL4B04T

CLASS: MAMMALIA [25 hrs]

MODULE 3. Classification of Mammalia [11 hrs]

Classification of class Mammalia down to the orders cited with examples specified.

Subclass Prototheria [2 hr]

Infraclass Ornithodelphia [egg-laying mammals]

1. Order Monotremata e.g.,*Ornithorhynchus* [Platypus],

Tachyglossus [= Echidna]

Subclass Theria [2 hr]

Infraclass Metatheria [marsupials]

2. Order Marsupialia e.g.,Didelphis [Opossum], *Macropus* [Kangaroo]

Infraclass Eutheria [true placental mammals] [7 hrs]

3. Order Edentata e.g.,*Bradypus*(Sloth),*Dasypus*(Armadillo), *Myrmecophaga* (Spiny ant-eater)

4. Order Pholidota e.g.,*Manis* (Pangolin/ Scaly ant-eater)

5. Order Lagomorpha [rabbits and hares] e.g.,*Lepus nigricollis*(Indian Hare)

6. Order Rodentia e.g.,*Funambulus, Ratufa*(Giant squirrel)

7. Order Soricimorpha [shrews, moles] e.g.,*Suncusmurinus, Crocidura*

8. Order Erinaceomorpha e.g.,*Paraechinusmicropus* (Indian Hedgehog)

9. Order Chrysochloridea e.g., Golden mole of South Africa

10. Order Dermoptera [colugos] e.g., *Cynocephalusvolans* (flying lemur)

11. Order Chiroptera e.g.,*Pteropus, Pipistrellus, Kerivoulapicta* (Painted bat)

12. Order Primates e.g., *Loris, Macaca, Gorilla, Pongo, Hylobates, Homo*

13. Order Carnivora e.g.,*Phoca* (Seal), *Odobenus* (Walrus), *Panthera* sp.,*Viverriculaindica* (Civet), *Lutrogale* (Otter),*Cuonalpinus* (Wild dog).

14. Order Cetacea e.g.,*Physeter* (Sperm whale), *Delphinus* (Dolphins),*Phocaena* (Porpoise), *Balaenoptera* (Baleen whale]

15. Order Artiodactyla e.g.,*Sus scrofa cristatus* (Wild Boar), *Bos gaurus*(Gaur), *Giraffa* (Giraffe), *Hemitragus* [Tahr], *Rusa* (=Cervus) *unicolor* (Sambar deer), *Axis axis* (Spotted deer), *Moschiola* (Mouse deer), *Antilope cervicapra* (Blackbuck).

16. Order Perissodactyla e.g.,*Equus caballus* (Horse), *Rhinoceros*

17. Order Sirenia e.g.,*Trichechus* (Manatee), *Dugong*

18. Order Proboscidea e.g.,*Elephas maximus indicus* [Indian elephant],*Elephas maximus borneensis* [Borneo pigmy elephant], *Loxodonta africana* [African savanna elephant] and *Loxodonta cyclotis* [African forest elephant].

19. Order Hyracoidea e.g.,*Hyrax* (Coney)

20. Order Tubulidentata e.g.,*Aardvark*

MODULE 4. Type*: Oryctolagus cuniculus* (European Rabbit) [14 hrs]

[External features, integumentary system, skeletal system (dentition in detail – skull excluded), digestive system, respiratory system, circulatory system (exclude arterial and venous systems), excretory system, sense organs and reproductive system].

Topics for Assignments/ Seminars

1. Aquatic mammals and their adaptations

2. Dentition in mammals [adaptations related to food)

3. Endangered mammals of Kerala

4. Flying mammals

REFERENCES

•Johnsingh, A. J. T. & Manjrekar, N. (2012). Mammals of South Asia – Volume 1 & 2. Orient BlackSwan Publishing, Hyderabad.

•McKenna, M. C. & Bell, S. K. (1997). Classification of Mammals: Above the Species Level. Columbia University Press, USA.

•Menon, V. (2014). Indian Mammals: A Field Guide. Hachette India, New Delhi.

•Wilson, D. E. & Reeder, D. M. (2005). Mammal Species of the World: A Taxonomic and Geographic Reference, Volume 1. Johns Hopkins University Press

FIFTH SEMESTER

ZOOLOGY CORE COURSE- V [Theory]

CELL BIOLOGY AND GENETICS

Code: ZOL5B06T

COURSE OUTCOMES (COs)

Course outcome Statements
Understand the principles and applications of various types of light microscopes, electron, Scanning-tunnelling and atomic force microscope and illustrate thehistological and histochemical processing of tissues (7 hrs)
Explain the basic structure of a eukaryotic cell and the structure and functions ofplasma membrane, mitochondria, lysosome, cytoskeletal elements and interphase nucleus (12 hrs).
Illustrate the nucleosome organization of chromatin and higher order structures;structure of chromosomes and giant chromosomes (2 hrs).
Enumerate eukaryotic cell cycle and cell division by amitosis, mitosis and meiosis (4hrs)
Explain the causes of transformation, characteristics of transformed cells and therole of protooncogenes and tumour suppressor genes in malignant transformation; mechanism and significance of apoptosis (2 hrs)

Section A: CELL BIOLOGY (27 hrs)

MODULE 1. Techniques in Cell Biology (7 hrs)

Microscopy (4 hrs)

Light microscope: principles and uses; use of oil immersion objective. Types of light Microscopes: Bright-field, Phase contrast and Fluorescence microscope. Camera lucida: Principle and uses. Micrometry. Electron microscope: Principle, applications; advantages and disadvantages. Principles and applications of - Scanning Electron Microscope (SEM); Scanning-tunnelling microscope and Atomic force microscope.

Histological Techniques (2 hrs)

Preparation of materials for light microscopy (for temporary and permanent mounts): Fixation: common fixatives: buffered formalin, ethanol, Bouin's solution and Carnoy's fluid (mention composition). Processing of the fixed tissue: mention dehydration, infiltration, and embedding. Sectioning: Rotatory microtome (brief description), uses. Staining: Mention deparaffinization, hydration, staining, dehydration and mounting. Histological stains: Haematoxylin and Eosin. Vital stains: Neutral red and Janus green.

Histochemical Techniques (1 hr)

Mention the techniques for the demonstration of proteins (mercuric bromophenol blue method),carbohydrates (PAS) and lipids (Sudan)

MODULE 2. Structure of eukaryotic cell (12 hrs)

Plasma membrane (6 hrs)

Chemical composition and structure (unit membrane concept and fluid mosaic model), membrane lipids and membrane fluidity; significance of membrane fluidity; membrane proteins-integral proteins, peripheral proteins and lipid-anchored proteins; membrane carbohydrates.

Interactions between cells and their environment – extracellular space, glycocalyx, extracellular matrix - Mention basal lamina, collagen, fibronectin, proteoglycans and laminins.

Interaction of cells with other cells – cell adhesion molecules, selectins, immunoglobulins, integrins and cadherins. Modifications of the plasma membrane

– microvilli, desmosomes, nexuses, tight junction and gap junction.

Functions: trans-membrane transport mechanisms – diffusion, osmosis, active transport, ion transport (channels), co-transport, bulk trans-membrane transport – exocytosis, endocytosis. Membrane receptors: Mention insulin receptor.

Mitochondria(2 hrs)

Ultra-structure; mitochondrial membranes; functions of mitochondria; Biogenesis of mitochondria.

Lysosomes (1 hr)

Structure and function; polymorphism in lysosomes, lysosomal enzymes. Concept of GERL (Golgi body – Endoplasmic Reticulum – Lysosome complex).

Cytoskeleton(1 hr)

Location, ultrastructure, biochemical composition and functions of microfilaments, intermediate filaments and microtubules.

Interphase nucleus(2 hrs)

General structure and functions; nucleo-cytoplasmic index; ultrastructure of nuclear membrane and nuclear pore complex (NPC), functions of NPC;

Nucleoplasm - Composition and function; Nucleolus - Structure, composition, nucleolar organizer, nucleolar cycle and functions of nucleolus. Chromatin: Euchromatin and heterochromatin.

MODULE 3. Structure of chromatin (2 hrs)

Nucleosome organization and higher order structures; Chromosome structure; Giant chromosomes - Polytene chromosomes: structure, puffs and bands; Endomitosis; significance. Lamp brush chromosomes: structure, loops and significance.

MODULE 4. Cell Cycle & Cell division (4 hrs)

Cell Cycle: G1, S, G2 and M phases – Check points; G0 phase. Cell division: Amitosis (brief account); Mitosis: description of all stages, cytokinesis and significance; Meiosis: description of all stages and significance. Role of centriole in animal cell division.

MODULE 5. Cancer and Apoptosis (2 hrs)

Characteristics of cancer cells; causes of transformation; protooncogenes and tumor suppressor genes and their role in transformation. Apoptosis, mechanism of apoptosis and its significance.

Topics for assignments/seminars

1. Ribosomes: structure and functions
2. Golgi bodies: structure and functions

REFERENCES

•Gerald Karp (2013): Cell Biology; 7th Edition, ISBN-10: 1118318749, Wiley, 872 pages

•Gupta, P. K.(2018): Cell and Molecular Biology, Revised 5th edition, ISBN, 978-93-5078-154-8, Rastogi Pubs.,1192 pages

FIFTHSEMESTER

BIOTECHNOLOGY, MICROBIOLOGY AND IMMUNOLOGY

Code: ZOL5B07T

COURSE OUTCOMES (COs)

Course Outcome statements
Illustrate the steps in genetic engineering and animal cell culture (12 hrs)
Explain transfection methods, transgenic animals and ethical issues of
transgenic animals (5 hrs)
Enumerate the applications of biotechnology (7 hrs)
Understand the biological diversity of microbial forms and the various techniques for handling microbes in the laboratory (8 hrs)
Enumerate the basic structure and life cycle of bacteria and virus (8 hrs)
Understand the industrial and medical importance of microorganisms (8 hrs)

Section A: BIOTECHNOLOGY (24 hrs)

MODULE 1: Genetic Engineering and Animal cell culture (12 Hrs)

Genetic Engineering (10 hrs)

Concept and scope of biotechnology – Mention branches of biotechnology. Introduction to the concept of Recombinant DNA Technology: Cloning vectors (Plasmid, pBR322, Phages, Cosmids, Virus vectors, YAC vector and Bac vector).

Enzymes: Type II Restriction endonucleases, polynucleotide kinase, exonuclease, terminal transferase, reverse transcriptase and DNA ligase.

Construction of Recombinant DNA: Preparation of vector and donor DNA, Joining of vector DNA with the donor DNA, Introduction of recombinant DNA into the host cell and selection of transformants (brief account).

Animal Cell Culture (2 hrs)

Cell culture media (Natural and Defined), Preparation and Sterilization, Primary cell culture, Cell Lines, Pluripotent Stem Cells, Cryopreservation of cultures. Somatic cell fusion and HAT selection of hybrid clones – production of monoclonal antibodies.

MODULE 2: Transgenic Organisms (5 hrs)

Transfection Methods: (Chemical treatment, Electroporation, Lipofection, Microinjection, Retroviral vector method, Embryonic stem cell method and Shot

Gun Method). Transgenic Animals: (Fish, Pig, Sheep, Rabbit, Mice, Goat andInsects), Knock Out Mice. Human Cloning and Ethical Issues of transgenic Animals.

MODULE 3: Applications of Biotechnology (7hrs)

Molecular diagnosis of genetic diseases (Cystic Fibrosis, Huntington's Disease and Sickle Cell Anemia). Vaccines and Therapeutic agents, Recombinant DNA in Medicines (Recombinant Insulin and Human Growth Hormone).

Human gene therapy (gene therapy for severe combined immune deficiency).

Enzymes in detergents and leather industries, Heterologous protein production, Biofiltration, Bioremediation, Bioleaching, Molecular pharming and Bioreactors.

Molecular markers (brief account) RFLP, RAPD, VNTR, SNPs and their uses.

Section B: MICROBIOLOGY (24 hrs)

MODULE 4: Introduction and Methods in Microbiology (8 hrs)

Introduction (1 hr)

Microbial Diversity: Archaebacteria, Eubacteria, Prochlorophyta, Algae, Fungi, Protozoa, Viruses, Viroids, Prions, Mycoplasma and Rickettsias

Methods in Microbiology (7 hrs)

Sterilization: Physical and Chemical methods - Dry and Moist Heat, Pasteurization, Radiation, Ultrasonication. Disinfection, Sanitization, Antiseptics, Sterilants and Fumigation. Preparation of culture media: Selective, Enrichment and Differential media. Plating techniques and Isolation of pure colonies. Staining: Simple staining, Negative staining and Gram staining. Culture preservation techniques: Refrigeration, Deep freezing, Freezing under liquid Nitrogen and Lyophilisation.

MODULE 5: Basic Concepts in Bacteriology and Virology (8 hrs)

Bacteria: Structure of a typical Bacterium, Different types of bacterial culture (Batch, Synchronous, Arithmetic), Bacterial growth: Growth phases, Methods of growth determination.

Basic Concepts of Virology: General characteristics and classification of viruses. Bacteriophages: Diversity, lytic and lysogenic Phages (Lambda and P1 Phage), Applications of bacteriophages. Oncogenic Viruses. Prevention and control of Viral diseases: Antiviral compounds, Interferons and viral vaccines.

MODULE 6: Industrial and Medical Microbiology (8 hrs)

Industrial Microbiology (4 hrs)

Bioengineering of microorganisms for industrial purposes: Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses) - citric acid, ethanol, wine, penicillin, glutamic acid, riboflavin, enzymes (amylase, cellulase, protease, lipase, glucose isomerase, glucose oxidase). Bioinsecticides (Bt) and Steroid biotransformation.

Medical Microbiology(4 hrs)

Normal microflora of the human body: skin, throat, gastrointestinal tract and urogenital tract. Diseases caused by: (with reference to causative agent, symptoms and mode of transmission).

a)Bacteria: anthrax, tuberculosis, typhoid, whooping cough, pneumonia, cholera, gonorrhea, and syphilis.

b)Viruses: polio, chicken pox, herpes, hepatitis, rabies, dengue, AIDS and chikungunya.

c)Protozoa: malaria, kala-azar and toxoplasmosis.

d)Fungi: dermatomycoses and opportunistic mycoses Bacterial drug resistance.

Topics for assignments/seminars

1. Microbiological analysis of drinking water
2. Biogas plant
3. Social acceptance of biotechnology
4. Biofertilizers
5. DNA vaccines

REFERENCES

Module 1-3 (Biotechnology)

•Bernard R. Glick and Jack J. Pasternak (2002) Molecular Biotechnology-Principles and applications of recombinant DNA, 3rd Edition, ISBN-10: 1555812244, ASM press, 860 pages

•Butler, M. (2003) Animal cell culture and technology: The basics, 2nd Edition, ISBN 9781859960493, CRC Press, 256 pages

•Dubey, R.C.(2006) A text book of biotechnology, 4th Revised Edition, S. Chand & Co., 725 p.

Module 4-6 (Microbiology)

•Atlas RM. (1997) Principles of Microbiology, 2nd Edition, ISBN-10: 0815108893 William T.Brown Publishers, 1298 pages

•Chakraborty.P.A.(2009) Text Book of Microbiology, ISBN-10: 8173810818 New Central Book Agency, 1026

•Prescot L.M., Harley, J..P. and Klein. D.A.(2008) Microbiolgy, 7th Edition, McGraw Hill Inc., New York.

FIFTH SEMESTER

BIOCHEMISTRY AND MOLECULAR BIOLOGY

Code: ZOL5B08T

COURSE OUTCOMES (COs)

Course Outcome statements
Understand the elements of biological importance and the non-covalentinteractions that stabilize biomolecules (1 hr).
Describe the classification, types, structure, reactions and biological roles ofcarbohydrates, and diabetes Type I and II (6 hrs)
Enumerate the properties and classification of amino acids and their standard abbreviations; hierarchial levels of protein structure, classification, separation,purification and sequencing of proteins (7 hrs).
Explain the classification and functions of lipids and fatty acids; chemistry andstructure of nucleic acids and sequencing of DNA (7 hrs)
Understand the classification, nomenclature and properties of enzymes; enzymeaction, co-enzymes, cofactors, isozymes, ribozymes and allosteric enzymes (3 hrs)
Explain glycolysis, Kreb's cycle, glycogenesis, glycogenolysis, gluconeogenesis,HMP pathway; amino acid and fatty acid oxidation and oxidative phosphorylation (12 hrs).

BIOCHEMISTRY (36 hrs)

MODULE 1. Introduction (1 hr)

Elements of biological importance; non-covalent bonds that stabilize biomolecules – Hydrogen bonds, hydrophobic interactions and Van der Waals Interactions.

MODULE 2. Carbohydrates (6 hrs)

Monosaccharides: Aldoses and ketoses, trioses, tetroses, pentoses and hexoses; glyceraldehyde, dihydroxyacetone, ribose, deoxyribose, ribulose, glucose and fructose. Cyclization of pentoses and hexoses, optical activity and mutarotation, inversion and invert sugar, monosaccharides as reducing agents, Osazones.

Disaccharides: Glycosidic bond, reducing and non-reducing disaccharides, maltose and sucrose as examples.

Polysaccharides: Starch and glycogen, amylose and amylopectin, homo and heteropolysaccharides.

Biological functions of carbohydrates; Mention diabetes Type I and II.

MODULE 3. Amino acids, peptides and protein (7 hrs)

Proteinogenic amino acids, abbreviations (three letter and single letter) of the standard amino acids, structure and classification and general properties of amino acids, isoelectric point, peptide bonds, nonstandard amino acids.

Peptides and proteins: Classification of proteins - simple, conjugated and derived. Structure of proteins: primary, secondary, tertiary and quaternary structure. Denaturation of proteins.

Separation and purification of proteins: Paper chromatography, column chromatography, ion exchange chromatography, size exclusion chromatography, affinity chromatography and high - performance liquid chromatography (Brief account only). Polyacrylamide Gel Electrophoresis.

Sequencing of peptides: Sanger's method, Edman degradation procedure and Mass spectrometry (Brief account only)

MODULE 4. Lipids and Nucleic acids (7 hrs)

Lipids(2 hrs)

Classification and functions (simple, compound, derived and miscellaneous lipids).

Fatty acids: saturated and unsaturated; triglycerides; mention phospholipids; lecithins; cephalins; phosphoinositides; prostaglandins and cholesterol. Mention the clinical significance of lipid profile estimation.

Nucleic acids(5 hrs)

Chemistry and structure of purines and pyrimidines, structure of nucleotides (ATP, dATP and cAMP), Watson – Crick model of DNA, Different forms of DNA, secondary and tertiary structure of tRNA. Sequencing of DNA by Sanger's method. Mention Maxam-Gilbert sequencing.

MODULE 5. Enzymes and co-enzymes (3 hrs)

Classification, nomenclature and properties of enzymes; Active centre, mechanism and theories of enzyme action, enzyme inhibition, co-enzymes (NAD, FAD) and cofactors. Mention isozymes, ribozymes and allosteric enzymes.

MODULE 6. Metabolism of carbohydrates, proteins and lipids (12 hrs)

Glycolysis, Kreb's cycle, glycogenesis, glycogenolysis, gluconeogenesis and HMP pathway. Amino acid oxidation and production of urea. β-oxidation of fatty acids.

Brief account on redox reactions, redox potentials, electrochemical gradients, electron transport chain, oxidative phosphorylation, proton gradient and chemiosmotic synthesis of ATP.

Topics for assignments/seminar

1. B-Complex vitamins as co-enzymes
2. Different types of eukaryotic RNAs
3. Biological functions of steroids

REFERENCES

•David L. Nelson and Michael Cox (2012):– Lehninger Principles of Biochemistry 6th Edition, ISBN-10: 1429234148, W.H. Freeman, 1328 pages

•David L. Nelson and Michael Cox (2017): Lehninger Principles of Biochemistry 7th Edition, ISBN-10: 1-4641-2611-9, W.H. Freeman, 1172 pages

•Donald Voet, Charlotte W. Pratt and Judith G. Voet (2001): Principles of Biochemistry 4th Edition, ISBN-10: 9780471417590, Wiley

•Jeremy M Berg, LubertStryer, John L. Tymoczko, Gregory J Gatto (2015): Biochemistry 8th Edition, ISBN-10: 1464126100, W.H. Freeman, 1120 pages

SIXTH SEMESTER

ENVIRONMENTAL AND CONSERVATION BIOLOGY

Code: ZOL6B12T

COURSE OUTCOMES [Cos]

Understand the threats to biodiversity, and strategies adapted for theconservation of diversity of organisms (10 hrs)
Describe the various international strategies for conserving biodiversity (4 hrs)
Describe the toxic chemicals, their toxicity levels and the health hazards caused bythem (4 hrs).

Section B: CONSERVATION BIOLOGY (14 hrs)

MODULE 7. Biodiversity (10 hrs)

Introduction, Components of biodiversity: Genetic diversity, species diversity (mention Shannon diversity index and Simpson's dominance index), community

diversity and ecosystem diversity, landscape diversity; Levels of diversity in community and ecosystem diversity: Alpha, beta and gamma diversities.

Hot spots of biodiversity. Mention hotspots in Indian region (Western Ghats and Sri Lanka, Himalayas, Indo Burma and Sundaland).

Threats to biodiversity; Loss of biodiversity and its causes.

Threatened species, Extinction of species, red data book and IUCN Red list categories.

Conservation of biodiversity and wildlife: conservation measures; Wild life (protection Act) 1972, Conservation projects: Project Tiger, Elephant, Lion, Crocodile, Gangetic Dolphins, Kashmir Red Deer and Brow-antlered Deer (Sangai).

Biodiversity conservation strategies: Protection of endangered species- Ex situ conservation (conservation in Seed banks, Gene banks, Germ plasm banks, Zoo, Botanical gardens etc.).

In situ conservation: Wildlife Sanctuaries -Thattekkad bird sanctuary, ParambikulamWLS, PeriyarWLS, Malabar WLS); National Parks- Eravikulam NP & Silent Valley NP; Biosphere Reserves - Nilgiri BR &Agasthyamalai BR; Community reserve- Kadalundy.

MODULE 8. Global strategy for conservation (4 hrs)

Brief notes on i) Stockholm conference/Declaration (1972), ii) IUCN, iii) WWF, iv) UNEP, v) CITES, vi) Rio Declaration vii) Rio convention on Biodiversity, 1992 (Rio Earth Summit, 1992), Rio (2012). viii) Kyoto Agreement (1997), Paris Agreement (2016) and Conference of the Parties (COP) on climate change (2018), ix) Ramsar convention (2018).

Section C: TOXICOLOGY (4 hrs)

MODULE 9. Toxicants and public health hazards (4 hrs)

a.Toxic chemicals (biocides, automobile emissions, heavy metals, fertilizers, food additives, xenobiotics, radioactive wastes).

b.Classification of poisons; Physico-chemical characteristics and mode of action of poisons; Accidental, suicidal and homicidal poisonings; Signs and symptoms of common poisoning and their antidotes.

c.Levels of toxicity: Acute, sub-acute, chronic, Dose-response relationship. Measures of toxicity: LD50 and LC50.

Topics for Assignments/Seminars

1. Individual responsibilities – Role of Governmental and Non-Governmental Organizations in biodiversity conservation – Chipko, Green peace WWF

10.Food additives.

REFERENCES

•BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, ISBN 13: 9788188204069

•Burchan, P.C. (2013) An Introduction to Toxicology, Springer

SIXTH SEMESTER

ETHOLOGY, EVOLUTION AND ZOOGEOGRAPHY

Code: ZOL6B13T

[54 hrs] [3 hours per week] [3 credits]

COURSE OUTCOMES [COs]

Course Outcome Statements
Describe the patterns and mechanisms of animal behaviour (5 hrs)
Illustrate biological rhythms and the chemical basis of communication (7 hrs)
Explain ecological and historical foundations for understanding the distribution and abundance of species, and their changes over time and comprehend the basicprinciples of biogeography as a discipline (8 hrs)

Section A: ETHOLOGY (12 hrs)

MODULE 1 (10 hrs)

Patterns and Mechanisms in Animal Behaviour (5 hrs)

Introduction and Patterns of behavior (4 hrs)

History (brief), scope of ethology. (a) Innate behaviour: Orientation-taxes/kinesis, simple reflexes, instincts, motivation. (b) Learned behaviour: Habituation, conditioned reflex, trial and error learning; latent learning, imprinting, insight learning, memory and learning.

Neural mechanism in behavior (1 hr)

Role of hypothalamus in thirst and feeding; role of cerebral cortex in emotional behavior; mammalian limbic system and control of behavior (brief account).

[

MODULE 2. Biological rhythm and Sociobiology (7 hrs)

Biological clocks/rhythms(4 hrs)

Photoperiodism, circadian rhythm; migration, orientation, navigation and homing; diapause, hibernation and aestivation (brief account)

Sociobiology(3 hrs)

Social groups in termites and elephants; Chemical communication: classification and significance of pheromones (mention human pheromones also).

Section C: ZOOGEOGRAPHY (8 hrs)

MODULE 9: Zoogeographical realms and Biogeography of India (8 hrs)

Geographical Distribution(4 hrs)

(a) Geographical distribution of animals: Cosmopolitan, discontinuous, bipolar and isolated distribution. (b) Barriers in animal distribution: Physical, climatic and biological barriers.

Zoogeographical realms(2 hrs)

Zoogeographical regions with specific fauna (faunal regions): Palaeartic region, Nearctic region, Neotropical region, Ethiopean region, Oriental region and Australian region; brief description on Wallace line, Weber line and Wallacea.

Insular fauna(1 hr)

Faunal characteristics of continental (Madagaskar and Sri Lanka) and oceanic islands (Galapagos and New Zealand).

Biogeography of India(1 hr)

Biogeographical zones of India: Himalayan, Desert zone, Semi-arid zone, Western Ghats, Deccan plateau, Gangetic plain, North east Indian zone, Island zone and Coastal zone (brief account).

REFERENCES

Module 1-2 (Ethology)

•Jerry A. Hogan. 2017. The Study of Behavior: Organization, Methods, and Principles. ISBN: 9781107191976. Cambridge University Press. 380 pages.

•John Alcock& Dustin R Rubenstein. 2019. Animal Behaviour, 11th edition. Published by Sunderland, Massachusetts Sinauer Associates, Oxford University Press. 672 pages.

•Lee Alan Dugatkin. 2013. Principles of Animal Behavior, 4th Edition. ISBN-13: 978- 0393920451. ISBN-10: 0393920453. W. W. Norton & Company.

Module 9 (Zoogeography)

•Andrews, M.I. & Joy, K.P. Ecology, Evolution & Zoogeography. S.M. Book Depot, Changanassery

•Rastogi V. B. & Jayaraj.1998. Animal Ecology and Distribution of Animals. Kedar Nath and Ram Nath. ISBN: 5551234001809.

•Tiwari, S. K. 1985. Zoogeography of India and South East Asia. CBS Pubs, New Delhi

FIRST SEMESTER ANIMALDIVERSITY: NON CHORDATA PART- I

Code: ZOL1B01T **[2 Credits]**

COURSE OUTCOMES (COs)

Course Outcome Statements
Describe the characteristic features of phylum Ctenophora (1 hrs)
Explain the salient features of phylum Platyhelminthes and illustrate its classification down to classes (3 hrs)
Explain the characteristic features and classification of super-phylum Aschelminthes and phylum Nematoda (3 hrs)
Elucidate the characters of Pseudocoelomate minor phyla Rotifera and Gastrotricha (2 hrs)

Section C. KINGDOM: ANIMALIA

Salient features of the Major Phyla of animals and their diversity.

[*Habits, habitat,morphology, functional anatomy and life history of representative types (wherever specified) and classification of each phylum down to classes, except otherwise mentioned, and examples thereof: Study of animal diversity with typical examples from each class, with emphasis on ecological and adaptive features, economic importance and such other points of biological interest expected. Only very brief account of each example is to be studied.*]

Phylum CTENOPHORA [=ACNIDARIA] (1 hr)

Unique features as exemplified by *Pleurobrachia*; mention cidippid larva.

MODULE 8. ACOELOMATA (3 hrs)

Phylum PLATYHELMINTHES

Classification down to classes and salient features of the following classes.

ClassTurbellaria e.g.*Bipalium*
Class Trematoda e.g.*Fasciola*
Class Cestoda e.g.*Taenia*

Type ***Dugesia*** (Planaria):Structural organization, Digestive system, locomotion and reproduction.

MODULE 9. PSEUDOCOELOMATA (3 hrs)

Super Phylum: ASCHELMINTHES

Classification down to phyla; highlight the heterogeneous nature of animals of this group.

Phylum: NEMATODA

Characteristic features of *Ascaris*.
Examples: *Ancylostoma, Enterobius, Wuchereria*

MODULE 10. PSEUDOCOELOMATE MINOR PHYLA (2 hrs)

Salient features of the followingpseudocoelomate minor phyla:

Phylum **Gastrotricha** e.g.*Chaetonotus*

Phylum **Rotifera** e.g.*Brachionus*

Topics for assignments/seminars

1. Helminth parasites of man.
2. Reef building corals and coral reefs.

Procedure / Process of Teaching –

Lecture
Power point presentations
Flipped class – videos of topics to be sent day before and only discussion to be held in the class.
Peer learning – topics divided among student groups – each group to teach the rest of the students their assigned topic.

Procedure/ Process of Assessment –

Seminars
Quiz in groups
Quiz individually

REFERENCES

- Animal Diveristy – Non Chordata – Bhaskaran
- Anderson, D. T. (2001). *Invertebrate Zoology*. 2nd edition. University of Michigan, Oxford University Press (Indian Edition. 2006).
- Barnes, R.D. (1982). *Invertebrate Zoology*, 5th Edition. Holt Saunders International Edition.

SECOND SEMESTER

ANIMAL DIVERSITY: NON-CHORDATA PART – II

Code: ZOL2B02T - **2 Credits**

COURSE OUTCOMES [COs]

Course Outcome Statements
Explain the classification with examples and characteristic features of phylum Annelida and describe the morphology and structural organization of *Neanthes* (7 hrs)
Describe the distribution, peculiarities and affinities of phylum Onychophora (2 hrs)

COELOMATA MODULE 1. Phylum ANNELIDA (7hrs)

Classification down to subclasses; salient features of the following classes and subclasses:

1. Class Polychaeta e.g. *Arenicola*
2. Class Clitellata
   - Subclass Oligochaeta e.g. *Megascolex*
   - Subclass Hirudinea e.g. *Hirudinaria*, *Haemadipsa*

Type: ***Neanthes*** [Nereis]

[Morphology, body wall, digestive system, respiratory system, circulatory system, excretory system, sense organs and reproductive system. Mention Heteronereis stage and Trochophore larva.]

MODULE 2. Phylum ONYCHOPHORA (2 hrs)

Peripatus [distribution, peculiarities and affinities).

MODULE 7. COELOMATE MINOR PHYLA (3 hrs)

Salient features of the following coelomate minor phyla; mention examples specified [structure and life history not required).

1. Phylum **Phoronida** e.g. *Phoronis*
2. Phylum **Ectoprocta** [**Bryozoa]** e.g. *Bugula*
3. Phylum **Echiura** e.g. *Bonellia*

Procedure / Process of Teaching –

Lecture
Power point presentations
Flipped class – videos of topics to be sent day before and only discussion to be held in the class.
Peer learning – topics divided among student groups – each group to teach the rest of the students their assigned topic.

Procedure/ Process of Assessment –

Seminars
Quiz in groups
Quiz individually

REFERENCES

- Anderson, D. T. (2001). *Invertebrate Zoology*. 2nd edition. University of Michigan, Oxford University Press (Indian Edition. 2006).
- Apte, D. (2015). *Sea Shells of India: An Illustrated Guide to Common Gastropods*. Bombay Natural History Society & Oxford University Press, New Delhi.
- Barnes, R.D. (1982). *Invertebrate Zoology*, 5th Edition. Holt Saunders International Edition.

THIRD SEMESTER
ANIMAL DIVERSITY: CHORDATA PART - I

CODE: ZOL3B03T - **3 credits**

COURSE OUTCOMES [COs]

Course Outcome Statements
Describe the salient features and affinities of class Amphibia and its classification up to orders; explain the morphology and organ systems of *Hoplobatrachus tigerinus* (13 hrs)
Elucidate the characteristic features of the class Reptilia and its classification down to orders; describe the morphology and organ systems of *Calotes versicolor* (15 hrs)

Super class **TETRAPODA**

MODULE 6. Class AMPHIBIA [13 hrs]

Classification of Amphibia down to orders with examples [of extant forms only].
Subclass **Stegocephalia** (extinct)
Subclass **Lissamphibia**

1. Order Apoda (=Gymnophiona) e.g.*Ichthyophis, Uraeotyphlus*
2. Order Caudata (=Urodela) e.g.*Necturus, Ambystoma,* mention Axolotl larva.
3. Order Anura (=Salientia) e.g.*Duttaphrynus, Rhacophorus*

Type: ***Hoplobatrachus tigerinus*** (Indian Bullfrog)
[Morphology, body wall, skeletal system,digestive system, respiratory system, circulatory system, excretory system, sense organs and reproductive system].

Mention about the diversity of bush frogs, dancing frogs and night frogs in Western Ghats and the discovery of *Nasikabatrachus sahyadrensis* (Purple frog).

MODULE 7. Class REPTILIA [15 hrs]

Classification of class Reptilia down to orders and salient features of thefollowing orders (only extant forms):

Subclass I - **Anapsida**

1. Order Cotylosauria [stem reptiles] e.g.*Hylonomus*
2. Order Chelonia [common turtles, tortoises etc.] e.g. *Melanochelys*, *Chelone*

SubclassII - **Diapsida**

1. Order Rhynchocephalia e.g. *Sphenodon*
2. Order Squamata
   - Suborder Lacertilia (Lizards) e.g. *Chamaeleo, Hemidactylus*
   - Suborder Ophidia (Snakes)

Common venomous and non-venomous snakes of Kerala: a] *Python molurus* b]*Ptyas mucosus* c] *Gongylophis* (= *Eryx*) *conicus* d] *Indotyphlops braminus* e] *Bungarus caeruleus* f] *Naja naja* g] *Daboia russellii* h] *Ophiophagus hannah*

Identification key for venomous and non-venomous snakes.

3. Order Crocodilia e.g. *Crocodylus*, *Gavialis*

[Mention the extinct subclasses **Euryapsida**, **Parapsida** and **Synapsida** (mammal-like reptiles) and mention the origin of mammals from synapsids].

Topics for Assignments/Seminars

1. Parental care in amphibians.
2. Snake venom: nature; composition; antivenin; poly antivenins; prophylaxis.

REFERENCES

- Areste, M. & Cebrian, R. (2003). *Snakes of the World*. Sterling Publishing Company, New York.
- Barbour, T. (1926). *Reptiles and Amphibians-Their Habits and Adaptations*. Houghton Mifflin Co., New York.

Procedure / Process of Teaching –

- Lecture
- Power point presentations
- Flipped class – videos of topics to be sent day before and only discussion to be held in the class.
- Peer learning – topics divided among student groups – each group to teach the rest of the students their assigned topic.

Procedure/ Process of Assessment –

- Seminars
- Quiz in groups
- Quiz individually

ZOOLOGY [CORE COURSE] PRACTICAL – I: ANIMAL DIVERSITY

Code: ZOL4B05P

[144 hours] [2 hrs per week] [Spread over first 4 semesters] [4 Credits]

COURSE OUTCOMES [COs]

COs	Course Outcome Statements
CO1	Identify and describe specified protists and acoelomate & pseudocoelomate non-chordates and perform the culture of selected protists; understand the histological features of coelenterate, platyhelminth and nematode. (36 hrs)
CO2	Identify and describe specified coelomate non-chordates and the transverse sections of annelids; Perform mounting of the specified organs of selected non-chordates. (36 hrs)
CO3	Identify and describe specified chordates and specified bones of chordates; Prepare key for identification of venomous snakes; Perform mounting and dissection of specified organ systems of chordates. (36 hrs)
CO4	Identify and describe selected vertebrates and specified bones of vertebrates.(36 hrs)

Course Outcomes

1. Students are expected to identify the specimens by their generic names and assign them to the respective phyla and classes.
2. Students should be able to identify slides or specimens related to transverse sections and osteology of the different animal groups.

1. **Prepare a Local Biodiversity Record**:
    a. Observe water samples from the locality for live protists and make a field note;
    b. Observe fishes/amphibians or any other vertebrate group (any one group) of the locality in their natural habitat and prepare a field note.
    c. Observe birds/mammals (any one group) of the locality in their natural habitat and prepare a field note.
3. Students should be able to mount the given specimens and display it.
4. Dissect and display neatly the specimens provided.

MODULE 1. [36 hrs]

MODULE 2. [36 hrs]

MODULE 3. [36 hrs]

MODULE 4. [36 hrs]

Process of teaching –

Show specimens, charts or pictures of the organisms.

Demonstration of culture methods of Protists[*Amoeba*/ *Euglena*/ *Paramecium*].

Demonstrate mounting of specimens mentioned in the syllabus

Demonstrate the dissection of the specimens mentioned in the syllabus.

Process of Assessment –

Quiz – show the specimen and student identifies it – writes its classification – gives its salient features

The student has to mount of given specimen.

The student has to dissect and display the given specimen.

FIFTH SEMESTER B.Sc. ZOOLOGY PROGRAMME

CELL BIOLOGY AND GENETICS

Code: ZOL5B06T

[54 hours] [3 hours per week] [4 Credits]

COURSE OUTCOMES (COs)

Course outcome Statements
Enumerate allelic and non-allelic gene interactions; supplementary, complementary, polymeric, duplicate and modifying genes and polygenic inheritance (5 hrs).
Illustrate multiple allelism and solve problems related to blood group inheritance (4 hrs).
Explain characteristics of linkage groups and linkage map; crossing over and calculation of recombination frequency; sex-linked, sex-influenced and sex-limited characters; sex differentiation and disorders of sexual development (8 hrs).
Describe the mechanisms of sex determination including chromosomal, genic, haploid-diploid mechanisms; the hormonal and environmental influence on sex determination and gynandromorphism (3 hrs).
Explain mutagenesis, mutagens and chromosomal and gene mutations (3 hrs).
Enumerate the classification and grouping of human chromosomes; numerical and mutational human autosomal and sex chromosomal anomalies; polygenic human traits and genetic counseling (4 hrs).

Section B: GENETICS (27 hrs)

MODULE 6. Interaction of genes (5 hrs)

Allelic interactions: incomplete dominance and co-dominance with examples. Non-allelic interactions: epistasis (inheritance of plumage colour in poultry), mention dominant and recessive epistasis. Supplementary genes (example: inheritance of comb pattern in poultry). Complementary genes, mention any one example. Polymeric genes, mention one example. Duplicate genes, mention one example. Modifying genes. Atavism, Penetrance and Expressivity. Polygenic (quantitative) inheritance (example: skin colour in man).

MODULE 7. Multiple alleles (4 hrs)

Definition and characteristics; example: coat colour in rabbits. Blood group genetics: ABO blood group system; MN blood group and Bombay phenotype. Inheritance of Rh factor; mention erythroblastosis foetalis. Problems related to blood group inheritance (5 problems). Isoalleles, mention any one example.

MODULE 8. Linkage and Recombination (8 hrs)

Definition and characteristics of linkage groups, Morgan's work on *Drosophila.* Types of linkage: complete and incomplete - examples*;* Linkage groups.

Crossing over and recombination, Calculation of Recombination Frequency and Percentage; Linkage map, Map Distance; Mitotic Recombination (brief).

Sex-Linked Characteristics: Types of sex-linkage - X linked characters - Colour blindness and haemophilia in humans, holandric genes – hypertrichosis.

Dosage compensation – Barr body – Lyon hypothesis.

Sex-Influenced and Sex-Limited Characteristics.

Sex Differentiation: Testis-determining factor (TDF), Müllerian inhibition factor. Disorders of Sexual Development (short notes) - XX males and XY females, Point mutations in the *SRY* gene and testicular feminization.

MODULE 9. Sex determination (3 hrs)

Chromosomal mechanism of Sex-Determination: Male heterogametic and female heterogametic mechanism of sex determination. Genic Sex Determining Systems - Genic balance (ratio) theory of Bridges. Haploid-diploid mechanism of sex determination, honey bee as example.

Environmental Sex Determination: Example – *Bonellia,* Crocodile.

Hormonal influence on sex determination: Example - sex reversal in fowl and free martin in cattle; Gynandromorphism – types and causes. Intersex (brief).

MODULE 10. Mutations (3 hrs)

Chromosome mutations: numerical (euploidy and aneupoloidy) and structural changes (deletion, duplication, insertion, inversion, translocation).
Gene mutations: types- spontaneous, induced, somatic, gametic, forward and reverse. Types of point mutations- deletion, insertion, substitution, transversion and transition. Mutagenesis- Natural and artificial mutagenesis, Mutagenic agents: a) UV radiation and ionising radiation b) Base analogues, alkylating and intercalating agents.

MODULE 11. Human Genetics and Genetic counselling (4 hrs)

Classification and grouping of human chromosomes (Patau's scheme). Chromosomal anomalies and disorders: Autosomal - (Down's, Patau's, Edward's and Cri du Chat syndromes). Sex chromosomal - (Turner's and Klinefelter's syndromes). Gene mutations: Autosomal mutation - albinism, PKU, alkaptonuria, galactosemia, Tay-Sach's syndrome, Gaucher's disease, Sickle cell anaemia, thalassemia and brachydactyly. Sex chromosomal mutations: haemophilia, Lesch–Nyhan syndrome, dermal hypoplasia. Polygenic traits: cleft palate / lip, club foot and hydrocephaly. Eugenics, Euthenics and Euphenics.

Topics for assignments/seminars

1. Mendel’s experiments on pea plants

2. Mendel's laws of inheritance

REFERENCES

- Brooks, R. J. (2008): *Genetics: Analysis and Principles*.3rd Edition, ISBN-10: 0071287647, Irwin/McGraw-Hill, 844 pages
- Gardner, E. J., Michael J. Simmons and Peter Snustad (2006): *Principles of Genetics*. 8th Edition, ISBN-10: 8126510439, Wiley, 740 pages

Procedure / Process of Teaching –

Lecture

Power point presentations

Flipped class – videos of topics to be sent day before and only discussion to be held in the class.

Peer learning – topics divided among student groups – each group to teach the rest of the students their assigned topic.

Procedure/ Process of Assessment –

Seminars

Quiz in groups

Quiz individually

FIFTH SEMESTER

BIOTECHNOLOGY, MICROBIOLOGY AND IMMUNOLOGY

Code: ZOL5B07T

[72 hours] [4 hours per week] [4 Credits]

COURSE OUTCOMES (COs)

Course Outcome statements
Describe different types of immunity and the cells and organs of the immune system (6 hrs)
Explain antigen, antibody, immunity and major histocompatibility complex (9 hrs)
Enumerate autoimmune and immunodeficiency diseases and immunology of tumor and organ transplantation (9 hrs)

Section C: IMMUNOLOGY (24 hrs)

MODULE 7: Cells and organs of immune system (6 hrs)

Introduction **(1 hr)**

Immunity: Natural and acquired, active and passive, immunization, vaccines, mechanisms of innate immunity - barriers, inflammation, phagocytosis.

Cells of the immune system **(3 hrs)**

B- cells, T – cells, NK cells, monocytes, macrophages, neutrophils, basophils, eosinophils, mast cells, and dendritic cells (APCs).

Organs of the immune system **(2 hrs)**

Lymphoid organs: Primary (thymus, bone marrow) and secondary (lymph nodes, spleen).

MODULE 8: Antigens, antibodies, immunity and MHC (9 hrs)

Antigens **(3 hrs)**

Types, factors for immunogenecity, exogenous antigens, endogenous antigens,

adjuvant, haptens, epitopes, antigen-antibody reaction - precipitation reaction, agglutination reaction, agglutination inhibition reaction.

Immunoglobulins (2 hrs)

Structure, classification and biological functions. Mention immunoglobulin gene families – κ and λ light chain families and the heavy chain family.

Immunity (2 hrs)

Types of Immunity: humoral and cell mediated immunity, primary and secondary response, generation of cytotoxic T- cells (CTLs), NK cell mediated cytotoxicity, ADCC and cytokines (brief).

Major Histocompatability Complex (2 hr)

MHC, HLA, Class I MHC, Class II MHC molecules and structure. Mention Class III MHC.

MODULE 9: Autoimmune and Immunodeficiency diseases, Tumor and transplantation immunology (9 hrs)

Autoimmune diseases (2 hrs)

Auto immune diseases: Systemic (SLE, multiple sclerosis and rheumatoid arthritis). Organ specific-(Hashimoto's thyroiditis, Grave's disease, Myasthenia gravis)

Immunodeficiency disease (3 hrs)

Primary (Bruton's Disease, Di-George syndrome and SCID)

Secondary (AIDS) – Clinical course of HIV – acute infection, seroconversion, window period, chronic latent phase - lymph adenopathy and crisis phase. Mention anti-retroviral therapy (ART)

Tumor immunology (2 hrs)

Malignant transformation of cells, tumor antigens, immune response to tumor antigens.

Transplantation Immunology (2 hrs)

Transplantation Antigens, Various organ transplantation (liver, kidney, heart, skin), Xenotransplantation

Topics for assignments/seminars

1. Immunity and malnutrition

REFERENCES

Abul K. Abbas, Andrew H. Lichtman & Shiv Pillai (2017) *Cellular & Molecular Immunology* 8th Edtion, Paperback ISBN: 9780323479783, Elsevier, 608 pages

- Andrew E Williams (2011) *Immunology Mucosal and Body Surface Defenses*, Ist Edition, ISBN: 0470090049, Wiley and Blackwell, 398 pages

Procedure / Process of Teaching –

Lecture

Power point presentations

Flipped class – videos of topics to be sent day before and only discussion to be held in the class.

Peer learning – topics divided among student groups – each group to teach the rest of

the students their assigned topic.

Procedure/ Process of Assessment –

Seminars
Quiz in groups
Quiz individually

FIFTH SEMESTER

METHODOLOGY IN SCIENCE, BIOSTATISTICS AND BIOINFORMATICS

Code: ZOL5B09T

[54 hours] [3 hours per week] [4 Credits]

COURSE OUTCOMES (COs)

Course Outcome Statements
Explain science, its importance, disciplines and the major steps in formulating a hypothesis, various hypothesis models, theory, law and importance of animal models, simulations and virtual testing (6 hrs)
Illustrate the principles and procedures in designing experiments and elaborate the requirements for carrying out experiments (4 hrs)
Describe the ethical concerns in practicing science (5 hrs)
Perform DNA and protein sequence analysis, including sequence alignment and sequence similarity search using BLAST, FASTA, CLUSTAL W and CLUSTAL X (4 hrs)
Understand molecular phylogenetics and tools and methods for construction of phylogenetic trees (3 hrs)
Explain genome sequencing technologies, functional genomics, proteomic technologies and molecular docking and drug design (9 hrs)

Section A: METHODOLOGY IN SCIENCE (15 hrs)

MODULE 1. Science, Scientific Studies and Methods (6 hrs)

Science and Scientific Studies

Science as a human activity; scientific attitude; Empiricism; Science disciplines; Interdisciplinary approach.

Scientific Methods

Major steps: Observation, Defining the problem, Collection of information, Formulation of a hypothesis, Experimentation, Analysis of the results and Conclusion based on interpretation of the results.

Methods in scientific enquiry: Inductive and deductive reasoning.

Hypothesis: Formulation of a hypothesis, different thought processes in developing hypothesis (analogy, induction, deduction and intuition), hypothetico-deductive model, testing hypothesis, auxiliary hypothesis, adhoc hypothesis.

Theories and laws in science; peer review; importance of models, simulations and virtual testing (brief account).

MODULE 2. Experimentation (4 hrs)

Types of experiments; design of an experiment: principles and procedures; necessity of units and dimensions; repeatability and replications; documentation of

experiments; Planning of Experiments: design, selection of controls, observational and instrumental requirements; Test animals used in experiments.

MODULE 3. Ethics in Science and Animal Ethics (5 hrs)

Scientific information: Depositories of scientific information – primary, secondary and digital sources; Sharing of knowledge: transparency and honesty, Publications, Patents, Plagiarism.

Constitution of India Article 51A (g); Prevention of cruelty to animals Act of 1960 - Section 17.1(d), Committee for the purpose of control and supervision of experiments on animals (CPCSEA).

SECTION C: BIOINFORMATICS (24 hours)

MODULE 6. Introduction and Biological Databases (8 hrs)

Overview of bioinformatics, Scope and application of Bioinformatics.

Major Databases in Bioinformatics: Biological databases, Features of a good database. Classification format of biological databases.

Primary databases: Nucleotide sequence databases – Mention EMBL, DDBJ, Genbank; Protein sequence databases – Mention Swiss Prot, PIR, MIPS.

Structure databases: PDB, NDB.

Special databases – PROSITE, Pfam, CATH, OWL, PubMed.

Secondary databases: Mention PROSITE, PRINTS. Databases of patterns, motifs and profiles, EST databases, SNP databases.

Metabolite databases – Mention KEGG, EcoCyc.

*Database Search Engines***:** Entrez at NCBI of USA, SRS at EBI of England, STAG at DDBJ of Japan. Data retrieval with Entrez and SRS.

Sequence submission to NCBI.

MODULE 7. Sequence Analysis (4 hrs)

Web based and standalone tools for DNA and protein sequence analysis. Types of sequence alignment, methods of sequence alignment. Sequence similarity search – pair wise and multiple sequence alignments; BLAST, FASTA, CLUSTAL W, CLUSTAL X.

MODULE 8. Molecular Phylogenetics (3 hrs)

Basics of Phylogenetics; molecular evolution and molecular phylogenetics, cladistics and ontology. Gene Phylogeny versus species phylogeny. Phylogenetic tree construction methods and programmes. Forms of Tree representation.

MODULE 9. Genomics and Proteomics (9 hrs)

Genome sequencing technologies; Sanger capillary sequencing, Roche 454 (pyrosequencing), Illumina/Solexa, SOLiD System, Single molecule sequencing. Whole genome sequence assembly, annotation and analysis. Functional Genomics: Microarrays, SAGE, ESTs; Transcriptomics; Metabolomics. Metagenomics: Concept and applications.

Proteomics

Aims, strategies and challenges in proteomics. Brief account on proteomics

technologies: 2D-electrophoresis, iso-electric focusing, LC/MS-MS, MALDI-TOF mass spectrometry, yeast 2-hybrid system. Protein-protein interactions: experimental and computational methods; structural proteomics. Deriving function from sequence databases.

Cheminformatics

Molecular docking and drug design; Structural Bioinformatics in drug discovery

Topics for seminar/assignment

1. Findings that changed the course of science.
2. Viral genome database (ICTVdb, VirGen).
3. Bacterial Genomes database (Genomes OnLine Database –GOLD, Microbial Genome Database-MBGD).

REFERENCES

Module 1-3 (Methodology in Science)

- Gieryn, T. F.(1999) *Cultural Boundaries of Science*, ISBN 9780226292625, Chicago Press, 412.
- Ruxton, G. D. and Colegrave, N.(2016) *Experimental Design for the Life Sciences*, 4th Edition, ISBN 9780198717355, Oxford University Press, 224 pages

Module 6-9 (Bioinformatics)

- Anna Tramontano (2006): *Introduction to Bioinformatics*, ISBN-10: 1584885696, Chapman & Hall, 192 pages.
- Atwood and Parry-Smith (1999): *Introduction to Bioinformatics*. ISBN 9780582327887, Pearson Education Asia, New Delhi, 218 pages

Procedure / Process of Teaching –

Lecture
Power point presentations
Flipped class – videos of topics to be sent day before and only discussion to be held in the class.
Peer learning – topics divided among student groups – each group to teach the rest of the students their assigned topic.

Procedure/ Process of Assessment –

Seminars
Quiz in groups
Quiz individually

FIFTH SEMESTER

REPRODUCTIVE HEALTH AND SEX EDUCATION

Code: ZOL5D01T

[54 hours] [3 hours per week] [3 credits]

COURSE OUTCOMES [COs]

Course Outcome Statements
Describe the structural and functional features of human reproductive system, fertilization, implantation, pregnancy, gestation, placenta, parturition and lactation. (17 hrs)

Understand the ethical aspects of sex (2 hrs)

MODULE 3. Human Reproduction (17 hrs)

Male reproductive system: Structure of testis, male accessory organs; Semen production and composition; ejaculation. Spermatogenesis.

Female reproductive system: Structure of human ovary; development of primary follicle; structure of graafian follicle; fallopian tubes; uterus; external genitalia; mammary glands. Ogenesis.

Menstrual cycle and hormonal control; brief account of fertilization, implantation, pregnancy, gestation, placenta, parturition and lactation (Brief account on hormonal control of lactation).

MODULE 9. Ethical aspects of sex (2 hrs)

Healthy relationship with opposite sex, role of counseling, gender discrimination in family and society.

Topics for Assignments/Seminars

1. Sexual counseling
2. Marriage counseling
3. Functions of male and female hormones
4. Hormones of pregnancy

REFERENCES

- Brian Walker Nicki R Colledge Stuart Ralston and Ian Penman (2014): *Davidson's Principles and Practice of Medicine*, 22nd edition; eBook ISBN: 9780702052248,Elsevier
- John Hall (2015): *Textbook of Medical Physiology; 13th Edition,* ISBN: 9781455770052, Elsevier Health, 1168 pages

SIXTH SEMESTER

PHYSIOLOGY AND ENDOCRINOLOGY

Code: ZOL6B10T

[54 hrs] [3 hours per week] [3 credits]

COURSE OUTCOMES [COs]

Course Outcomes Statements
Describe the regulation of digestion in man, nutrition in pregnancy and infancy, nutritional disorders, balanced diet, starvation, fasting and obesity. (5 hrs)
Understand the mechanism of transport and exchange of respiratory gases and its neurophysiological control and physiological problems in diving mammals, new-born and aged individuals. (6 hrs)
Describe functions, composition, coagulation, transfusion, agglutination and clinical analysis of blood, haemoglobinopathies, types of heart and common cardio-vascular problems. (6 hrs)
Understand the osmoregulatory mechanisms in animals; excretion and its hormonal control and common renal disorders in man. (6 hrs)
Explain the ultrastructure of skeletal muscles and biochemical events and energetics of muscle contraction. (5 hrs)

Understand the different types of nerve cells, glial cells and nerve fibres, and the mechanism of nerve impulse transmission (6 hrs)
Understand the types, physiology and significance of bioluminescence, and the structure and functions of electric organs. (2 hrs)
Describe invertebrate neuro-endocrine organs and hormones, vertebrate endocrine glands, their hormones and functions (12 hrs)
Understand the concept of neurosecretion and the mode of action of peptide and steroid hormones. (6 hrs)

Section A: PHYSIOLOGY (36 hours)

MODULE 1. Nutrition (5 hrs)

Regulation of digestive activity: Nervous and hormonal control; Ruminant digestion; Nutrition in pregnancy, infant nutrition, breast feeding, composition of breast milk; Importance of dietary fibres; Balanced diet; Nutritional disorders: anorexia, acidity, ulcer, flatulence; starvation, fasting and its significance; Obesity: causes and consequences.

MODULE 2. Respiration (6 hrs)

Gaseous exchange and transport of respiratory gases (brief account), Oxygen-Haemoglobin dissociation curve; Respiratory pigments, structure and properties of Hb; Neurophysiological control of respiration; Physiological problems in diving mammals, new-born and aged individuals.

MODULE 3. Circulation (6 hrs)

Blood: functions and composition; Coagulation of blood (Enzyme cascade theory); Clinical analysis of blood, ESR; Haemodynamics; Haemostasis, haemolysis and jaundice, haemoglobinopathies; Blood transfusion and agglutination, aphaeresis.

Types of heart; ECG; Common cardio-vascular problems: Abnormal variations in BP, Tachycardia, Bradycardia, Myocardial infarction, heart failure, cerebral hemorrhage and cerebro-vascular accident.

MODULE 4. Osmoregulation and Excretion (6 hrs)

Osmoconformers and osmoregulators; Water conservation in desert forms; Osmotic and ionic regulation in terrestrial, fresh water and marine animals; Types of excretion, urea cycle; Human kidney: Urine formation with counter-current mechanism and hormonal regulation; Common renal disorders: haematuria, uremia, proteinuria, renal hypertension, nephritis, renal calculi, oedema, acidosis and alkalosis; Dialysis.

MODULE 5. Muscle Physiology (5 hrs)

Structure of vertebrate skeletal muscle: EM structure of Myofibrils and Myofilaments, contractile proteins; Mechanism of muscle contraction: Ultra structural changes (sliding filament theory); physiology, biochemistry and energetics of muscle contraction; energy sources, role of creatine phosphate, cori cycle; Muscle twitch, fatigue, tetany and rigor mortis.

MODULE 6. Nerve Physiology (6 hrs)

Different types of nerve cells; glial cells, giant nerve fibre of crustaceans and cephalopods; regeneration of medullary fibres, neurotrophins; Nerve impulse transmission, synapses and neuromuscular junctions, synaptic transmission

(electrical and chemical), neurotransmitters.

MODULE 7. Bioluminescence and Bioelectricity (2 hrs)

Classification of bioluminescence: symbiotic, extracellular and intracellular; Physiology and significance of light production; Structure and functions of electric organs.

Section B: ENDOCRINOLOGY (18 hrs)

MODULE 8. Invertebrate and Vertebrate endocrinology (12 hrs)

Neuro- endocrine organs and hormones in crustaceans and insects.

Classification of hormones: Amine, peptide and steroid hormones; Endocrine glands in man (hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenal, thymus, pineal and gastro-intestinal): their hormones and functions (brief account); Hormonal disorders.

Hormones of reproduction: Testes, ovaries and placenta, their hormones and physiological effects; role of hormones in female sexual cycle; hormone related female and male sexual dysfunctions.

MODULE 9. Concept of neurosecretion and hormonal action (6 hrs)

Hypothalamus-hypophysial interactions, hypothalamus releasing and inhibiting hormones and their roles, Neuro-hormonal integration, Neuro-endocrine pathways, Regulation of hormone secretion.

Hormonal action :Hormone receptors; Mechanism of action of peptide and steroid hormones; mode of action of insulin and thyroxine; positive and negative feedback regulation.

Topics for assignments/seminars

1. History, aim, scope and branches of Physiology.
2. Absorption of carbohydrates, proteins, and lipids.
3. Conducting system of the heart.
4. Composition and functions of lymph.
5. Gross and micro structure of human kidney.
6. Endocrine disorders in man : Cushing's disease, Addison's disease, diabetes mellitus, diabetes insipidus, dwarfism, gigantism, cretinism, myxedema and goitre.

REFERENCES

- Arthur Vander, James Sherman and Dorothy Luciano (1998) Human Physiology: The Mechanisms of Body Function, ISBN-10: 9780070670655, William C. Brown Pub., 818 pages
- Berry, A.K (2008): *A Text book of Animal Physiology*, 12th Edition, ISBN 10 8185712034, Emkay Publications, 686 pages
- Chatterjee, C.C (2016): *Human Physiology*, 11th Edition, ISBN-10 8123928726 Medical Allied Agency.

SIXTH SEMESTER

REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

Code: ZOL6B11T

[54 hrs] [3 hours per week] [3 credits]

COURSE OUTCOMES [COs]

1. Explain teratogenesis, identify teratogens.

Teratology (2 hrs)

Environmental disruption in animal development: Teratogenic agents and their effects (alcohol, drugs, nicotine and other chemicals), infections (Herpes virus, Cytomegalovirus and Rubella virus), metabolic imbalance (malnutrition and autoimmunization) (brief account).

REFERENCES

- Balinsky, B.I. (1981*) An Introduction to Embryology*, 5th Edition, *Embryology*, ISBN-4833700298 (International ed.), Saunders College Pub., 768 pages
- Berril N. J. (1971)*Developmental Biology*, ISBN 10: 0070050201, McGraw Hill

SIXTH SEMESTER B.Sc. ZOOLOGY PROGRAMME

ZOOLOGY CORE COURSE –XI [Theory]

ENVIRONMENTAL AND CONSERVATION BIOLOGY

Code: ZOL6B12T

[54 hrs] [3 hours per week] [3 credits]

COURSE OUTCOMES [COs]

Course outcome statements
Enumerate the several tools and techniques employed for studies on populations, communities and ecosystems. (4 hrs)

MODULE 6. Ecological tools and Techniques (4 hrs)

Commonly used techniques for study of animal populations: a) Sampling of animal populations b) Trapping and collecting various groups of organisms [insects, aquatic organisms, soil organisms, birds and mammals] c) Marking of animals d) Determination of age in animal groups d) Determination of home range and territory e) Estimation of number of animals in a population f) Indirect method of estimating wild animal populations g) Recent trends- Camera trapping, Radio collaring and Remote sensing

REFERENCES

- Agarwal, K.C. (2008) *Environmental Biology*, Nidi Publishers, Bikaner.Hardcover: 552 pages, ISBN-13: 978-8189153021
- Arora, S. (1995).*Fundamentals of Environmental Biology*, Kalyani Publ.,New Delhi.
- Balachandran Thampi, K. *et al*.: *The Natural Resources of Kerala*. 1997, WWF for Nature - India, [Kerala State Office], Trivandrum.

SIXTH SEMESTER

ETHOLOGY, EVOLUTION AND ZOOGEOGRAPHY

Code: ZOL6B13T

[54 hrs] [3 hours per week] [3 credits]

COURSE OUTCOMES [COs]

Course Outcome Statements
Identify major evolutionary transitions over time, and explain the tools and evidences that support current hypotheses of the history of life on earth (8 hrs)
Describe the evidences for evolution and its required corollaries (5 hrs)
Explain the various theories of evolution (6 hrs)
Describe the mechanisms by which evolution occurs (5 hrs)
Recognize the significance of reproductive isolation in reducing gene flow between populations, biological and morphological species concepts and distinguish between prezygotic and postzygotic barriers to reproduction (7 hrs)
Review the events in human evolution (3 hrs)

Section B: EVOLUTION (34 hrs)

MODULE 3. Course of Evolution (8 hrs)

History of Evolutionary thought **(1 hr)**

History of evolutionary thought: Ideas of evolution during Pre-Darwinian, Darwinian and Post- Darwinian periods (brief account).

Origin of life (6 hrs)

Biochemical origin of life (Modern hypothesis–Oparin-Haldane Theory). Major steps in the biochemical evolution of life (brief account): Origin of Earth and the primordial atmosphere, formation of simple organic molecules, formation of macromolecules or polymers, and formation of coacervates, microspheres, protocells and full-fledged living cells; origin of mitochondria and chloroplast. Experimental evidence for biochemical origin of life: Urey-Miller experiment; Other experiments; Modern ideas on the origin of life. Mention origin of prokaryotes and eukaryotes.

History of Life on Earth (1 hrs)

Geological time scale (simple chart), mention Cambrian explosion. Fossils, Fossilization and Dating of fossils (brief account). Living fossils: *Peripatus*, *Limulus* and *Sphenodon* as examples.

MODULE 4. Evidences of Organic Evolution (5 hrs)

i) Morphological and anatomical, ii) physiological and biochemical, iii) embryological, iv) palaeontological, v) molecular, vi) taxonomical evidences and vii) biogeographical evidences

MODULE 5. Theories of Evolution (6 hrs)

Lamarck's theory: Explanation of the major postulates of the Lamarck's theory with examples, Criticism against Lamarckism, Neo-Lamarckism, Present status of Lamarckism.

Darwin's theory: Explanation of important postulates of Darwin's theory, Examples for natural selection, Criticism against Darwinism, Neo-Darwinism (Synthetic theory of evolution).

Weismann's germplasm theory; Mutation theory of De Vries. Mention the contributions of Wallace.

MODULE 6. Concepts of Evolutionary Process (5 hrs)

Genetic basis of evolution: i) Mutations (brief account of gene and chromosomal mutations), ii) Variations: somatic (environmental) variations and genetic (hereditary) variations, iii) Hardy-Weinberg Principle: Hardy-Weinberg Equilibrium, Factors that upset Hardy-Weinberg Equilibrium, iv) Genetic drift: effects on population, Evolutionary bottleneck and Founder effect, genetic drift and natural selection, importance of genetic drift in evolution; theory of punctuated equilibrium and its relevance.

MODULE 7: Nature of Evolution (7 hrs)

Species and Speciation: Species concept: phylogenetic and biological species concepts; General characteristics and subdivisions of species: subspecies, semi species, sibling species, cline and deme.

Speciation: Types of speciation i) Phyletic speciation ii) Quantum speciation iii) Gradual speciation; Major methods of natural speciation: Allopatric, parapatric and sympatric speciation.

Isolation and Isolating mechanisms: Types of isolating mechanisms i) Geographic isolation: mention examples, ii) Reproductive isolation (a) Prezygotic isolation (habitat, seasonal, ethological, morphological, physiological and cytological isolation with examples), (b) Postzygotic isolation (hybrid inviability, hybrid sterility and F2 breakdown isolation with examples).

Adaptive Radiation (Divergent Evolution): cause and significance, adaptive radiation in Darwin's finches; Convergent Evolution; Pre-adaptation; Co-evolution (mention examples also).

MODULE 8: Evolution of Modern Man (3 hrs)

Evolutionary trends in humans; Fore-runners of anthropoids-*Parapithecus*; Fore-runners of apes-*Dryopithecus*; Fore-runners of modern man-*Ramapithecus* (Kenyapithecus), *Australopithecus* (The ape-man), *Homo habilis* (The handy man), *H.erectus* (Pithecanthropines), *H.sapiens neanderthalensis* (Neanderthal man), *Homo sapiens fossilis* (The Cro-magnon), *Homo sapiens sapiens* (Modern man), mention Denizoans and Malapan man.

Topics for Assignments / Seminars

1. Old theories on origin of life: i) Theory of abiogenesis ii) Theory of biogenesis iii) Theory of special creation iv) Theory of Panspermia.
2. Evolution of Vertebrate Groups: Evolution of agnathans, fishes, amphibians, reptiles, birds and mammals (brief account).
3. Evolution of horse
4. Polypliody and Evolution
5. Ancestry of human population of India

REFERENCES

- Brian K. Hall & Benedikt Hallgrimsson. 2014. *Strickberger's Evolution.* 5th Edition. ISBN: 9789380853789, 9380853785. Publisher: Viva. 672 pages.
- Darlington P J 1966. Zoogeography: The Geographical Distribution of Animals. Fourth Edition. John Wiley & Sons, Inc. 675 pages.
- Jain P C & M.S. Anantharaman. *Palaeontology (Palaeobiology): Evolution and Animal distribution*. 9th Edition. ISBN-10: 9382956441; Vishal Publishing Co.

SIXTH SEMESTER

AQUACULTURE, ANIMAL HUSBANDRY AND POULTRY SCIENCE

Code: ZOL6B14BE02T

[54 hours] [3 hours per week] [3 Credits]

COURSE OUTCOMES [COs]

Course Outcome Statements
Enumerate the poultry rearing techniques and understand major breeds of fowl (7 hrs)
Understand the major breeds of cattle, cattle feeds and diseases of cattle (6 hrs)
Illustrate the steps in dairy processing and identify the role of dairy development in rural economy (5 hrs).

MODULE 4. Poultry science (7 hrs)

i. Egg production, cable bird production, nutritive value and bye products.
ii. Breeds of fowl – Exotic –Rhode Island Reds, Plymouth Rock, Naked Neck and Leghorn; Indigenous – Gramapriya, Giriraja and Kalinga Brown.
iii. Poultry rearing: Selection of eggs, hatching, incubation, brooding, sexing and vaccination.
iv. Poultry housing: Free range system, Semi-intensive system (deep litter system and individual cage system).
v. Equipments for feeding: Nutrients for starting, growing, laying hen.
vi. Common poultry feeds, food rations and feed formulation.
vii. Common diseases of poultry (Ranikket, Pullorum and Fowl pox)

MODULE 5. Animal husbandry (6 hrs) Introduction: History, origin, domestication.

Breeds of cattle:

Dairy breeds: Sindhi, Gir
Draught breeds of cattle: Nagori, Kangayam
Dual purpose breeds: Ongole, Hariana
Exotic breeds: Jersey, Holstein – Friesian
Native breeds: Conservation programmes, Vechur cow and Kasargod Dwarf

Feeding: Common cattle feeds, fodder Common diseases: Anthrax, Foot & Mouth disease. Parasites of cattle

Meat hygiene: Slaughter and clean meat production – Zoonotic diseases.

MODULE 6. Dairy science (5 hrs)

i. Role of dairy development in rural economy, employment opportunities, white revolution.
ii. Dairy processes: Straining, Filtration, Cooling, Chilling, Clarification, Pasteurisation, Freezing, Recombined milk, Soft curd milk, Skimmed and toned milk.
iii. Artificial milk, Milk adulteration.

Topics for Assignments/Seminars

1. Dairy products, manufacture and nutritive value.
2. Milk and milk spoilage.

REFERENCES

- Ashok Kumar Rathoure, Dinesh Kumar, Nazneen Z. and Deshmukh (2015): *Applied and Economic Zoology*; Daya Publishing House. 326 pages.
- Banerji, G.C (1986): *Poultry 3rd Edn.* , Oxford & IBH.148 pages.
- Banerji, G.C. (1998): *A text book of Animal husbandry 8th Edn.*, Oxford & IBH.1096 pages.

ZOOLOGY [CORE COURSE] PRACTICAL – III

Cod: ZOL6B16P

[Practical III*A + Practical III*B] [4 Credits]

PRACTICAL III*A: PHYSIOLOGY, ENDOCRINOLOGY, REPRODUCTIVE AND DEVELPOMENTAL BIOLOGY [72 hours] [4 hrs /week]

PRACTICAL III*B: ENVIRONMENTAL AND CONSERVATION BIOLOGY, ETHOLOGY, EVOLUTION, ZOOGEOGRAPHY & ELECTIVE COURSE [72 hours] [4 hrs/week]

COURSE OUTCOMES [COs]

COs	Course Outcome Statements
CO1	Perform standard laboratory experiments for the estimation of Hb, presence of hCG/abnormal constituents in urine, detection of blood pressure, bleeding and clotting time and identification of formed elements in blood (46 hrs)
CO2	Identify selected stages in the development of frog and chick and chosen larval forms of invertebrates and vertebrates (26 hrs)
CO3	Carry out experiments of laboratory standards to estimate water quality parameters including, dissolved Oxygen, Carbon dioxide, hardness and pH; determination of adulteration of selected food items and identify marine planktons and soil organisms (28 hrs)
CO4	Demonstrate the behavioural response of earthworm/dipteran larva to selected stimuli (11 hrs)
CO5	Describe homologous , analogous and vestigial organs, connecting links, adaptive radiation and evolution of man (11 hrs)
CO6	Illustrate zoogeographical realms, Wallace line, Weber line, Wallacea and the distribution of *Peripatus*, lung fishes, *Sphenodon*, monotremes and marsupials (11 hrs)
CO7	Identify the normal and selected abnormal human karyotypes and inheritance of chosen traits from pedigree charts, ornamental and other culture fishes and chosen beneficial and harmful insects (11 hrs)

PHYSIOLOGY, ENDOCRINOLOGY, REPRODUCTIVE AND DEVELPOMENTAL BIOLOGY

[72 hours] [4 hrs/week]

Section A. PHYSIOLOGY AND ENDOCRINOLOGY (46 hrs)

1. Detection of Abnormal constituents of urine [glucose, ketone bodies and albumin] (Major).
2. Preparation human bloodsmear to study the formed elements (Major).
3. Osmotic response of RBC to saline solutions of different concentrations (Minor).
4. Determination of Hb content in man using Haemoglobinometer (Minor)
5. Determination blood clotting time (Demonstration).
6. Determination of blood pressure (Demonstration).
7. Determination of Body mass index (individuals).
8. Study of the histology of the following endocrine glands - pituitary, thyroid, adrenal and endocrine pancreas using slides/photographs.
9. Detection of pregnancy using standard kits (Demonstration).

Section B. REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY (26 hrs)

1. Demonstration of chick blastoderm.
2. Induced ovulation in fish.
3. Study of life cycle in *Drosophila.*
4. Spotters:
   - Types of eggs (Insect, Amphioxus, frog, chick, and human).
   - Cleavage in frog (use slides / diagrams/models).
   - Shark: Yolk sac placenta.
   - Development of Frog: Blastula, gastrula, neurula.
   - Development of Chick: 18, 24, 32, 48 hours of incubation.
   - Mammal: Any two mammalian embryos.
   - Larval forms of invertebrates (any five) and vertebrates (any two).

REFERENCES

- F. S. Billet and A. E. Wild: Practical studies of animal development, ISBN: 9789401168861, Springer
- George Van Ness Dearborn (2016): A Text-Book of Human Physiology, Theoretic and Practical, ISBN-10: 1373146265, Wentworth Press, 572 pages
- G.K. Pal and Parvathy Pal (2016): Text book of practical physiology, 4th Edition, ISBN-10: 8173719969, Orient blackswan
- V.P. Varshney , Mona Bedi (2018): Ghai's Textbook of Practical Physiology, 9th Edition, ISBN-10: 9352705327, Jaypee Brothers, 376 pages

PRACTICAL III*B

ENVIRONMENTAL AND CONSERVATION BIOLOGY, ETHOLOGY,EVOLUTION, ZOOGEOGRAPHY & ELECTIVE [HUMAN GENETICS/AQUACULTURE, ANIMAL HUSBANDRY & POULTRY SCIENCE/APPLIED ENTOMOLOGY]

[72 hrs] [4hrs/week]

Section A: ENVIRONMENTAL AND CONSERVATION BIOLOGY (28 hrs)

1. Estimation of dissolved O_2 in water sample using Winkler's method (Major).
2. Estimation of dissolved CO_2 in pond and tap water (Major).
3. Estimation of total hardness of water (Major).
4. Determination of pH using pH paper / digital pH meter (Minor).
5. Extraction of soil organism by hand picking, floatation and Berlese funnel method (Minor).
6. Study of marine planktons (any five items up to genus level) (Minor).
7. Study of a pond ecosystem and preparation of food chains and food web (Minor).
8. Detection of food adulteration in selected food items (Minor).
   i) Detection of starch and urea in milk.
   ii) Detection of tea adulterated by colouring.
   iii) Detection of maida and chalk powder in wheat flour.

Section B: ETHOLOGY, EVOLUTION & ZOOGEOGRAPHY (33 hrs)

Ethology (Any three) **(11 hrs)**

1. Demonstration of the effect of alarm pheromones in ants.
2. Demonstration of phototaxis using Earth worm.
3. Study of Chaemotaxis in third instar larvae of Drosophila melanogaster to odours [Fructose, Yeast and Ethyl acetate].
4. Locomotory behaviour of dipteran larvae (Housefly/blowfly/fruitfly): on different types of substrata (writing paper, plastic sheet and sand paper].
5. Effects of light intensity and light quality on the rate of locomotion of dipteran larva.

Evolution **(11 hrs)**

Study of models, charts and specimens related to comparative study of:

1. Study of homologous organs (limbs of 5 different groups of vertebrates).
2. Study of analogous organs (wings of bird, insect and bat).
3. Study of any four vestigial organs in humans.
4. Study of evolution of man based on three hominid fossils.
5. Study of connecting links (*Peripatus* and *Archeopteryx*).
6. Study of adaptive radiation in feet of birds / mouth parts of insects.

Zoogeography **(11 hrs)**

1. Preparation of world map to show six zoogeographical realms.
2. Preparation of world map to show islands of zoogeographical significance.
3. Preparation of world map to show Wallace line, Weber line and Wallacea.
4. Locate the distribution of following animals in the world map: *Peripatus*, lung fishes, *Sphenodon*, monotremes, marsupials

Section C: ELECTIVE COURSE [11 hrs]
[Human Genetics/Aquaculture, Animal Husbandry & Poultry Science/Applied Entomology]

HUMAN GENETICS

1. Problems on (a) autosomal dominant and recessive (b) polygenic traits (skin colour), (c) Sex linkage (X-linked genes and Y-linked genes).
2. Study of identical and fraternal twins.
3. Dermatoglyphics: Identification of arch, loop and whorl patterns; total ridge count in male and female; Tri- radii, importance of atd angle, simian line.
4. Ischiara chart (to detect red-green colour blindness).
5. Seminars on genetics in cardiology, oncology and genetic counselling, Pre-natal sexing, amniocentesis, importance of genetic screening.
6. Pedigree studies and identification of the nature of inheritance from pedigree chart (any one trait).
7. Identification of human karyotypes (Edwards and Patau's) from ideogram

AQUACULTURE, ANIMAL HUSBANDRY AND POULTRY SCIENCE

1. Culture of fish food organisms: protozoans, rotifers and crustaceans.
2. Maintenance of spawn and its transportation to hatching or rearing tanks.

3. Identification of major food fishes (fresh water, estuarine and marine – 5 from each group).
4. Study of different crafts and gears.
5. Study of common ornamental fishes (record any seven with photograph).
6. Breeding techniques: preparation of hormone extracts and injection of hormones to fishes; Eyestalk ablation in prawns.
7. Study of fish products and by-products.
8. Identification of larval forms of prawn, pearl oyster, mussel, lobster and crab.
9. Identification of major edible crustaceans and molluscs.
10. Identification of edible sea weeds.

Process of teaching –

Show specimens, charts or pictures of the organisms.

Demonstration of various experiments as prescribed in the syllabus.

Process of Assessment –

Quiz – show the specimen and student identifies it – writes its classification – gives its salient features

The student has to mount of given specimen.

The student has to dissect and display the given specimen.

UNIVERSITY OF CALICUT

B.Sc. ZOOLOGY PROGRAMME

[CBCSS UG 2019]

Lesson Plan

Dr. Tessy K.L

ODD SEMESTERS

FIRST SEMESTER: ANIMALDIVERSITY: NON-CHORDATA PART- I,

Code: ZOL1B01T

Section A. CONCEPTS OF CLASSIFICATION OF ORGANISMS

MODULE 1. Principles of classification and nomenclature (5 hrs)

Systematics: natural and classical. Nomenclature: Binomial and Trinomial nomenclature; International rules of Zoological nomenclature (brief account); Mention modern trends in systematics: Chemotaxonomy, Serotaxonomy, Cytotaxonomy, Evolutionary taxonomy, Numerical taxonomy (Phenetics), Cladistics (Phylogenetics), Molecular systematics, DNA barcoding.

MODULE 2. Five kingdom classification of living organisms (1 hr)

Mention Cavalier-smith's eight kingdom classification also.

MODULE 3. Concepts of classification of animals (4 hrs)

Classification based on number of cells, tissue or organ system level of organization, development of germ layers, development of symmetry, development of coelom, segmentation, homology and analogy of organs and their origin, development of mouth and digestive tract (brief account).

Section B. CLASSIFICATION OF KINGDOM PROTISTA

MODULE 4. Kingdom: PROTISTA (6 hrs)

Characteristic features and classification of Kingdom Protista down to phyla. [*Salient features of the major groups of protists given below with notes on the examples cited*]

Phylum: Rhizopoda	e.g.*Entamoeba*
Phylum: Dinoflagellata	e.g.*Noctiluca*
Phylum:Parabasilia	e.g.*Trichonympha*
Phylum: Apicomplexa [=Sporozoa]	e.g. *Plasmodium*
Phylum: Ciliophora	e.g.*Vorticella.*

Type ***Paramecium***: Morphology and structural organization [as revealed by compound microscopy]; locomotion, nutrition, excretion, osmoregulation and reproduction; conjugation in detail.

Section C. KINGDOM: ANIMALIA

Salient features of the Major Phyla of animals and their diversity.

[*Habits, habitat,morphology, functional anatomy and life history of representative types (wherever specified) and classification of each phylum down to classes, except otherwise mentioned, and examples thereof: Study of animal diversity with typical examples from each class, with emphasis on ecological and adaptive features, economic importance and such other points of biological interest expected. Only very brief account of each example is to be studied.*]

MODULE 5. Subkingdom: MESOZOA (1 hr)

A brief account of Dicyemid (=Rhombozoans) mesozoans [e.g. *Dicyema*] and Orthonectid mesozoans [e.g. *Rhopalura*]

MODULE 6. Subkingdom: PARAZOA (3 hrs)

Phylum: PORIFERA

Classification down to classes and salient features of each class.

Class Calcarea (=Calcispongiae)	e.g.*Leucosolenia*
Class Demospongiae	e.g.*Spongilla*
Class Hexactinellida (=Hyalospongiae)	e.g.*Euplectella*

Give an account of canal system (Asconoid, Syconoid, Leuconoid and Rhagonoid); Mention amphiblastula, parenchymula and sponge gemmule.

COURSE OUTCOMES (COs)

Describe the principles of classification and nomenclature (5 hrs)
Explain the five kingdom classification of living organisms (1 hr)
Understand the concepts of classification of animals (4 hrs)
Explain the classification with examples and characteristic features of kingdom Protista and describe the morphology and structural organization of Paramecium
(6 hrs)
Describe the characteristic features of subkingdom Mesozoa (1 hr)
Explain the classification of phylum Porifera and elucidate the salient features of each class (3 hrs)
Describe the characteristic features of phylum Cnidaria and Ctenophora, illustrate the classification of phylum Cnidaria down to classes and explain the structural organization of Obelia (8 hrs)

REFERENCES

- Anderson, D. T. (2001). *Invertebrate Zoology*. 2nd edition. University of Michigan, Oxford University Press (Indian Edition. 2006).
- Barnes, R.D. (1982). *Invertebrate Zoology*, 5th Edition. Holt Saunders International Edition.

THIRD SEMESTER: ANIMAL DIVERSITY: CHORDATA PART – I, CODE: ZOL3B03T

MODULE 1. Introduction [**2 hrs**]

Chordate characters (fundamental, general and advanced); chordates versus non-chordates; diversity of chordates; outline classification down to classes; salient features of each subphylum.

MODULE 2.Subphylum UROCHORDATA [Tunicata] [**5 hrs**]

Classification of the subphylum down to classes. Affinities of urochordates with cephalochordates and vertebrates.

Class Ascidiacea	e.g. *Herdmania*
Class Larvacea	e.g. *Oikopleura*
Class Thaliacea	e.g. *Doliolum*

Type: ***Ascidia*** [Morphology and retrogressive metamorphosis]; add a note on neoteny and paedogenesis.

MODULE 3.Subphylum CEPHALOCHORDATA [**4 hrs**]

Type: ***Branchiostoma*** [=Amphioxus]

Morphology and anatomical features; digestive system in detail; primitive,degenerate and specialized features [affinities and systematic position to be emphasized).

MODULE 4. Subphylum VERTEBRATA [3 hrs]

Salient features of subphylum vertebrata and its outline classification down to classes.

Division 1. AGNATHA

Characters, classificationdown to classes and examples: *Myxine; Petromyzon* [mention Ammocoetes larva]

Division 2. GNATHOSTOMATA

MODULE 5. Superclass PISCES [12 hrs]

Classification of Pisces down to orders; salient features of the following extant groups:

Class Chondrichthyes [Cartilaginous fishes]

Subclass Selachii e.g.*Scoliodon, Trygon*

Subclass Holocephali e.g.*Chimaera*

Class Osteichthyes [Bony fishes]

Subclass **Sarcopterygii**

1. Order Crossopterygii [Coelacanths] e.g. *Latimeria*
2. Order Dipnoi [Lung fishes] e.g. *Neoceratodus, Protopterus, Lepidosiren* (Add a note on the distribution of lung fishes).

Subclass **Actinopterygii**

1. Superorder Chondrostei e.g. *Acipenser*
2. Superorder Holostei e.g. *Amia*, *Lepidosteus*
3. Superorder Teleostei [Spiny-rayed fishes] e.g. *Sardinella, Rastrelliger*

Type: ***Mugil cephalus*** (Grey Mullet)

[Morphology, body wall, digestive system, respiratory system, circulatory system, excretory system, sense organs (neuromast organ in detail) and reproductive system].

Sub-terranean fishes from Kerala: *Aenigmachanna Gollum* (Gollum Snakehead), *Kryptoglanis shajii, Horaglanis krishnai* (Blind Catfish) *& Monopterus digressus* (Blind cave eel). Mention recent addition to ornamental fish trade - *Sahyadria denisonii* (Miss Kerala).

Course Outcome -

Explain the characteristics of chordates and outline classification of the phylum Chordata (2 hrs)

Describe the salient features and affinities of subphylum Urochordata and its classification down to classes; elucidate the morphology and structural organization of Ascidia (5 hrs)

Explain the salient features and affinities of subphylum Cephalochordata with reference to Branchiostoma (4 hrs)

Describe the salient features of subphylum Vertebrata, illustrate its classification down to classes and elucidate the characteristics of division Agnatha (3 hrs)

Enumerate the salient features of superclass Pisces and illustrate its classification down to orders and the morphology and structural organization of Mugil cephalus (12 hrs)

REFERENCES

- Areste, M. & Cebrian, R. (2003). *Snakes of the World*. Sterling Publishing Company, New York.
- Barbour, T. (1926). *Reptiles and Amphibians-Their Habits and Adaptations*. Houghton Mifflin Co., New York.

FIFTH SEMESTER - BIOCHEMISTRY AND MOLECULAR BIOLOGY, **Code: ZOL5B08T**

MOLECULAR BIOLOGY (36 hrs)

MODULE 7. DNA Replication (4 hrs)

Semi-conservative and semi-discontinuous, priming of Okazaki fragments, primer removal and joining of Okazaki fragments, Meselson and Stahl experiment.

MODULE 8. Gene and genetic code (6 hrs)

Gene concept (2 hrs)

Classical and modern concepts, housekeeping and luxury genes. Gene action: gene expression and gene products; one gene one enzyme hypothesis; one gene one polypeptide hypothesis. Central dogma of molecular biology, reverse transcription and modified central dogma.

Genetic code (4 hrs)

Deciphering of genetic code, experiments of Nirenberg and Khorana, codon assignments, properties of the genetic code and wobble hypothesis.

MODULE 9. Transcription (7 hrs)

RNA polymerases of eukaryotes and prokaryotes; promoters, terminators, enhancers and silencers.

Transcription unit, mono and polycistronic transcription units; coupling of transcription with translation in bacteria.

Initiation, elongation and termination of transcription (brief account).

Post transcriptional modification of the primary transcript – hnRNA, capping, poly
(A) tailing and splicing (brief account), spliceosomes.

MODULE 10. Translation (7 hrs)

Activation of amino acids and aminoacyl tRNA synthetases; role of tRNA as adaptor molecules in translation. Role of ribosomes and active centres of ribosomes. Initiation, elongation and termination of translation.

Post translational modification of the peptide chain: cleavage, formation of disulfide-bridges, acetylation, glycosylation, myristoylation, sulphation, hydroxylation, prenylation, nitrosylation, ubiquitination and SUMOylation.

Protein folding and role of molecular chaperones; Protein targeting (brief account)

MODULE 11. Regulation of gene expression and organization of genome(8 hrs)

Regulation of gene expression (4 hrs)

Operon organization of bacterial transcription units; *trp* operon and its regulation. Regulatory RNAs – ncRNAs, miRNAs, piRNAs, siRNAs and RNA interference. Mention CRISPR–Cas9 and targeted genome editing.

Organization of genome (4 hrs)

Sequence components of eukaryotic genome – non-repetitive, moderately repetitive and highly repetitive DNA; satellite DNA. Mention selfish DNA. C-value and C-value paradox. Overlapping genes, pseudogenes, cryptic genes, transposons and retrotransposons. Human genome and human genome project (brief account). Mitochondrial and chloroplast genome (brief account).

MODULE 12. Genetics of bacteria and phages (4 hr)

Conjugation in bacteria. Transduction – generalized and specialized; sexduction. Structure and life cycle of a bacteriophage; temperate and virulent phages; lysogeny and lysis.

Course Outcomes

Describe the mechanism of DNA duplication and the role of enzymes (4 hrs).

Understand the concept of gene and gene expression; genetic code and wobble hypothesis (6 hrs).

Explain the mechanism of transcription and post-transcriptional modification of hnRNA (7 hrs).

Enumerate the processes of translation and post-translational modification and targeting of peptides (7 hrs).

Describe the regulation of trp operon, C-value, repetitive DNA, satellite DNA, selfish DNA, overlapping genes, pseudogenes, cryptic genes, transposons and retrotransposons (8 hrs).

Explain the structure and life cycle of bacteriophages and the gene transfer mechanisms in bacteria (4 hrs).

REFERENCES

Module 7-12 (Molecular Biology)

- Brooks, R. J. (2011): *Genetics: Analysis and Principles*.4th Edition, ISBN-10: 0073525286, Addison Wesley, McGraw-Hill Higher Education, 864 pages
- Bruce Alberts, Dennis Bray Karen Hopkin and Alexander D. Johnson (2013) Essential Cell Biology, 4th Edition, ISBN-10: 0853696470, Garland Publishing, 864 pages

FIFTH SEMESTER: METHODOLOGY IN SCIENCE, BIOSTATISTICS AND BIOINFORMATICS, **Code: ZOL5B09T**

Section B: BIOSTATISTICS (15 Hrs)

MODULE 4. Introduction (5 hrs)

Definition; scope; role of statistics in life sciences; terminology and variables. Sample and Sampling: Sample size, sampling errors, methods of sampling.

Collection/documentation of data of the experiments.

Classification of data; Presentation of data: Tabular, Graphical and Diagrammatic (histogram, frequency polygon and frequency curve; line diagram, bar diagram and pie diagram).

[Short answers/Paragraphs/Essays]

MODULE 5. Analysis and Interpretation of data (10 hrs)

Measures of central tendency: *(raw data, discrete series data, continuous series data- problems are to be discussed)*

a) Mean, b) Median and c) Mode.

Measures of Dispersion: *(raw data, discrete series data, continuous series data - problems to be discussed)*

a) Range, b) Mean deviation, c) Standard deviation, d) Standard error. Hypothesis testing and Interpretation of results: *(problems to be discussed)*

a)'t' test, b) F- test - ANOVA

Significance of statistical tools in data interpretation; Statistics-based acceptance or rejection of hypothesis.

Course Outcomes:

Understand the Scope and role of statistics; methods and procedures of sampling; Construction of tables, charts and graphs (5 hrs)

Calculate central tendency and measures of dispersion and application of its

knowledge on hypothesis testing as well as in problem solving (10 hrs)
Enumerate major biological databases and database search engines (8 hrs)

References

Module 4-5 (Biostatistics)

- Antonisamy B, Prasanna S. Premkumar and Solomon Christopher (2017) Principles and Practice of Biostatistics, ISBN-10: 8131248879, Elsevier, 390 pages
- Bailey, N. T. J (1995): *Statistical Methods in Biology*, 3rd Edition, CUP, 272 pages

FIFTH SEMESTER: REPRODUCTIVE HEALTH AND SEX EDUCATION, **Code: ZOL5D01T**

MODULE 1. Introduction (2 hrs)

Definition; Reproductive health - problems and strategies; reproductive rights; importance of sex education for teen and youth.

MODULE 4. Infertility and Assisted reproductive technologies (10 hrs)

Infertility: Causes and problems in male and female. Infertility management: semen collection, preservation and storage, artificial insemination, surrogacy. Cryopreservation and embryo transfer: Collection, care and preservation of embryos. *In vitro* fertilization (IVF) and embryo transfer: Major steps; Test tube babies. Assisted Reproductive Techniques (ART): GIFT, ZIFT, ICSI, oocyte donation and embryo donation.

MODULE 5. Prenatal Diagnosis (4 hrs)

Different methods: Ultrasonography, amniocentesis, chorionic villus sampling and alpha-foetoprotein estimation; female foeticide: ethical issues and laws (Mention– PNDT Act).

MODULE 6. Fertility Control (4 hrs)

Natural methods; artificial methods; chemical methods; hormonal methods; contraceptive devices; surgical contraception; abortion, legal termination of pregnancy.

MODULE 7. Sexually transmitted infectious diseases (7 hrs)

Symptoms, mode of transmission, diagnosis, treatment and prophylaxis of AIDS, syphilis, gonorrhea, herpes (genital), human papilloma virus and genital warts, hepatitis, gonococcal vulvo vaginitis, Trichomonal vaginitis. Mention the term venereal disease. Socio economic dimensions of STD.

MODULE 8. Sexual orientation, sexual abuse and myths (5 hrs)

Homosexuality and bisexuality (mention LGBT), oral sex, animal sex, cyber sex, sexual abuse, premarital and extramarital sex, sexual perversions, paraphilia, child abuse, prostitution, sexual hygiene, protection of children from sexual offences (POCSO) Act, 2012 (brief account only), sexual myths.

Course Outcome

Understand the reproductive health, and importance of sex education for teen and youth. (2 hrs)

Explain the scope of reproductive technologies in infertility management and the assisted reproductive techniques. (10 hrs)

Understand the different methods of prenatal diagnosis and associated ethical

issues (4 hrs)

Describe the different methods of fertility control. (4 hrs)

Understand the symptoms, mode of transmission, diagnosis and treatment of

different sexually transmitted diseases and their socio economic dimensions. (7 hrs)

Describe sexual orientation, sexual abuse and myths (5 hrs)

REFERENCES

- Brian Walker Nicki R Colledge Stuart Ralston and Ian Penman (2014): *Davidson's Principles and Practice of Medicine*, 22nd edition; eBook ISBN: 9780702052248,Elsevier
- John Hall (2015): *Textbook of Medical Physiology; 13th Edition,* ISBN: 9781455770052, Elsevier Health, 1168 pages

EVEN SEMESTERS

FOURTH SEMESTER B. Sc. ZOOLOGY PROGRAMME ANIMAL DIVERSITY: CHORDATA PART-II

Code: ZOL4B04T

CLASS: AVES [25 hrs]

MODULE 1. Classification of Aves [11 hrs]

Classification of class Aves down to the orders specified; mention at least one example for each order.

Subclass **Archaeornithes** **[2 hrs]**

1. Order Archaeopterygiformes e.g. *Archaeopteryx lithographica* – a brief account on its discovery and evolutionary significance.

Subclass **Neornithes** **[2 hrs]**

Super order **Palaeognathae** [=Ratitae]

2. Order Casuariiformes e.g. *Casuarius* (Cassowary)
3. Order Dinornithiformes [=Apterygiformes] e.g. *Apteryx* (Kiwi)
4. Order Rheiformes e.g. *Rhea*
5. Order Struthioniformes e.g. *Struthio* (Ostrich)

Super order **Neognathae** [=Carinatae] **[7 hrs]**

6. Order Galliformes [pheasants, quail, turkeys, grouse] e.g. *Pavo cristatus*
7. Order Anseriformes [screamers, water fowls] e.g. *Anas poecilorhyncha*
8. Order Passeriformes [perching birds] e.g. *Passer domesticus*
9. Order Piciformes [woodpeckers, barbets, honeyguides] e.g. *Dinopium*
10. Order Coraciiformes [kingfishers & allies] e.g. *Alcedo atthis*
11. Order Apodiformes [swifts, humming birds] e.g. *Apus nipalensis*
12. Order Strigiformes [owls] e.g. *Bubo*
13. Order Cuculiformes [cuckoos, roadrunners, turacos] e.g. *Eudynamys*
14. Order Psittaciformes [parrots, lories, cockatoos] e.g. *Psittacula krameri*
15. Order Gruiformes [cranes, rails, coots, bustards] e.g. *Ardeotis nigriceps*
16. Order Charadriiformes [plovers, gulls, terns, auks, sand pipers] e.g. *Tringa*
17. Order Columbiformes [pigeons, doves, dodoes, sand grouse] e.g. *Columba*
18. Order Falconiformes [diurnal birds of prey – falcons, hawks] e.g. *Mylvus*
19. Order Ciconiiformes [herons, storks, ibis, spoon bills] e.g. *Ardeola grayii*
20. Order Pelecaniformes [pelicans, cormorants] e.g. *Pelecanus*
21. Order Sphenisciformes [Impennae] (penguin) e.g. *Aptenodytes*
22. Order Phoenicopteriformes [flamingos] e.g. *Phoenicopterus*

Recent Extinctions: Passenger Pigeon [*Ectopistes migratorius*), Dodo [*Raphus cucullatus*], Pink-headed Duck [*Rhodonessa caryophyllacea*], Elephant Bird [*Aepyornis*].

Rediscovery of Jerdon's Courser [*Cursorius bitorquatus*] & Forest Owlet [*Athene blewitti*].

MODULE 2. Type: ***Columba livia*** (Rock Pigeon) **[14 hrs]**

[External characters, integumentary system (structure of feather in detail

– exclude development of feather), skeletal system (skull excluded), digestive system, respiratory system, circulatory system, excretory system, sense organs and reproductive system].

MODULE 5. Comparative Anatomy [4 hrs]

Compare the circulatory, excretory and nervous systems of vertebrates.

REFERENCES

- Burnie, D. & Wilson, D. E. (2001). *Animal*. Dorling-Kindersley, London.
- Colbert, E. H. (1980). *Evolution of the Vertebrates: A History of the Backboned Animals through Time*, 3rd Edition. J. Wiley & Sons, Wiley – Interscience Publication, New Jersey.

Course Outcomes

Describe the classification of class Aves down to orders, salient features of eac order with suitable examples (11 hrs)
Describe the external characters and functional systems of Columba livia (14 hrs)
Enumerate the salient features and classification of class Mammalia down t orders with suitable examples (11 hrs)
Elucidate the external characters and functional systems of Oryctolagus cuniculus (14 hrs)
Compare the circulatory, excretory and nervous systems of vertebrates (4 hrs)

SIXTH SEMESTER B.Sc. ZOOLOGY PROGRAMME ZOOLOGY CORE COURSE – X [Theory]

REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY

Code: ZOL6B11T

SECTION A: REPRODUCTIVE BIOLOGY (14 hrs)

MODULE 1. Introduction and Human Reproductive system (6 hrs)

Introduction to Reproductive Biology (1 hr)

Importance and scope. Reproductive strategies in invertebrates and vertebrates; semelparity and iteroparity. Sex patterns; Mention sex reversal with examples.

[Short answers/Paragraphs]

Human Reproductive system (5 hrs)

Male reproductive system: structure of testis, semen production and composition. Female reproductive system: structure of ovary and graafian follicle, ovulation, mention corpus haemorrhagicum, corpus luteum and corpus albicans. Accessory reproductive organs.

Secondary sexual characteristics. Menstrual cycle and its hormonal control (brief account of oestrous cycle in mammals). Gametogenesis: spermatogenesis and oogenesis.

[Short answers/Paragraphs]

MODULE 2. Fertilization, Pregnancy, Gestation, Placentation, parturition and lactation (3 hrs)

Fertilization: Fertilizin and anti-fertilizin, capacitation, agglutination, sperm penetration, activation of egg and amphimixis. Physiological and biochemical changes during and after ferti

MODULE 3. Reproductive technologies (5 hrs)

Reproductive technologies (3 hrs)

Infertility and its management: Brief account of semen collection, preservation, storage, artificial insemination, surrogacy.

Cryopreservation and embryo transfer: Collection, care and preservation of embryos; *in vitro* fertilization and embryo transfer: major steps; Test tube babies.

Assisted Reproductive Techniques (ART): GIFT, ZIFT, ICSI, oocyte donation and embryo donation.

Prenatal Diagnosis (1 hr)

Different Prenatal Diagnostic techniques (invasive and non-invasive); Prevention of Female foeticide - ethical issues and laws (Mention–PNDT Act).

Fertility control (1 hr)

Natural methods, artificial methods, chemical methods, hormonal methods, surgical contraception, removal of gonads and uterus; abortion.

SECTION B: DEVELOPMENTAL BIOLOGY (40 hrs)

MODULE 4. Introduction and Types of eggs (3 hrs)

Introduction to Embryology (1 hr)

Historical Perspective (brief account): Mention phases in development. Theories: preformation, epigenesis, recapitulation and germplasm theory.

Types of eggs (2 hrs)

Classification of eggs with examples based on: Amount of yolk (micro, meso & macrolecithal); Distribution of yolk (iso, centro and telolecithal); Presence or absence of shell (cleidoic & non cleidoic); Types of development (determinate and indeterminate).

Egg membranes: primary, secondary and tertiary; functions of egg envelopes.

MODULE 5. Cleavage and cell lineage (3 hrs)

Types of cleavage with examples based on: Plane of cleavage (Meridional, Vertical, Equatorial and Latitudinal); Amount of yolk (Holoblastic and Meroblastic); Types of development (Determinate and Indeterminate); Pattern of arrangement of blastomeres (Radial and Spiral).

Germ layers and derivatives. Cell lineage studies in Planocera (brief account only). Different types of blastula.

MODULE 6. Development of Amphioxus, frog, chick and man (22 hrs)

Early development of Amphioxus (3 hrs)

Brief account of fertilization. Cleavage, Blastulation, Gastrulation and Neurulation.

Development of Frog (8 hrs)

Fertilization, Cleavage, Blastulation and fate map, Gastrulation (Morphogenetic movements) and formation of germ layers, neurulation and notochord formation, mesoderm and coelom formation; organogeny

of brain and eye. Hormonal control of amphibian metamorphosis.

Development of Chick (7 hrs)

Structure of egg; fertilization, cleavage, blastulation, gastrulation and formation of germ layers. Salient features of chick embryo at primitive streak stage, 24, 33 and 48 hours stages. Development and functions of extra embryonic membranes.

Development of Man (4 hrs)

Cleavage and formation of morula, development of blastocyst, implantation, gastrulation up to the formation of germ layers. Human placenta; functions of placenta.

MODULE 7. Cell Differentiation and Gene action during development (3 hrs)

Cell differentiation, totipotency, pluripotency, dedifferentiaton and redifferentiation. Controlled gene expression during development; Homeotic genes, Mention Hox- genes. Stem cells – embryonic and adult stem cells; their significance and applications.

MODULE *8*. Parthenogenesis (2 hrs)

Definition and types. Natural parthenogenesis: Arrhenotoky, Thelytoky, Obligatory and Facultative. Artificial parthenogenesis. Significance of parthenogenesis.

Course Outcomes

Explain the reproductive strategies in invertebrates and vertebrates and structural
and functional features of human reproductive system (6 hrs)
Describe process of fertilization, pregnancy, gestation, placentation, parturition and
lactation in humans. (3 hrs)
Explain the scope of reproductive technologies in infertility management; prenatal
diagnostic techniques and methods of fertility control (5 hrs)
Understand the phases and theories of development, and classification of eggs (3 hrs)
Enumerate the types of cleavage, arrangement of blastomeres, germ layers and their derivatives, cell lineage in Planocera and different types of blastula. (3 hrs)
Illustrate the early developmental process of egg in Amphioxus, frog, chick and man
(22 hrs)
Explain the basics of cell differentiation and its genetic control, stem cells and applications of stem cell technology (3 hrs)
Describe parthenogenesis, types, and significance (2 hrs)
Explain fate map construction, Spemann's constriction experiments on amphibian embryos, organizers in development, embryonic induction, gradient experiments in
sea urchin eggs, cloning experiments in sheep and teratogenesis (7 hrs)

REFERENCES

- Balinsky, B.I. (1981) *An Introduction to Embryology*, 5th Edition, *Embryology*, ISBN- 4833700298 (International ed.), Saunders College Pub., 768 pages
- Berril N. J. (1971) *Developmental Biology*, ISBN 10: 0070050201, McGraw Hill

SIXTH SEMESTER B.Sc. ZOOLOGY PROGRAMME ENVIRONMENTALANDCONSERVATION BIOLOGY Code: ZOL6B12T

Section A: ENVIRONMENTAL BIOLOGY (36 hrs)

MODULE 1. Introduction, Ecosystem and Energetics (6 hrs)

Introduction to Environmental biology: Definition, divisions of ecology, modern branches and scope.

Ecosystem-Structure and functions: Concept of ecosystem, characteristics; Structure (components) of ecosystem (pond as an example); Mention kinds of ecosystems.

Ecosystem Energetics: Photosynthetic production and energy fixation; Energy flow in the ecosystem, Energy flow and laws of thermodynamics, Energy transfer and energy transformations [Trophic dynamics or community dynamics (Lindeman's model of energy flow)]; Ecological efficiency.

Productivity of ecosystem: Concept of productivity- standing crops, material removed and production rate; Kinds of productivity: a) Primary productivity (GPP, NPP, NCP) b) Secondary productivity).

[Short answer/Paragraph/Essays]

MODULE 2. Biogeochemical Cycles and Limiting factors (5 hrs)

Biogeochemical Cycles: Basic types of biogeochemical cycles: Gaseous cycles (Carbon and nitrogen cycles) Sedimentary cycle (Phosphorous cycle).

Limiting factors: Basic concepts. Leibig's law of minimum; Shelford's law of tolerance and combined concept of limiting factors. Ecological indicators.

MODULE 3. Population, Community and Habitat Ecology (14 hrs) Population Ecology

Properties of population: density, natality, mortality, age distribution, biotic potential, environmental resistance, migration, emigration, immigration and carrying capacity. Population growth forms, J and S shaped curves.

Community Ecology

Biotic community: Definition and kinds of communities.

Characteristics: Species diversity, abundance, dominance, stratification, succession, growth forms, trophic structure, co-existence, interdependence and key stone species; Concept of ecotype, ecotone and edge effect.

Habitat ecology

a) Marine ecology: Biotic divisions of the marine habitat, their characteristics. Pelagic realm- planktonic and nektonic adaptations. Benthic realm – littoral and abyssal adaptations. Adaptations of animals of rocky, sandy and muddy sea shores.
b) Fresh water ecology: Lentic and lotic habitats, their characteristics, faunal characteristics and adaptations.
c) Terrestrial ecology: Tropical wet evergreen forests and Tropical dry deciduous forests, their characteristics, adaptations of animals of forests.

MODULE 4. Population Interactions (3 hrs)

a) Intraspecific interactions b) Inter specific interactions: Positive interactions- Mutualism, Commensalism and Proto-cooperation (with examples). Negative interactions- Competition, Predation and Parasitism (with examples).

MODULE 5. Social issues and Environment (4 hrs)

Sustainable development; Joint Forest Management; Goals of United Nations; Environmental ethics: Issues and possible solutions, Habitat destruction and its consequences- socio-ecological concern: wetland, paddy fields, mangrove, river encroachment, sand and clay mining; Ecological impacts of tourism.

Disaster management: Natural & Artificial - floods, drought, earthquake, cyclone and landslides.

Course Outcomes

Explain the structure of ecosystem and its functioning through energy flow and nutrient cycling (6 hrs).

Enumerate biogeochemical cycles and understand the concept of limiting factors (5 hrs).

Describe the ecology of population, community and habitat as a self regulating system (14 hrs)

Understand various types of population interactions and appraise the co-evolution (3 hrs).

Comprehend the diverse environmental and sustainability challenges ranging from local to global and the establishment of perfect harmony between economic development, social issues and environmental conservation (4 hrs).

REFERENCES

- Agarwal, K.C. (2008) *Environmental Biology*, Nidi Publishers, Bikaner.Hardcover: 552 pages, ISBN-13: 978-8189153021
- Arora, S. (1995).*Fundamentals of Environmental Biology*, Kalyani Publ.,New Delhi.

SIXTH SEMESTER B. Sc. ZOOLOGY PROGRAMME ZOOLOGY ELECTIVE CORE COURSE- II (Theory) AQUACULTURE,ANIMALHUSBANDRYANDPOULTRYSCIENCE

Code: ZOL6B14BE02T

MODULE 1. Aquaculture (10 hrs)

Types of aquaculture **(3 hrs)**

Brief account of classification of aquaculture based on:

Environment – Freshwater, brackish water and mariculture. Temperature – Warm water/cold water culture.
Culture techniques – pond aquaculture, cage culture, pen culture, raft culture, pole culture, rack culture and long line culture.
Number of species – Mono culture and poly culture.
Type of organism – prawn culture, shrimp culture, edible oyster culture, lobster culture etc.

Mariculture **(7 hrs)**

Prawn culture: Important cultivable species in India, seed collection, spawning and larval rearing, induced breeding, types of culture systems - Pokkali culture, culture in bheries/ponds, culture and harvesting.

Mussel culture: *Perna indica*, *Perna viridis*, Seed collection, artificial seed production, induced spawning, culture techniques and harvesting.

Pearl culture: Method of pearl formation, selection and preparation of host, preparation of nucleus and implantation, post-operation care, post-operation culture and collection of pearls.

MODULE 2. Pisciculture (13 hrs)

i. Egg collection; induced spawning; construction, preparation and maintenance of ponds; manuring; feeding and harvesting. Cryopreservation of fish germplasm, semen bank and preservation media.
ii. Biology and culture of following Indian major carps: *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala*.
iii. Biology and culture of Exotic carps: *Cyprinus carpio* (common carp), *Hypophthalmichthys molitrix* (Silver carp).
iv. Inland fishes and Fisheries (Brief account): *Channa, Clarias* and *Etroplus suratensis*
v. General account and fishery aspect of Sardine, Shark and Tuna. Mention GIFT Tilapia and Nutter (*Pygocentrus nutterei*)
vi. Ornamental fisheries: Common aquarium fishes: e.g: *Carassius auratus* (Gold fish), *Pterophyllum* spp. (Angel fish), *Astronotus ocellatus* (Oscar cichlid), *Poecilia reticulata (*Guppy), *Poecilia sphenops* (Black molly), aquarium management.
vii. Plankton and Fishery production: Zoo and Phytoplankton – Vertical migration
– Plankton and Productivity.

MODULE 3. Fishing Crafts and Gear, fish preservation and utilization (13 hrs)

i. Fishing crafts – Mention Catamaran, Canoes and dug-out-canoes.
ii. Fishing gears – Gillnet/drift gillnet, purse-seines, harpoon, Chinese dipnets, echo sounders, sonar, remote sensing.
iii. Fish Spoilage and Preservation: Biochemical changes, spoilage, use of ice, freezing, canning, dehydration, salting and smoking.
iv. Fish utilisation: Nutritive value, bye products, liver oil, body oil, fish meal, fish flour, Isinglass, glue, skin, fin soup, lime, chitin and chitosan.
v. Diseases and parasites of Fish: Fungal infection – Epizootic Ulcerative Syndrome (EUS), Saprolegnia, Fin and tail rot disease, Dropsy.
vi. Mud banks of Kerala coast.

Course Outcomes

Explain aquaculture and the process of prawn, mussel and pearl culture (10 hrs).
Illustrate the methodology of pisciculture and understand common culture fishes and ornamental fishes (13 hrs)
Identify major fishing crafts and gear and enumerate fish utilization and preservation (13 hrs)

REFERENCES

- Alikunhi, K H (1957): *Fish culture in India:* CMFRI Farm Bulletin (20). 144 pages

- Ashok Kumar Rathoure, Dinesh Kumar, Nazneen Z. and Deshmukh (2015): *Applied and Economic Zoology*; Daya Publishing House. 326 pages.
- Banerji, G.C (1986): *Poultry 3rd Edn.* , Oxford & IBH.148 pages.
- Banerji, G.C. (1998): *A text book of Animal husbandry 8th Edn.*, Oxford & IBH.1096 pages.

Mode of Instruction–

Lecture
Powerpoint presentation

Mode of Assessment –

Questions asked to the students, Open book tests, Quiz

UNIVERSITY OF CALICUT

M.Sc. ZOOLOGY PROGRAMME

[CBCSS PG 2020]

LESSON PLAN

Ms. RANI PAULY

THIRD SEMESTER THEORY
ZOL3C07 – IMMUNOLOGY (90 Hours)

3. **Antigens** (8 hours)

3.1. Immunogenicity, Antigenicity.
3.2. Factors that influence immunogenicity.
3.3. Adjuvants.
3.4. Haptens.
3.5. Epitopes.
3.6. Properties of B-cell and T- cell epitopes.

4. **Immunoglobulins** (Antibodies) (10 hours)

4.1. Structure and function of Antibody molecules.
4.2. Generation of Antibody diversity.
4.3. Immunoglobulin gene.
4.4. Antigenic determinants of immunoglobulin - (a) Isotype (b) Allotype (c) Idiotype.
4.5. B-cell receptor (BCR).
4.6. Monoclonal Antibodies.
4.7. Production of Monoclonal Antibodies (Hybridoma technology).
4.8. Clinical uses of Monoclonal Antibodies.
4.9. Antibody Engineering.

12. **Vaccines**. (5 hours)

12.1. Active and passive immunization.
12.2. Whole organism vaccines.
12.3. Recombinant vector vaccines.
12.4. DNA vaccines.

12.5. Synthetic peptide vaccines.
12.6. Multivalent vaccines.

13. Immunity and malnutrition and immune deficiency diseases. (6 hours)

13.1. Immunity and malnutrition.
13.2. Primary immune deficiency diseases. (a)Burton''s disease (b) Di-George syndrome and SCID.
13.3. Secondary immune deficiency - AIDS.
13.4. Transmission of HIV.
13.5. Vaccines to prevent AIDS.
13.6. Autoimmunity (systemic and organ specific brief)

References

1. Abdul K Abbas and Andrew H. Lichtman (2004). Basic immunology – Functions and Disorders of
the immune system. (second edition, Elsevier Science, USA)
2. Janis Kuby (2000) .Immunology.7th ed. W.H. Freeman& Co. New York.

Course outcomes

- The student gain conceptual knowledge regarding key principles, procedure and applications of different Immunetechniques used in the biomedical field and to develop new methods and techniques on the basis of the earned knowledge.
- Mechanisms of humoral and cellular immunity, immune cell receptor and intracellular signal cascades related to immune system activation and response.

THIRD SEMESTER THEORY

ZOL3C08–DEVELOPMENTAL BIOLOGY

& ENDOCRINOLOGY (90hours)

1.Endocrine glands and their Hormones

(Brief account) (5 hrs)

- Hormone secreting organs and tissues -skin, liver, kidney, heart.
- General classes of chemical messengers- Peptide, thyroid, steroid hormones, neurotransmitters and pheromones
- Synthesis and delivery of hormones- storage, secretion and transportation Control of hormone secretion.
- Physical characteristics of hormones - latency, post-secretary modification and half- life Physiological roles of hormones.

2. General mechanisms of Hormonal action (5 hrs)

- Hormone Receptors and transducers;
- Types of receptors- g protein coupled receptors, steroid receptors and nitric oxide receptors,
- Regulation of receptor number, receptor activation
- Second messengers of hormone action- cAMP, cGMP, inositol triphosphate, diacylglycerol
- Receptor signal transduction Eicosanoids and hormone action

3. Anatomy of endocrine glands; structure, physiological functions, and control of secretion of their hormones and pathophysiology (13 hrs)

- Hypothalamus
- Hypophysis
- Thyroid
- Parathyroid
- Adrenal
- Pancreas

4. Hormones and male reproductive physiology (7 hrs)

- Synthesis**,** chemistry, and metabolism of androgens
- Endocrine control of testicular function Physiological roles of androgens and estrogens
- Pathophysiology

Course Outcomes

- Describe different classes of chemical messengers and their physical characteristics.
- Explain how the secretion of hormone is regulated through positive and negative feedback mechanisms.
- Summarize the anatomy, regulation, and physiological functions of the hormones of the hypophysis, thyroid, parathyroid, pancreas adrenal, hypothalamus and adrenal glands.
- Describe the anatomy of male and female reproductive systems including hormonal functions and pathophysiology.

UNIVERSITY OF CALICUT

M.Sc Zoology Programme
(CBCSS PG 2019)
Under Choice Based Credit Semester System

LESSON PLAN

THANZEEN.P.S

FIRST SEMESTER THEORY

ZOL1C01 - BIOCHEMISTRY AND CYTOGENETICS

Part A. Biochemistry

UNIT I - Chemistry and functions of Biomolecules

1. Introduction (2 hrs)

1.1Macromolecules and their subunits

1.1. Chemical bonds of biomolecules (Covalent and Non-covalent bonds)

3. Proteins (6 hrs)

3.1. Amino acids

3.1.1. Classification: (a) on the basis of number of amino and carboxyl group (b) on the basis
of the chemical composition of side chain (c) based on the polarity of side chain (R)

3.1.2. Amphoteric properties of amino acids

3.1.3. pK value and Isoelectric point (pI) of amino acids

3.1.4. Peptide bond and peptides (di, tri, tetra, oligo and polypeptide).

3.2. Structure of protein

3.2.1. Primary structure, Secondary structure (Alpha helix, Beta-parallel & antiparallel and
Beta-pleated sheet), random coil conformation, Tertiary structure, Quarternary structure.

3.2.2. Brief note on protein domains, motifs, folds and Ramachandran plot.

3.2.3. Biological roles of proteins

4. Lipids (5 hrs)

4.1. Classification of lipids -Simple lipids (fats, oils and waxes), compound lipids (phospholipids, glycolipids, lipoproteins and sulpholipids) and derived lipids.

4.2. Biological roles of lipids - as food reserves (storage lipids), structural lipids in membrane,
as signals, as co-factors, as pigments, as insulators, as vitamin carriers etc

4.3. Prostaglandins - Chemical nature and functions.

4.4. Fatty acids - definition; essential fatty acids

4.5. Classification with examples- Saturated, unsaturated, hydroxyl and cyclic fatty acids

4.6. Nomenclature of fatty acids - Genevan system

5. Nucleic acids (3 hrs)

5.1. Structural organization of DNA (Watson -Crick model)

5.2. Structural organization of t-RNA; brief note on micro-RNA

5.3. Biological roles of nucleotides and nucleic acids

Unit - II - Enzymes (7 hrs)

1. Classification- (I.U.B. system)

2. Mechanism of enzyme action: Formation of enzyme substrate complex- Michaelis-Menten
theory, Fischer's template theory and Koshland's induced fit theory. Factors influencing
enzyme action
3. Enzyme kinetics - Michaelis-Menten equation - derivation; significance of Km and Vmax
Values. Lineweaver-Burk equation and double reciprocal plot of enzyme reaction.
4. Enzyme inhibition - Competitive, non-competitive and uncompetitive inhibition (distinguish
kinetically), suicide inhibition and feedback inhibition
5. Classification, Structure and functions of Vitamins.Vitamins as co-enzymes.

Unit - III - Bioenergetics (2 hrs)

1. Laws of thermodynamics and biological system- Enthalpy, Entropy, Free energy concept .
2. Energy of activation, Standard free energy change.
3. Role of ATP as a free energy carrier in the biological system.

Unit - IV - Metabolism and biosynthesis of biomolecules

1. Carbohydrate metabolism (4 hrs)

1.1. Glycolysis - (PFK as pacemaker - Hexokinase conformation and change by glucose), Fate
of pyruvic acid
1.2. Citric acid cycle; Pyruvate dehydrogenase complex and ketoglutarate dehydrogenase
complex
1.3. Electron transport system and oxidative phosphorylation; Redox potential, Chemiosmotic
hypothesis; inhibitors of electron transport chain

2. Amino acid metabolism (4 hrs)

2.1. Biosynthesis and degradation of amino acids - glutamic acid, phenyl alanine,methionine,
tryptophan, isoleucine, histidine, valine.
2.2. Fate of amino acids in the body
2.3. Transamination, Decarboxylation and deamination reactions in the biological system.

3. Lipid metabolism (5 hrs)

3.1. Oxidation of fatty acids
3.2. Biosynthesis of fatty acids
3.3. Biosynthesis of cholesterol

4. Nucleic acid metabolism (4 hrs)

4.1. Biosynthesis and degradation of purines and pyramidines

Course Outcomes

The student will describe the importance of various chemical interactions in the biological system

The student develops the ability to describe classification, structural organization, and purification techniques of proteins.

The student acquire knowledge regarding the classification and functions of lipids and fatty acids

The student develops appreciation on the mechanisms of enzyme action, inhibition, and acquire knowledge regarding classification of enzymes that facilitate the functioning of enzymes

The student develops appreciation on Watson and Crick model of DNA

The student will explore various anabolic and catabolic pathways of biomolecules such as glucose,nucleic acids, amino acids and lipids.

The student develops a conceptual knowledge regarding the principles of energetics in biological systems.

References

Biochemistry

1. David L Nelson & Michael M Cox Lehninger, Principles of Biochemistry, VIth edition, (2013) Mac Millan
2. Robert Harper's Biochemistry, (2012) 29th Edition, K. Murray, Daryl K. Granner, Peter, A. Mayes and Victor, W. Rodwell Appleton and Lange, Prentice Hall of India Private limited, New Delhi,
3. Lubert Stryer,(2011) Biochemistry, VII th edition, W.H. Freeman & Co.
4. Eric E. Conn, Paul K. Stumpf, George Bruening, Roy H. Doi, (2007) Outlines of Biochemistry, Vth edition, John Wiley & Sons, Inc.
5. Deb, A.C.(2004) Fundamentals of biochemistry, New Central Book Agency (P) Ltd.
6. Keith Wilson and John Walker (2008) Principles and techniques of Biochemistry and Molecular biology - 6th edn, Cambridge University Press
7. Voet, D. and Voet, J.G. & Pratt (2012). Principles of Biochemistry, John Wiley & sons .
8. Zubay, G (1997). Biochemistry, Mc Graw – Hill Publications
9. Devlin,T.M. (2010). A Text of Biochemistry with clinical correlations, John Wiley& sons.
10. Lenhninger, A. L. (2008). Principles of Biochemistry. (5th edn). CBS Publishers and Distributors, New Delhi.
11. Mathews, H. R., Freeland, R. and Miesfeld, R. L. (1997). Biochemistry: A Short Course – Wiley- Liss, Inc. NY.
12. Mary, K. Campbell (1995) Biochemistry. II Ed. Harcourt Bracce and Co. Florida.
13. Murray, Robert, Granner, K. and Harper, Daryl K. (2006). Harper¨s Illustrated Biochemistry. Mc Graw-Hill, New York.

14. Nelson, D. L. Cox, M. M. and Lehninger, A. L. (2007). Principles of Biochemistry, 4th Ed. Freeman and Co, NY.
15. Stryer, L. (2011). Biochemistry. 7th Ed. W. H. Freeman & Co. New York.
16. Zubay, G. L., Parson, W. W. and Vance, D. E. (1995). Principles of Biochemistry,Brown Publishers, England.

Part B. Cytogenetics (36 hrs)

1. Introduction to Cytogenetics (1 hr)
2. Membrane structure and function . (4 hrs)
2.1. Molecular organization of cell membrane - Lipid bilayer and membrane protein. Molecular
models of cell membrane.
2.2. Cell permeability-osmosis, diffusion, ion channels, active transport, membrane pumps.
2.3. Mechanism of sorting and regulation of intracellular transport.
2.4. Electrical properties of membranes.
2.5. Microvilli and cell coat.
3. Structural organization and function of intracellular organelles- (6 hrs)
Nucleus, Mitochondria, Golgi complex, Lysosomes, Endoplasmic reticulum, Ribosomes,
Peroxisomes and Cytoskeleton.
4. Organization of chromosomes and genes. (6hrs)
4.1. Structure of chromatin and chromosomes, heterochromatin, euchromatin –unique and
repetitive DNA
4.2. Chromosomal changes- euploidy, aneuploidy, chromosomal aberrations- Structural
alterations- gene mutations- molecular changes- deletion, duplication, translocation,
inversion and sister chromatid exchange.
4.3. Interrupted genes and gene families.
4.4. Concept of gene- Allele, multiple alleles, pseudoallele, complementation tests.
4.5. Extrachromosomal inheritance- inheritance of mitochondrial and chloroplast genes,
maternal inheritance.
5. Cellular communication (6 hrs)
5.1. General principles of cell communication
5.2. Cell-cell interactions – cell adhesion and roles of different adhesion molecules

5.3. Intercellular attachments- gap junctions, desmosomes, intermediary and tight junctions.
5.4. Interaction of cells with extracellular matrix: Integrins. Focal adhesion and hemidesmosomes.
5.5. Interaction of cells with other cells: Selectins, Immunoglobulins, Cadherins, Adherens.
6. Cell signaling (8 hrs)
6.1. Signal transduction
6.2. Concept of cell-signaling
6.3. Signaling through cell surface receptors: G protein linked receptors; signaling via cAMP,
PKA, IP3, Ca2+/calmodulin, PKC, Ca-MK, Enzyme linked receptors, Receptor tyrosine
kinase (RTK), signaling of growth factors, Tyrosine kinase associated receptors, JAKSTAT
signaling pathway, Receptor protein tyrosine phosphatase (PTP), Receptor serine/threonine kinase, Receptor guanyl cyclase, cGMP, PKG, Histidine kinase associated
receptors
6.4. Receptor desensitization
6.5. Signaling by nitric oxide, carbon monoxide
6.6. Signaling network
7. Apoptosis and its significance (5 hrs)
7.1 Necrosis; Programmed and induced cell death
7.2 Process of apoptosis: Initiation, Execution: cytochrome C, caspases, Phagocytosis
7.3 Regulation of apoptosis - Extracellular and Intracellular
7.4 Apoptosis in Caenorhabditis elegans, Drosophila, mammals and bacterial population
7.5 Mechanism of cell death
7.6 Genes involved in apoptosis.

Course Outcomes

The student acquire knowledge about the structure and functions of Cellular components, plasma membrane and its models, membrane transport mechanisms and properties , cytoskeletal elements and Intracellular trafficking.

The student gain knowledge of Chromatin structure and chromosomal alterations, Interrupted genes, gene families and extra chromosomal inheritance.

The student explore and appreciate the importance of cellular adhesion molecules, cell-cell and cell -matrix interactions, intercellular communications along with noted signal transduction pathways and intracellular signaling mechanisms and their significance.

The student will describe the process and significance of necrosis and apoptosis and, its regulation in the cellular level

References

Cytogenetics

1. Becker, W. M., Reece, J. B. and Poenie, M. F. (1999; 2000). The World of the Cell, 4th edition, Benjamin/Cummings Publishing Co.
2. Benjamin Lewin (2008). Genes IX. Jones & Bartlett Learning Publishers, New York.
3. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter(2002). Molecular Biology of the Cell. 4th Edition, Garland Science, New York.
4. De Robertis, E. D. P. and De Robertis, Jr. E. M. F. (1996). Cell and Molecular Biology,Eighth Edition, B.I. Waverly Pvt Ltd, New Delhi.
5. Karp, G. (2002). Cell and Molecular Biology. John Wiley, New York.
6. Kleinsmith, L. J. and Kish, V. M. (1995). Principles of Cell and Molecular Biology (Second Edition). Harper Collins College Publishers, New York
7. Peter Snustad, D. and Michael J. Simmons (2000). Principles of Genetics. 2nd Ed. John Wiley & Sons Inc.
8. Purves W. K., Orians G. H. and Heller H. C. (1995). Life: The Science of Biology, 4th Edition. Sinauer Associates, Sunderland.
9. Robert H. Tamarin (2002). Principles of Genetics, 7th Edition, Tata McGraw-Hill Education Pvt Ltd, New Delhi.
10. Sheeler, Philip and Donald, E. Bianchi. (1987) Cell and Molecular Biology. III Ed. John Wiley.
11. Watson J. D., Hopkins N. H., Roberts, J. W., Steits, J. A. and Weiner, A. M. (1987). Molecular Biology of the Gene 4th Edition. The Benjamin Cumming. Publishing Company. Menlo Park, California.

FIRST SEMESTER THEORY

ZOL1C02 - BIOPHYSICS AND BIOSTATISTICS

3. PH (2 hrs)

3.1 Dissociation of water.
Dissociation of a weak acid.
Henderson Hasselbalch equation.
Electrometric determination of pH, pH meter
PH value calculation.

Buffer –Importance of buffers in biology.

6. Biophysical methods (Brief account of the following) (5 hrs).

Properties of electromagnetic radiations.
Molecular analysis using UV / visible spectroscopy.
Mass spectroscopy.
NMR and Electron Spin Resonance (ESR) spectroscopy -Applications
Structure determination using X-ray diffraction crystallography.
Circular dichroism.
Surface Plasma Resonance (SPR)

9. Separation Techniques (10 hrs)

Chromatography - Different types - Adsorption, Partition and Ion exchange chromatography
Column chromatography
Paper chromatography
Thin- layer chromatography
Gel-filtration.
Gas chromatography,
Affinity chromatography,
HPLC
Electrophoresis
Paper electrophoresis
Disc electrophoresis
PAGE, Two dimensional PAGE, Highvoltage Electrophoresis
Isoelectric focusing.

Course Outcomes

The student develops conceptual knowledge regarding the basic principles of physics involved in biological processes.

The student may familiarize with various biophysical and electrophysiological methods

The student explore the possibilities of the applications of separation techniques.

References

Biophysics

1. Ackerman, E. (1962).Biophysical Science. Prentice Hall Inc.
2. Alonso, A and Arrondo, J.L.R (2006) - Advanced techniques in Biophysics, Springer
3. Alok Srivastava and Ipsita Roy-(2009)-Bio-Nano- Geo Sciences- The future challenge-Ane Books Ltd.
4. Baker, E.J and Silverton, R.E. (1978) - Introduction to medical laboratory technology, ELBS
5. Bengt Nolting (2006), Methods in modern Biophysics 2nd edn.Springer.

6. Daniel, M (2002), Basic Biophysics for Biologists. Agro Botanics, Bikaner
7. Das, D. (1991) Biophysics and Biophysical Chemistry, Academic Publishers, Calcutta.
8. Ernster, L (1985), Bioenergetics, Elsevier, New York.
9. Frank H. Stephenson (2006)- Calculations for Molecular Biology and Biotechnology- A guide to Mathematics in the laboratory-Academic Press- An imprint of Elsevier.
10. Ghatakk.L. (2011).Techniques and methods in Biology.PHI, Learning Pvt. New Delhi.
11. Gupta.A. (2009). Instrumentation and Bio-analytical techniques.Pragati Prakashan, Meerut.
12. Hoppe, W, Lohmann,W, Markl,H and Ziegler,H (1983). Biophysics. Springer Verlag, New York.
13. Keith Wilson and John Walker (2008), Principles and techniques of Biochemistry and Molecular biology - 6th edn, Cambridge University Press
14. Marshall, A.G. (1978) Biophysical Chemistry, Principles, Techniques and Applications-John Wiley and Sons, New York
15. Mohan P. Arora-(2007), Biophysics -Himalaya Publishing House.
16. Muralidharan.V.S. and Subramania, A (2010)- Nanoscience and Technology- Ane Books Ltd.

Part B –Biostatistics

4. Probability distributions (4 hrs)

Basic concepts and definition:
Laws of probability
Probability distribution: - Binomial, Poisson and Normal

5. Statistical inference (problems to be discussed) (7 hrs)

Difference between parametric and non-parametric statistics;
Testing of hypothesis
Errors
Confidence interval; levels of significance, Critical region;
Normality test
t-test, chi-square test, F-test, ANOVA
Kruskal-Wallis, Mann-Whitney

6. Correlation and Regression (problems to be discussed) (7 hrs)

Types of correlation.
Methods to measure correlation- Scatter diagram.
Karlpearson's coefficient of correlation, Spearman's correlation
Types of regression analysis
Regression equations
Difference between regression and correlation analysis

Course Outcomes

The student skills in various methods of data collection, tabulation and presentation of data for biological research

The student develops the ability to apply measures of central tendency and dispersion in biological research, and various types of probability distribution.

The student analyze and apply parametric and non parametric tests and its applications in biological research

References

Biostatistics

1. Agarwal, B.L. (1996) Basic statistics, New Age International(P) Ltd. Publishers, New Delhi.
2. Bailey, N.T.J. (1981) Statistical methods in Biology. Hodder and Stongtton, London.
3. Campell, R.C. (1978), Statistics for biologists. Blacker and Sons Publishers, Bombay.
4. Gupta, C.B. and Gupta, V. (2002) Statistical methods. Ikas Publishing House, New Delhi.
5. Rostogi, V. B. (2009) Fundamentals of Biostatistics. Ane's Students Edition, New Delhi.
6. Magurran AE. 2004. Measuring Biological Diversity. Blackwell Publishing
7. Stephen W,Looney(2008) Methods in Molecular Biology-Biostatistical Methods Springer International Edition
8. Zar, J.H. (2003) Biostatistical Analysis - Fourth edition. Pearson Education. New Delhi.

SECOND SEMESTER THEORY

ZOL2C04-PHYSIOLOGY

1. Nutrition (10 hrs)

Constituents of normal diet and their daily requirements.
Physiological calorie value of food stuffs.
Antioxidant nutrients.
Movements of GI tract: deglutition, gastric motility and emptying, intestinal motility and defecation.
The role of hormones and neurotransmitters in the control of gastrointestinal motility.
Energy balance and obesity-causes and consequences.
BMR and its significance.

2. Excretory System (12 hrs)

Introduction: Brief description of different types of excretory organs in different animal groups (flame cells, green glands, malpighian tubules).
Functional anatomy of mammalian kidney, nephron and juxtaglomerular apparatus structure, parts and function.
Urine formation (glomerular filtration, tubular reabsorption and tubular secretion)
Regulation of water balance -Mechanism of concentration of urine – CounterCurrent system (counter current multiplier and counter current exchanger).
Renal regulation of acid- base balance & electrolyte balance.
Structure of urinary bladder, micturition reflex and micturition.
Renal clearance – definition, concept and significance; clearance value of urea,creatinine, phosphate, potassium, chloride and sodium.

3. Respiratory system (10 hrs)

Introduction: Brief description of major respiratory organs (tracheal system, book lungs, gills and ctenidia).

Physiological anatomy and histology of respiratory passage and lungs.

Mechanism of pulmonary ventilation (inspiration & expiration) .

Alveolar ventilation, dead space and its effect on alveolar ventilation.

Role of surfactant in alveolar expansion.

Pulmonary volumes and capacities – definition & normal values (tidal volume, inspiratory reserve volume, expiratory reserve volume, residual volume, functional residual capacity, inspiratory capacity, vital capacity, total lung capacity).

Exchange of gases- partial pressures involved-lung and tissues.

Oxygen dissociation curve – factors affecting binding of oxygen to haemoglobin (PO_2, PCO_2, CO, pH, body temperature, diphosphoglyceric acid level, foetal haemoglobin and also myoglobin).

Neural and chemical regulation of respiration: Respiratory centres & factors regulating respiration.

4. Nervous system (21 hrs)

Organisation of human brain.

Cerebrum and cerebral lobe.

Cerebral cortex and its functional areas- Motor cortex, Broca's area , somatosensory cortex and its association area, gustatory cortex, visual cortex and its association area, auditory cortex and its association area, olfactory cortex, wernick's area, Brodman map, cerebral dominance .

Cortical white matter- commissures, association fibers, projection fibers,corpus callosum and fornix, basal nuclei-organisation and function.

Brain stem- organisation and function.

Cerebellum- structure and function.

Diencephalon – organisation and function.

Functional brain systems - Limbic system and reticular formation.

Protection of brain – Meninges, cerebrospinal fluid- formation and function, blood brain barrier and its function.

Diseased states of brain - schizophrenia, Alzheimer's disease, Senile dementia & Parkinso's disease.

Memory- definition, types of memory- short term, intermediate long term and long term memory, consolidation of memory.

PNS and Autonomic nervous system.

Spinal cord – structure.

Reflex action, reflex arc, monosynaptic and polysynaptic reflexes, inverse stretch reflex and golgi tendon organ

5. Special senses (16 hrs)
Vision:
Structure of eyeball
Fluid systems of the eye
Layers of Retina and photoreceptors (rods & cones)
Brief notes on the neuronal cell types and neural circuitary of the retina and visual pathways from retina to visual cortex
Image formation
Formation of image on the retina.
A brief general account of electrophysiology of vision
Photochemistry of vision & colour vision
Taste:
Primary sensations of taste (agents and site of sensation)
Taste buds (location, structure, receptors and nerve supply)
Physiology of taste (receptor stimulation, generation of nerve impulse by taste buds and its transmission to CNS)
Smell:
Olfactory membrane and receptor cells
Physiology of olfaction (stimulation of olfactory cells and transmission of smell signals to CNS)
6. Tactile response: (brief note) (4hrs)
Mechanoreceptors and their stimulation
Pain receptors and their stimulation
Thermal receptors and their stimulation
7. Cardiovascular system (8hrs)
Introduction: Brief description of vertebrate hearts
Structural organization of myogenic heart (in human beings).
Physiological anatomy of cardiac muscle – specialized tissue.
Heart as a pump.
Cardiac cycle.
Neural and chemical regulation of heart function.
Blood volume and blood pressure.
Physiological anatomy of coronary blood flow, coronary blood flow and its control.
Ischemic heart disease – mention causes.
8. Lymphatic System (5 hrs)
Lymph channels of the body.
Composition and formation of lymph.
Functions of lymph and lymphatic system including role of it in controlling Interstitial fluid protein concentration, interstitial

fluid volume and interstitial fluid pressure.

9. Environmental Physiology (4 hrs)

Thermal regulation.

Comfort zone, normal body temperatures (oral, skin & core).

Temperature regulating mechanism (hot & cold), mention the role of hypothalamus, thyroid and adrenal glands.

Acclimatization

Course Outcomes

The student create an awareness among the society to promote balanced lifestyle and improve people's diet

The student will be able to explain the role of nutrition in health
Discuss the physiology of various organ systems in the body

The student will be able to differentiate the structure and functions of various organs in the human body

The student will describe different functional areas of cerebral cortex
The student will describe the cardiac cycle

The student will be able to discuss the physiology and mechanisms of respiration
The student will Identify and define neuro-anatomical structures

The student will summarize the various neurological disorders
Discuss different types of excretory organs in different animal groups

Explain the role of excretory system in the regulation of water balance, ,acid base balance and electrolyte balance

Identify the symptoms of life style diseases and suggest ways to control them
Explain the environment's influence on the physiological function and performance of living organisms

References

1. Arthur C.Guyton & John E. Hall (2003): Textbook of Medical Physiology, Saunders (An imprint of Elsevier).
2. William F.Ganong (1999): Review of Medical Physiology, Lange Medical Publications(Appleton & Lange).
3. Jain A.K. (2009): Text Book of Physiology (Vol. I & II), Avichal Publishing Company, New Delhi.
4. Deb, A.C. (2002): Fundamentals of Biochemistry (2002): New Central Book Agency(P) LTD, India.
5. Prosser & Brown.(1973). Comparative Animal Physiology. W.B.Sauders and Co.
6. William S. Hoar.(1966). Comparative Animal Physiology . Prentice Hall, Inc. USA.
7. Kunt-Schmidt-Nielsen.(1994).Animal Physiology, Adaptation and

Environment.Cambridge University Press.
8. Jensen D. (1976): Principles of Physiology, Appleton Century Crafts, N.Y.
9. Lonco,G.N.(1993):PhysiologicalAnimalEcology.Longman Scientific and Techhnical Essex.
10. Oser,B.L.-(1965).Haw"s Physiological chemistry. Tata McGraw Hill Pub. Co. New Delhi.
11. 11.Shepherd, G.M: Neurobiology-Principles of Neural Science, E. Kandel & P. Schwartz.
12. Campbell et al. (1984): Clinical Physiology, 5th Edn. Blackwall Scientific Publications, Oxford.
13. Pragnelli,C.V& Farhi, L.E. (1989): Physiological function of special Environment-Springerverlag, N.Y.
14. Davie IV & Lewid S.M.- Practical Haematology, 6th Edn. Churchill, Livingstone, Edinburgh.

SECOND SEMESTER THEORY

ZOL2C06 - SYSTEMATICS AND EVOLUTION

Part –A: Systematics

5. Classification (7 hrs)

Uses of Classification
Purpose of Classification
Theories of Classification
(a) Essentialism (b) Nominalism
(c) Empiricism (d) Cladism (e) Evolutionary Classification
Hierarchy of Categories
The objectives of classification

6. Taxonomic Collections and the Process of identification (8 hrs)

Taxonomic collections: Types of collections, Value of Collection
Purpose of scientific collection
Preservation of Specimens
Labeling
Curating of collections
Curating of types
Identification- Methods of identification
Use of keys, types of keys.
Merits and demerits of different keys
Description and publication

7 .Taxonomic Characters (6 hrs)

Nature of taxonomic characters
Taxonomic characters and adaptation
Kinds of taxonomic characters
(a) Morphological (b) Physiological (c) Ecological (d) Ethological and (e) Geographical characters

Taxonomic characters and classification
Taxonomic characters and evolution
Functions of taxonomic characters

8. Zoological Nomenclature (6 hrs)

Brief History of nomenclature
International Code of Zoological Nomenclature
The nature of scientific names
Species and infraspecies names
Gender of generic names
Synonyms and Homonyms
The Law of Priority
Rejection of names
Type method and different kinds of types

9. Newer trends in systematics (4 hrs)

DNA Bar coding
Molecular systematics
Chemo taxonomy and serotaxonomy
Cytotaxonomy
Numerical taxonomy
Cladistics

10. Ethics related to taxonomic publications (4 hrs)

Authorship of taxonomic papers
Correspondence
Suppression of data
Undesirable features of taxonomic papers
Taxonomist and user communities

Course Outcomes

The student develops skills in the identification and taxonomic classification of organisms based on their characters

The student will be able to describe different levels of taxonomy

Aware about Place, importance, applications and goals of taxonomy
Learn about purpose of classification, use of classification, theories of biological classification and types classification

Explain taxonomic procedures like Taxonomic collections,Curation, Recording of field data, storage of collection, labelling and cataloguing of collection
Identification- methods of identification, Use of keys,Taxonomic descriptions, Taxonomic and ecological publication and their difference.

The student will acquire knowledge regarding Species concept and the taxonomic diversity within species, different kinds of species, sub species and other infra specific categories, hybrids

Recognize the importance of Zoological nomenclature, International Code of Zoological Nomenclature

Interpret Principle of priority, Homonymy and Synonymy and Different kinds of types in descriptive taxonomy

Use new trends in Systematics especially Chemo and Serotaxonomy, Cytotaxonomy, Numerical taxonomy, Cladistics, Molecular systematics and DNA bar coding vs traditional taxonomy

Recognize the ethics related to taxonomic collections and publication

References

Part -A Systematics
1. David.M.H, Craig Mortiz and Barbara K.M (1996) Molecular Systematics. Sinauer Associates, Inc
2. Dalela, R.C. and Sharma, R.S.(1992). Animal Taxonomy and Museology, Jai Prakash Nath & Co Meerut City U.P (India)
3. Kapoor V.C (1998) Theory and practice of animal taxonomy. Oxford & IBH, Publi.Co New Delhi
4. Mayr. E (1969) Principles of Systematic Zoology. McGraw Hill Book Company, Inc, New York
7. Narendran, T.C (2008) An introduction to Taxonomy. Zoological Survey of India
8. Sneath P.H.A.(1973) Numerical Taxonomy: The Principles and Practice of Numerical Classification.W.H. Freeman &Co

Part- B Evolution

I. Natural Selection: (7 hrs)

Mechanism of natural selection- directional, disruptive and stabilizing selection
Natural selection in islands
Sexual selection; intrasexual and intersexual selection- secondary sexual characteristics-sexy son hypothesis, good gene hypothesis

3 Tempo of evolution (5hrs)

Gradualism Vs punctuated equilibrium
Anagenesis Vs Cladogenesis

4 Molecular evolutions (8 hrs)

Neutral theory of molecular evolution
Molecular divergence
Molecular drive
Molecular clocks, genetic equidistance, human mitochondrial molecular clock
Phylogenetic relationships- Homology, homologous sequence of proteins and DNA, orthologous and paralogous evolution, nucleotide sequence analysis

5 Evolutionary trends (9 hrs)

Biochemical evolution- Collapse of orthogenesis
Stages in primate evolution including Homo: dry and wet nosed primates, prosimians and simians, human and the African apes, African origin for modern humans, Y chromosome Adam and mitochondrial Eve
Can evolution explain language? Communication, speech, language and self awareness in primates

Course Outcomes

Describe the mechanism of natural selection and the evolutionary mechanisms

Explain tempo of evolution

Describe molecular evolutionary theories like Neutral theory of molecular evolution,Molecular clocks- genetic equidistance- human mitochondrial molecular clock and Phylogenetic relationships

Recognize Evolutionary trends in Biochemical evolution and primates evolution

An enhanced knowledge about the Mechanism of natural selection

The student develops appreciation about the major processes involved in the Co-evolution; Microevolution, Macroevolution etc.

The process involved in the Gradualism and punctuated equilibrium along with anagenesis and cladogenesis will be acquired

An enhanced level of conceptual learning regarding Neutral theory of molecular evolution

References

1. Coyne, J.A and Allen O.H (2004) Speciation. Sinauer Associates Inc. Massachusetts, USA
2. David, M.H, Craig Moritz and Barbara K.M (1996) Molecular Systematics. Sinauer Associates, Inc.
3. David, M.S (2009) DNA bar-coding will frequently fail in complicated groups: an example in wild
potatoes. American journal of Botany 96(6) : 1177-1189. Downloadable from
www.vcru.wisc.edu/spoonerlab/.../ Bar Codes %20 and % 20 wild % 20 Potatoes.pdf
4. Gould, S.J (1997) Ontogeny & Phylogeny, Belkrap Press. Harvard University Cambridge
5. Kipling, W.W; Brent, D.M and Quentin, D.W.(2005) The perils of DNA bar-coding and the need for
Integrative Taxonomy. Syst. Biol. 54(5): 844-851, Downloadable from
sysbio.oxfordjournals.org/cgi/reprint/54/5/844.pdf
6. McHenry, H.M (2009) Evolution. In Michael Ruse & Joseph Travis. Evolution: The first four Billion
Years. Cambridge, Massachusetts: The Belknap Press of Harvard University Press.p 265.
7. Motoo Kimura (1983) The neutral theory of molecular evolution. Cambridge University Press.

8. Roderick D.M. Page and Edward. C.H. (2000) Molecular Evolution: A Phylogenetic Approach: Blackwell Science.
9. Strikberger, M.W. (2000) Evolution, Jones and Bartett Publishers, London. 38
10. Brain,K.Hall and Benedikt, Hallgrinmson (2008). Strickberger¨s Evolution, 4th ed. Jones and Barlett
Publishers International ,London.
11. Futuyama, D.J.(2005). Evolution. Sinauer Associates Inc. Sunderland, Massachusetts.

THIRD SEMESTER THEORY

ZOL3C07 – IMMUNOLOGY

1. Introduction (1 hour)

2. Hematopoiesis (7 hours)

Hematopoiesis – Lymphoid and myeloid lineages.
Hematopoietic growth factors.
Genes that regulate hematopoiesis.
Regulation of hematopoiesis.
B- Lymphocytes, T- lymphocytes and Antigen presenting cells.

5. Antigen Antibody interactions (10 hours)

Strength of antigen – antibody interactions.(a) Antibody affinity
(b) Antibody avidity.
Cross- reactivity.
Precipitation reactions.
Immunotechnics – ELISA, RIA, WesternBlot, Immunoelectrophoresis,
Flow cytometry and fluorescence.

6. Generation of B-cell and T-cell responses. (9 hours)

Humoral immunity.
Cellular immunity.
T- Cell receptor, TCR-CD3 complex.
Activation, maturation and differentiation of B-Cells.
Activation, maturation and differentiation of T- Cells.

8. The Complement system. (3 hours)

The complement components.
The functions of complement components.
Complement activation (a) Classical pathway (b) Alternate pathway
(c) Lectin pathway.

Course Outcomes

An in-depth knowledge in the process of immune cell synthesis and maturation, antigen receptor structure and the mechanisms of antigen recognition by B-cell and T-cells.

The student gains conceptual knowledge regarding key principles, procedure and applications of different Immune Techniques used in the biomedical field and to develop new methods and techniques on the basis of the earned knowledge.

Mechanisms of humoral and cellular immunity, immune cell receptor and intracellular signal cascades related to immune system activation and response.

The complement system and its components, hypersensitivity and allergic responses, diseases related to hypersensitivity, autoimmune disorders and complement deregulation

References

1. Abdul K Abbas and Andrew H. Lichtman (2004). Basic immunology –Functions and Disorders of the immune system. (6th edition, Elsevier Science, USA)
2. Abdul K Abbas and Andrew H. Lichtman (2003). Cellular and Molecular Immunity (9th edition, Elsevier Science, USA).
3. Godkar, P.B (1998): A Text Book of Medical Laboratoy Technology.Bhalani Bhalani Publishing House Mumbai.
4. Janis Kuby (2000) .Immunology.9th ed. W.H. Freeman& Co. New York.
5. Joshi K. R and Osamo. N. O (1994) : Immunology. Agro Bios Publishers. Jodhpur.
6. Chakraborty ,A.K.(2006).Immunology and Immunotechnology.Oxford University Press.
7. Peter Parham (2004): The immune system (Second edition, Garlands, New York).
8. Ivan .M.Roit(2002). Essentials of Immunology.ELBS, New Delhi.
9. Shetty, N (1993) Immunology: Wiley Eastern Ltd, New Delhi.
10. Richard, Coico and Geoffrey, Sunshine (2009).Immunology- A short course.Wiley Blackwell. C A, USA.
11. David Male, Jonathan Brastoff, David Roth and Ivan Roitt (2006). Immunology. Mosby, Edinburgh, UK.
12. Hannigan, B.M., Moore, C.B.T. and Quinn, D.G.(2010). Immunology. Viva Books, New Delhi.
13. Khan F,H,(2009). Elements of Immunology. Pearson Education ,New Delhi.
14. Thomas J. Kindt, Barbara, A., Osborne And Richard, A.Goldsby.(2007). Kuby Immunology.6th ed. W.H.Freeman,New York.
15. Helen Chappel and Moused Harney (2006). Essentials of clinical Immunology. 5th ed. Blackwell Scientific Publications.

THIRD SEMESTER THEORY

ZOL3C08–DEVELOPMENTAL BIOLOGY

4. Cellular and Molecular basis of development (7 hrs)

Induction and competence- cascade of induction- reciprocal and sequential inductive events, instructive and permissive interactions.

Epithelial- Mesenchymal interactions- paracrine factors - The Hedhog family, The Wnt family, Juxtacrine signaling and cell patterning, notch pathway.

Cellular interactions concerned in fertilization, blastulation, gastrulation and organogenesis.

Molecular basis of cellular differentiation – Cadherins.

5. Genetic basis of development (8 hrs)

Differential gene transcription –Promoters and Enhancers, DNA

methylation, Transcription factors, Silencers and Insulators.
Differential RNA processing- X chromosome inactivationdosage compensation.
Control of gene expression at the level of translation-Differential mRNA longevity, selective inhibition of mRNA translation, Selective activation of mRNA translation, micro RNAs, Control of RNA expression by cytoplasmic localization.
Post translational regulation of gene expression.
Models of cell differentiation- hematopoiesis, myogenesis, differentiation of neural crest cells.
Reversibility of patterns of gene activity-cell fusion, transdifferentiation.

6. Metamorphosis, Regeneration and Ageing (7 hrs)

Metamorphosis in Amphibians and Insects and their hormonal control
Types of regeneration - Super, Hetero, Epimorphic, Morphallactic and Compensatory regeneration, Histological process during regeneration
Ageing – The biology of senescence, cellular and extra cellular ageing, Genes and ageing, DNA repair enzymes, Ageing and the insulin signaling cascade, The mTOR pathway, Chromatin modification, Wear and tear Oxidative damage, Mitochondrial genome damage, genetically programmed ageing

7. Environmental regulation of animal development (4 hrs)

Environmental regulation of normal development - types of polyphenism
Environmental disruptions of normal development (Teratogenesis)
Teratogenic agents - Alcohol, retinoic acid, Bisphenol A(BPA), heavy metals, pathogen, Testicular Dysgenesis Syndrome, DES as an endocrine disruptor, Endocrine disruptors as obesogens
Environmental oestrogens.
Impact of pesticide on development.

Course Outcomes

The student will appreciate the genetic, cellular and molecular basis of development.

The student will describe the process of ageing and mechanisms.

The student realize the impact of environment on development

References

Developmental biology
1. Balinsky, B. I.(1981). An introduction to Embryology. Holt Saunders, Philadelphia
2. Berril, N. J.and Karp.G.(1978). Developmental biology.Tata McGraw Hill., New Delhi.
3. Deuchar, E. M. Cellular interactions in animal development.
4. Gilbert, S. F.(2003). Developmental Biology. 7th ed. Sinauer Associates Inc. Massachusetts.
5. Hodge, R. Developmental Biology: From a Cell to an Organism.
6. Hopper, A. S. & N. H. Hart. Foundation of animal development.

7. Lash, J & J. R. Whittaker. Concepts of development.
8. Muller, W. A. Developmental biology. Springer.
9. Snustad, D. P., J. M. Simmons & J. B. Jenkins. Principles of Genetics.
10. Wolpert, L. Beddington,R.,Jessel,T., Lawrence, P., Meyerowitz,E.and
11. Smith, J.(2002). Principles of Development. Oxford university press, 2nd edition.
12. Slack, J, (2001). Essential Developmental Biology. Blackwell Publishing ,UK.
13. Twyman,R.M.(2001). Instant notes in Developmental Biology. Bios Scientific Publishers Ltd. Oxford.
14. Vasudeva Rao, K.(1994). Developmental Biology-a modern synthesis. Oxford IBH, New Delhi.

Part B- ENDOCRINOLOGY

5. Hormones and female reproductive physiology (3 hrs)

Synthesis, chemistry, and metabolism of Ovarian steroid hormones
Physiological roles of Ovarian steroid hormones
Hormonal regulation of female monthly rhythm
Hormonal factors in pregnancy, parturition and lactation

Course Outcomes

Describe the anatomy of male and female reproductive systems including hormonal functions and pathophysiology

References

1. Ganong, W. F. (2005). Review of medical physiology, Mc Graw Hill, New Delhi.
2. Hadley, M. E. (2000). Endocrinology, Pearson education, Inc., New Delhi.
3. Nelson R. J. Introduction to behavioral endocrinology
4. Norris D. O. (2005). Vertebrate endocrinology.
5. Williams, R. H.(1988). Text Book of Endocrinology. W. B. Saunders Company, Philadelphia.
6. Turner,K. and Bagnara, G. (1976). General Endocrinology.W.B. Saunders Company,Philadelphia.
7. Brook, C.G. and Marshall, N.J.(1996).Essential Endocrinology.3rded.Blackwell Science , London.
8. 17.Guyton, A.C. and Hall, J. E. (2001). Text Book of Medical Physiology.10thed. Prism Books, Pvt. Ltd. Harcourt Asia Ltd.India ed.
9. Hadley, M.G. (2000). Endocrinology .3rd ed. Prentice Hall International Inc. New Jersey

Mode of Instructions

PowerPoint Presentations
Lectures
Animated Videos

Mode Of Assessment

Regular Class Tests, Interactive Discussions, Presentations by Students, Quizzes,Q & A Sessions,Periodic Examinations

LESSON PLAN
M.Sc. Zoology
University of Calicut -2019 onwards

ZOL1C01 - BIOCHEMISTRY AND CYTOGENETICS

COURSE OUTCOMES (COs)

CO2	The Student develops the ability to analyse the structure, classification, and biochemical properties of carbohydrates from other organic molecules.
CO7	The student will explore various anabolic and catabolic pathways of biomolecules such as glucose, nucleic acids, amino acids and lipids.

2. Carbohydrates (8hrs)

2.1. Classification of carbohydrates with examples-
2.1.1 Structure of monosaccharides- glucose, fructose, galactose, mannose and ribose.
2.1.2. Methods of representation of sugars (Ball and stick, projection formula and perspective Formula)
2.1.3. Isomerism - Structural isomerism (functional group isomerism) and stereo isomerism (Optical isomerism)- mention epimer, anomer and enantiomer with examples, Mutarotation
2.1.4. Biological roles of monosaccharides.
2.2. Structure and biological roles of maltose, sucrose, lactose, trehalose and cellobiose.
2.3.1. Hompolysaccharides - Structure and biological roles of cellulose, starch, glycogen, Inulin and chitin
2.3.2. Heteropolysaccharide - Structure and biological roles of hyaluronic acid, chondroitin, Chondroitin sulphate, keratan sulphate, heparin and agar-agar.

Unit - IV - Metabolism and biosynthesis of biomolecules

1. Carbohydrate metabolism (4 hrs.)

1.4. Gluconeogenesis, Glycogenesis, Glycogenolysis; regulation of glycogen synthesis and breakdown.
1.5. Pentose phosphate pathway (HMP pathway) and its significance
1.6. Uronic acid pathway

Procedure / Process of Teaching –

- Lecture
- Power point presentations
- Illustrations
- Videos
- Peer learning – topics divided among students- each of them present their topic and discuss in class.

Procedure/ Process of Assessment –
Tests

Seminars

Individual quiz

REFERENCES

- Lenhninger, A. L. (2008). Principles of Biochemistry. (5th edn). CBS Publishers and Distributors, New Delhi.
- Lubert Stryer,(2011) Biochemistry, VII th edition, W.H. Freeman & Co.

ZOL1C02 - BIOPHYSICS AND BIOSTATISTICS
Part A. Biophysics

Course outcomes (COs)

CO 1	The student develops conceptual knowledge regarding the basic principles of physics involved in biological processes.
CO2	The student appreciate the biological aspects and implications of sound energy
CO4	The student may familiarize with various biophysical and electrophysiological methods
CO5	The student gain conceptual knowledge on the principles of microscopy and apply
CO7	The student explore the possibilities of the applications of separation techniques.
CO8	The student will describe gravity 'G' force and its multi-faceted applications.

1. Colloidal System (3 hrs)
1.1. Crystalloids and Colloids,
1.2. Properties of colloids- Kinetic, optical and electrical properties- Electrosmosis, Cataphoresis, Coagulation.
1.3. Forms of colloids, Suspensions and Emulsions, preparation and properties of emulsions.
1.4. Biological importance of colloids.

2. Diffusion and Osmosis (4 hrs)
2.1. Fick's laws and diffusion coefficient.
2.2. Gibb's Donnan equilibrium.
2.3. Application of diffusion processes in biology: haemolysis.
2.4. Osmosis, Osmotic concentration, Osmotic pressure and osmotic gradient.
2.5. Vant Hoff's laws
2.6. Electrolytic and ionic balance in biological fluid.

4. Bioacoustics (5 hrs)
4.1. Characteristics of sound.
4.2. Physical basis of hearing.
4.3. Physical organization of ear.
4.4. Physical aspects of sound transmission in the ear.
4.5. Audible sound frequency.
4.6. Pitch perception and theories.
4.7. Infrasonic and ultrasonic sounds.
4.8. Echolocation; receiving and analyzing echoes

5. Radiation Biology (9 hrs)
5.1. Radioactivity, different types ionizing radiations and their sources
5.2. Radioactive disintegration. Decay curve, half-life.
5.3. Biological effects of ionizing radiations – effects at macromolecular,cellular and organ system level, effects of whole body irradiation-Radiation therapy.
5.4. Biological applications of radioisotopes.
5.5. Radiation dosimetry- dose units and dose measurement.
5.6. Radiation Detectors - GM Counter, Solid and Liquid Scintillation Counter, Proportional counter, Semiconductor detectors.
5.7. Autoradiography

7. Electrophysiological methods (Brief) (3 hrs)
7.1. Single neuron recording.
7.2. Patch clamp recording.
7.3. ECG.
7.4. Brain activity recording.
7.5. Lesion and stimulation of brain.
7.6. Pharmacological testing.
7.7. PET (Positron Emission Tomography), MRI, fMRI, CAT.

8. Principles and applications of (8 hrs)
8.1. Fluorescent, Interference, Scanning and Transmission electron microscopes (SEM &TEM) .
8.2. Resolving powers of different microscopes.
8.3. Different fixation and staining techniques for EM (freeze-etch and freeze fracture methods for EM-image processing methods in microscopy).
8.4. Laser and its applications in Biology

10. Influence of gravity (3 hrs)
10.1. Human body posture in the gravitational field
10.2. Influence of G force.
10.3. s Force of centrifugal acceleration - importance of aviation and space travel
10.4. Effect of positive G. Force & negative G. Forces.
10.5. Protection against G. Force
10.6. Influence of linear acceleration on the body

11. Nanotechnology (2 hrs)
11.1. Definition
11.2. Nanotechnology and its applications in the field of health care.
11.3. Role of nanotechnology in environmental management.

Procedure / Process of Teaching –

- Lecture
- Power point presentations
- Illustrations
- Videos
- Peer learning – topics divided among students- each of them present their topic and discuss in class.

Procedure/ Process of Assessment –

- Tests
- Seminars
- Individual quiz

References

Roy, R.N (1996)-A text book of Biophysics-New central book Agency Calcutta

Part B –Biostatistics

Course outcomes (COs)

CO 10	The student develops ability to apply measures of central tendency and dispersion in biological research, and various types of probability distribution.
CO 11	The student analyse and apply parametric and non-parametric tests and its applications in biological research
CO 12	The student learn how to apply different types of ecological indexes in biological research

1. Introduction (2 hrs)
1.1 Biostatistics: Definition,
1.2 Characteristics of Statistics
1.3 Importance and usefulness of statistics
1.4 Limitations of Statistics
2. Data (5 hrs)
2.1. Types of data: classification based on Source of data, Compilation, Variable, Nature .
2.2. Methods of data collection and classification.
2.3. Types of sampling methods.
2.4. Advantages and disadvantages of census and sampling method.
2.5. Class intervals- exclusive and inclusive method
2.6. Frequency curve (types. skewness, kurtosis, ogive)
3. Statistical Methods: Measures of central tendency and dispersal (4 hrs)
3.1. Mean, (raw data, discrete series and continuous series)
3.2. Standard deviation, Standard error, degree of freedom (raw data, discrete series and continuous series)
3.3. Quartile deviation- Box- whisker plot

7. Ecological data analysis (problems to be discussed) (7 hrs)
7.1. Alpha diversity

Shannon diversity index, Simpsons Dominance index, Pielou‟s evenness index,

Margalef species Richness, Fisher‟s apha,

7.2. Beta diversity
Morisita Horn index, Sorenson index, Bray-Curtis similarity

Procedure / Process of Teaching –

- Lecture
- Power point presentations
- Illustrations
- Videos
- Peer learning – topics divided among students- each of them present their topic and discuss in class.

Procedure/ Process of Assessment –

- Tests

- Seminars
- Individual quiz

References

1. Agarwal, B.L. (1996) Basic statistics, New Age International(P) Ltd. Publishers, New Delhi.
2. Bailey, N.T.J. (1981) Statistical methods in Biology. Hodder and Stongtton, London.
3. Campell, R.C. (1978), Statistics for biologists. Blacker and Sons Publishers, Bombay.
4. Gupta, C.B. and Gupta, V. (2002) Statistical methods. Ikas Publishing House, New Delhi.
5. Rostogi, V. B. (2009) Fundamentals of Biostatistics. Ane's Students Edition, New Delhi.

ZOL1C03 - ECOLOGY AND ETHOLOGY (90 Hours)
Part-A-Ecology (54 hrs)

CO1	The student develops ability to differentiate between the concepts of Habitat, Niche
CO2	The student explain the concepts of, Ecosystem energetic sand Mineral cycling.
CO3	The student learn to appreciate nature's way to maximize efficiency in utilization of energy and resources; to reduce competition.
CO4	The student will be able describe the characteristics of population growth and species interaction.
CO5	The student will explain the components of Ecological community, the process of Ecological succession, Biomes etc.
CO6	The student will appreciate the complexity of relationship between organisms.
CO7	The student will be able to describe the characteristics of various biogeographically realms, and Indian biodiversity.
CO8	The student will be able to give explanation to the differential distribution of organisms across the world.
CO9	The student will describe the characteristics of various biogeographically realms, and Indian biodiversity
CO 10	The student will explain the concept of Carbon credit, Carbon trading etc.
CO 11	The student will learn to analyse various aspects of Green building technology and interlinking of rivers.
CO 12	The student learn to appreciate the richness of Indian biodiversity and various strategies of Wildlife conservation
CO 13	The student will be able to describe the components of animal behaviour, factors of motivation and conflict behaviour, properties of instinctive behaviour, types of learning, adaptiveness of behaviour, importance of biological rhythms and parental care, influence of hormones on behaviour.
CO 14	The student develops appreciation about the importance of nature watch and field study.

1. Introduction (3hrs)

1.1. Habitat and niche

1.1.1. Concept of habitat and niche

1.1.2. Niche width and overlap

1.1.3. Fundamental and realized niche

1.1.4. Resource partitioning

1.1.5. Character displacement

2. Ecosystem (9 hrs)

2.1. Structure and function

2.2. Ecosystem energetics

2.3. Primary production

2.4. Energy flow models

2.5. Mineral cycling (CNP)

2.6. Trophic levels, Food chain, food web and secondary production

2.7. Decomposers and detritivores

3. Population Ecology (7 hrs)

3.1. Characteristics of a population

3.2. Methods of estimating population density of animals, ranging patterns through direct,

indirect and remote observations
3.3 Sampling methods in the study of behaviour, habitat characterization
3.4. Ground and remote sensing methods
3.5. Population growth curves, Life tables, survivorship curves, population regulation, Life history strategies, r and k selection, Demes and dispersal, interdemic extinctions, age structure of populations.
3.6. Growth and regulation of human population

4. Species interaction (5 hrs)

4.1. Types of interactions, interspecific competition
4.2. Herbivory, Carnivory, Pollination, Symbiosis; mutualism, commensalisms and proto cooperation

5. Community Ecology (4 hrs)

5.1. Nature of communities**.**
5.2. Characteristics of a biotic community**.**
5.3. Species diversity and latitudinal gradients in diversity.
5.4 Edges and ecotones.

6. Ecological succession (4 hrs)

6.1. Types, mechanisms ,changes involved in succession .
6.2 Concept of climax

7. Biogeography (6 hrs)

7.1. Major terrestrial biomes: (a) Tropical rain Forest (b) Grassland (c) Desert (d) Chaparral (e) Temperate deciduous Forest (f) Temperate boreal forest (g) Tundra (h) Savanna

8. Biogeographical zones of India (4 hrs)

(a) Trans Himalayan zone; (b) Himalayan zone; (c) Desert zone; (d) Semiarid zone; (e) Western Ghats zone; (f) Deccan plateau zone; (g) Gangetic plain zone; (h) North east zone. (i) Coastal zone; (j) Islands present near the shore line.

9. Applied Ecology (8 hrs)

9.1 Carbon credit, Carbon trading, Blue Carbon
9.2 Green building technology and its ecological importance.
9.3 Discuss the benefits and disadvantages of the idea of (brief)
a. Inter linking of major rivers of India,
b. Sethusamudram ship canal project.
c. Biodiversity with special reference to India-status monitoring and documentation, major drivers of biodiversity change.

10. Conservation Biology (4 hrs)

10.1 Principles of conservation.
10.2 Major approaches to management,
10.3 Indian case studies on conservation & management strategy (concepts of project tiger, Biosphere reserves).

Part B. Ethology (36 hrs)

1. Introduction (1 hr)

2. Concepts of Ethology (4 hrs)

2.1. Ethology as different from the other schools studying animal behavior like behaviourism.
2.2. Behaviour as a reaction to stimuli - sign stimuli, social releasers, Ethograms, super normal stimuli, stimulus filtering.
2.3. Concepts of Fixed Action Patterns (FAP), Innate Releasing Mechanism(IRM),Action Specific Energy(ASE),Concepts of Learning and Imprinting.

3. Motivating factors (3 hrs)

3.1. General factors in motivation; Studies of motivation in guppies;
3.2. Mating systems-parental investment and reproductive success

4. Conflict behaviour- stress-displacement activities- Ritualization. (2 hrs)

5. **Instinctive behaviour & reflex action, neural basis of sleep and arousal. (2hrs)**

6. Learning- Neural basis of learning, memory, cognition, sleep and arousal **(3hrs)**
Biological clocks

7. Adaptiveness of behaviour (3 hrs)

JP Scott‟s categories of behaviour.

8. External stimulus - circadian rhythms (3 hrs)
8.1- Proximate and Ultimate factors.
8.2-Types of orientation-reafference theory of Von Holst & Mittel Steadt.
8.3-Navigation & migration

9. Parental care – (6 hrs)
9.1. Mating systems, Parental investment and Reproductive Success.
9.2. Development of behavior.
9.3. Social communication; Social dominance; Use of space and territoriality; domestication and behavioural changes; Social behaviour of termites & Primates;

10. Evolution and advaptiveness of behaviour (4 hrs)
Altruism, Kin selection, inclusive fitness, selfish gene theory, cultural transmission of behaviour.

11. Hormones and Behaviour- (5 hrs)
Hormones of gonads, adrenal gland , Pituitary gland,-Hormonal effects on different behavioural patterns , Maternal behavour- mechanism of hormonal action.

Procedure / Process of Teaching –

- Lecture
- Power point presentations
- Illustrations
- Videos
- Peer learning – topics divided among students- each of them present their topic and discuss in class.

Procedure/ Process of Assessment –

- Tests
- Seminars
- Individual quiz

References

1. Ahluwalia and Sunitha Malhorta-Environmental Science-Ane Books Pvt.Ltd
2. Allan Beebi and Anne Maria Brennan(2006)- First Ecology-Ecological principles and environmental issues-Oxford university press .
3. Archbold, O. W. (1995). Ecology of World Vegetation. New York, NY: Chapman and Hall.
4. Begon,Harper, Townsend- Ecology- Individuals, Populations, and communities- Blackwell Science,Second edition
5. Brewer Richard (1994).The Science of Ecology-Saunders college publishing.
6. Chapman J.L and Reiss.M.J- Ecology principles and applications-Cambridge low price editions
7. Charles J .Krebs- Ecology.The experimental analysis of distribution and abundance .
8. David Quammen. 1997. The Song of the Dodo: Island Biogeography in an age of Extinctions. Scribner. ISBN 0-684-82712-3
9. Dick Neal- Introduction to population Biology- Cambridge University Press

10. Eugene P.Odum- Fundamentals of Ecology- W.B.Saunders Company.
11. Fred, Van Dyke (2003). Conservation biology-foundation concepts, applications-Mc Graw Hill, New Delhi.
12. MacArthur, R. H. and Wilson, E. O.(1967). The Theory of Island Biogeography. Princeton, N.J.: Princeton University Press.
13. Magurran, A. E.(2004). Measuring biological diversity. Oxford: Blackwell Publishing. ISBN 0- 632-05633-9
14. May and Mc Lean- Theoretical Ecology principles and applications-Oxford University Press
15. Peter.S.(2002). Ecology- Theories and Applications. Prentice Hall of India.
16. Whittaker, Robert H. Communities and Ecosystems New York: MacMillan Publishing Company, Inc., 1975.

Ethology

1. Chris Barnard (2003): Animal Behaviour: Mechanism, Development, Function and Evolution, Publisher: Pearson Education.
2. David McFarland (1999): Animal Behaviour: Psychobiology, Ethology and Evolution, 3rd Edition. Publisher: Pearson Education.
3. David Mcfarland (2006) A Dictionary of Animal Behaviour. Publisher: Oxford Uiversity Press.

4.Goodenough, J; McGuire B. and Robert, W. (1993) Perspectives on Animal Behaviour. John Wiley and Sons, Lond.
5. Graham Scott (2004) Essential Animal Behaviour. Publisher: Wiley-Blackwell
6. Lenher, P. (1996) Handbook of Ethological methods. Cambridge Univ.Press, Lond.
7. Manning, A. (1967) An Introduction to Animal Behaviour. Edward Arnold Pub., London.
8. Manning, A. and Dwakins, M.S. (1995) An Introduction to Animal Behaviour. Cambridge Univ. Press, Lond.
9. Martin P. and Bateson .P.(2001). Measuring Behaviour – an introductory guide. Cambridge University Press, UK.
10. Scott, J.P. (1972) Animal Behaviour. Publisher: Univ of Chicago.

SECOND SEMESTER
ZOL2C05 - MOLECULAR BIOLOGY
Course outcomes

CO1. The student will acquire knowledge regarding the mechanism of DNA replication- both chromosomal and extra chromosomal, enzymes involved, models of replication, inhibitors and the significance of DNA replication
CO2. The student learn to know the safeguard systems of DNA, restriction enzymes and their significance, mechanisms involved in damage and repair of eukaryotic DNA and its importance.
CO3. Learn to explain the general features of genetic code, special features of the genetic code in mitochondria, and variations in genetic code.
CO4. The student gain in-depth knowledge regarding the structural organization of mRNA in prokaryotes and eukaryotes, the mechanism of transcription, translation, post transcriptional and translational modifications, structure , biogenesis and role of ribosomes in protein synthesis ; and RNA editing.
CO5. The student will gain knowledge regarding the regulation of gene expression in Phages, Bacteria, and in Eukaryotes ; recent research findings like antisense RNA strategies and role of si RNA and mi RNA in the regulation of eukaryotic gene expression and their applications.
CO6. The components , organization and special features of eukaryotic genome, interrupted genes and their evolution; concept of gene families, and molecular evolutionary clock.
CO7. Introduction to transposition mechanisms in prokaryotes and eukaryotes, and their significance.
CO8. Molecular mechanisms of genetic recombination models, and significance.
CO9. Special features of microbial genetics, and organelle genome, their replication and mapping.
CO10. The student gain an in depth knowledge regarding the events and regulation of cell cycle, its alteration and causes of cancer. Genes involved in the regulation of cancer and modern therapeutic interventions like immunotherapy and gene therapy.

1. DNA replication (11 Hrs)

1.1. Semidiscontinuous synthesis-Okazaki fragments
1.2. Replication origin and replication fork
1.3. Unit of replication, extra chromosomal replicon of bacterial Ti plasmid
1.4. Enzymes/proteins of replication- Primase, Replisomes, Helicase, DNA polymerases, Single strand binding proteins, Topoisomerases and Ligase;
1.5. Fidelity of replication
1.6. Replication of the ends of eukaryotic chromosome – role of telomerase
1.7. Models of DNA replication –Rolling circle model and looped rolling circle model, D-loop model, θ-model.
1.8. Inhibitors of DNA replication – Methotrexate and Fluorodeoxyuridylate

2. Safeguard systems of DNA (5 Hrs)

2.1. Restriction: significance, role and features of Type I, II & III restriction enzymes
2.2. Modification: enzymes and significance
2.3. Repair:
2.3.1. Major kinds of damage to DNA and causes
2.3.2. Repair mechanisms: Direct reversal, Mismatch repair, Excision repair, Recombination repair, SOS response

3. Transcription of mRNA in prokaryotes and eukaryotes (10 Hrs)
3.1. Structural organisation and life span of mRNA; monocistronic and polycistronic mRNA
3.2. Transcription in prokaryotes and eukaryotes
3.2.1. Promoter (mention Pribnow, TATA, CAAT and GC box), enhancer and silencer sites
3.2.2. Transcription factors; Transcription activators and repressors
3.3. Characteristic features of RNA polymerases of phages, prokaryotes and eukaryotes and their functions
3.4. Post transcriptional modification of RNA
3.4.1. Capping
3.4.2. Polyadenylation
3.4.3. Splicing
3.5. RNA editing: site specific deamination and role of gRNAs
3.6. mRNA transport
4. Genetic code (5 Hrs)
4.1. Characteristics of genetic code
4.2. Start codons and stop codons
4.3. Degeneracy of the code: Wobble hypothesis and isoacceptor tRNAs
4.4. Special features of the genetic code in mitochondria, mitochondrial tRNA
4.5. Variations in the genetic code in *Mycoplasma* and *Tetrahymena*
4.6. Point mutations that alter genetic code (missense, nonsense & frameshift)
5. Ribosome: The site of protein synthesis: (2 Hrs)
5.1. Structure

5.2. Composition; Reconstitution experiments
5.3. Active centres
5.4. Biogenesis of ribosome in eukaryotes
6. Translation in prokaryotes and eukaryotes: (8 Hrs)
6.1. Aminoacylation of tRNA & initiation, elongation and termination of protein synthesis
6.2. Aminoacyl tRNA synthetases & initiation, elongation and termination factors
6.3. Translational proof-reading
6.4. Differences in protein synthesis between prokaryotes and eukaryotes
6.5. Translational inhibitors in prokaryotes and eukaryotes – role of tetracycline, streptomycin, neomycin, chloramphenicol, erythromycin, puromycin and diphtheria toxin
6.6. Post- translational modification of proteins: protein folding (role of chaperones) and biochemical modifications
7. Control of gene expression at transcription and translation level: (9 Hrs)
7.1. Regulation of gene expression in Phages – alternate patterns of gene expression for control of lytic and lysogenic cycle in λ phage
7.2. Regulation of gene expression in bacteria – basic features of tryptophan, arabinose and galactose operons
7.3. Regulation of gene expression in eukaryotes –
7.3.1. Role of chromatin in regulating gene expression
7.3.2. Activation and repression of transcription
7.3.3. Regulation of translation by gene arrangement
7.3.4. Regulation of translation by alternate pathways of transcript splicing
7.3.5. Antisense RNA strategies for regulating gene expression
7.3.6. si RNA and mi RNA in regulation
8. Eukaryotic genome: (5 Hrs)
8.1. Special features of eukaryotic genome
8.2. Features, components and reassociation kinetics of Unique, Moderately repetitive and Highly repetitive DNA
8.3. Junk DNA, Satellite DNA and Selfish DNA

8.4. Cot value and complexity of genome
8.5. Organisation of human genome (brief account)

9. Interrupted genes (4 Hrs)

9.1. Definition and explanation
9.2. Organisation and special features of interrupted genes
9.3. Evolution of interrupted genes

10. Gene families: (6 Hrs)

10.1. Definition and concept
10.2. Classification with example
10.2.1. Simple multigene family - organisation of rRNA gene in *Xenopus*
10.2.2. Complex multigene family - organisation of histone genes in sea urchin and tRNA genes in *Drosophila*
10.2.3. Developmentally controlled complex multigene family e.g., globin gene
10.2.3.1. Globin genes and its products

10.2.3.2. Organisation of globin genes and its expression in Man
10.2.3.3. Evolution of globin genes
10.2.4. Concept of an evolutionary clock
10.2.5. Pseudogenes

11. Transposable genetic elements - Transposons (6 Hrs)

11.1. Definition, features and types
11.2. Transposition and mechanism
11.3. Transposons in bacteria
11.3.1. IS elements
11.3.2. Tn family
11.3.3. Mu phage as a transposable element
11.4. Transposons in eukaryotes
11.4.1. SINE, Alu family; LINE, L1
11.4.2. P elements in *Drosophila*
11.4.3. Transposons in Maize
11.5. Retroviruses and transposition

12. Molecular mechanisms involved in recombination of DNA: (5 Hrs)

12.1. Genetic recombination – types with example
12.1.1. Site specific recombination
12.1.2. Non-homologous recombination
12.1.3. Homologous recombination
12.2. Molecular mechanism involved in homologous recombination of DNA in eukaryotes- Holliday model: Holliday intermediate, heteroduplex DNA, gene conversion
12.3. Role of Rec A protein in genetic recombination

13. Microbial genetics (5 Hrs)

13.1. Prokaryotic genome- *Escherichia coli* genome – basic features
13.2. Methods of genetic transfers in bacteria– transformation (in *Streptococcus pneumonia*), conjugation and sexduction, transduction
13.3. Brief note on mapping genes by interrupted mating (in bacteria)

14. Organelle genome (4 Hrs)

14.1. Chloroplast genome: special features
14.2. Mitochondrial genome
14.2.1. Special features of yeast mitochondrial genome, petite mutants
14.2.2. Special features of human mitochondrial genome.

15. Cancer (5 Hrs)

15.1. Genetic rearrangements in progenitor cells, oncogenes, protooncogenes and tumour suppressor genes
15.2. Virus-induced cancer

15.3. Alteration of cell cycle regulation in cancer
15.4. Interaction of cancer cells with normal cells
15.5. New therapeutic interventions of uncontrolled cell growth (immunotherapy and gene therapy).

Procedure / Process of Teaching –

- Lecture
- Power point presentations
- Illustrations
- Videos
- Peer learning – topics divided among students- each of them present their topic and discuss in class.

Procedure/ Process of Assessment –

- Tests
- Seminars
- Individual quiz

References

1. Attwood T.K, Parry-Smith D.J. (2003): Introduction to Bioinformatics. Pearson Education
2. Benjamin Lewin (2008): Genes, Vol. IX, Boston, Jones, Bartlet.
3. Brown, T.A. (2006): Genomes 3.Garland Science, New York.
4. Elliott, W. H and Elliott, D. C. (1997): Advanced Molecular Biology, Viva Books, New Delhi
5. Freifelder, D. (2003): Molecular Biology, Narosa Publishing House, New Delhi
6. Gupta, P. K. (2005): Cell and Molecular Biology, Rastogi Publications, New Delhi
7. Kothekar, V. (2004): Introduction to Bioinformatics. DHRUV Publications, Delhi.
8. Kumar, H. D. (2001): Molecular Biology, Vikas publications, New Delhi
9. Malacinski, G. M. (2005): Essentials of Molecular Biology, Narosa Publishing House, New Delhi
10. Mayers, R.A (Ed) (1995). Molecular Biology and Biotechnology: A Comprehensive Desk Reference.VCH Publishers, Inc., New York
11. Russel, P. J. (2009): Cell and Molecular Biology, Cengage learning
12. Tropp, B. E. (2008): Molecular Biology, Jones and Bartlet.
13. Veer Bal Rastogi (2008): Fundamentals of Molecular Biology, Ane Books India
14. Watson, J. D. (1998): Molecular Biology of the gene, Benjamin Publishing house.
15. Watson, J. D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R.. (2006).Molecular Biology of the Gene, Pearson Education.
16. Benjamin Lewin (2006). Essential Genes, Pearson, London.
17. Brown, T.A.(2000). Essential Molecular Biology. IInd ed. Oxford OUP.
18. Sinden, Richars,R.(2006). DNA structure and function. California, Academic Press,.
19. Snustad, D.P. and Simmons, M.J.(2000). Principles of Genetics. 2nd ed. John Wiley and Sons Inc.

SECOND SEMESTER
ZOL2C06 - SYSTEMATICS AND EVOLUTION

CO1. The student develops skills in the identification and taxonomic classification of organisms based on their characters
CO2. The student will be able to describe different levels of taxonomy
CO3. Aware about Place, importance, applications and goals of taxonomy
CO4. Learn about purpose of classification, use of classification, theories of biological classification and types classification
CO11. Realize the taxonomic impediments
CO17. The student develops conceptual understanding on Hardy-Weinberg law, founder principle, bottleneck effect and genetic drift, process of Isolating mechanisms-Prezygotic and Postzygotic isolating mechanisms; speciation-allopatric, peripartric-parapatric heteropatricsympatric speciation; ecotypes etc.
CO18. The student develops appreciation about the major processess involved in the Co-evolution; Microevolution, Macroevolution etc

Part –A: Systematics

I. Introduction (1 hr)

2. Definition and basic concepts in Systematics and Taxonomy (4 hrs)

2.1 Levels of Taxonomy

(a) Alpha, Beta and Gamma taxonomy

2.2 Importance and applications of taxonomy

2.3 Goals of taxonomy

2.4 Definition of systematics

2.5 Definition of classification

3. Species (4 hrs)

3.1 Monotypic species

3.2 Polytypic species

3.3 Ecospecies and Cenospecies

3.4 Morphospecies

3.5 Super species

3.6 Species as a Population Complex

4. Species Concepts (6 hrs)

4.1 Typological Species Concept

4.2 Nominalistic Species Concept

4.3 Biological Species Concept

4.4 Evolutionary Species Concept

4.5 Difficulties in the application of the biological species concept

11. Taxonomic impediments (4 hrs)

11.1 Impediments in taxonomic collections and maintenance

11.2 Shortage of man power

11.3 Lack of funding for taxonomic research

11.4 Lack of training and library facilities

11-5 Impediments in publishing taxonomic work

11.6 Solutions to overcome the impediments

(a) Improve international co-operation (b) Development of taxonomic centers
(c) Need for efficient international networking (d) the desired end product

Part- B Evolution

2 The Mechanisms (7 hrs)
2.1 Population genetics- populations, gene pool, gene frequency, Hardy-Weinberg law, founder principle, bottleneck effect and genetic drift as factors in evolution
2.2 Evidence for evolution: DNA evidence, fossil evidence, embryological evidence, geological evidence, evolution in action, imperfection of evolution
2.3 Co-evolution: microevolution, macroevolution, convergent evolution (homoplasy), divergent (parallel) evolution

Procedure / Process of Teaching –

- Lecture
- Power point presentations
- Illustrations
- Videos
- Peer learning – topics divided among students- each of them present their topic and discuss in class.

Procedure/ Process of Assessment –

- Tests
- Seminars
- Individual quiz

References

Part -A Systematics
1. David.M.H, Craig Mortiz and Barbara K.M (1996) Molecular Systematics. Sinauer Associates, Inc
2. David, M.S (2009) DNA bar-coding will frequently fail in complicated groups: an example in wild potatoes. American journal of Botany 96(6) : 1177-1189. Downloadable from www.vcru.wisc.edu/spoonerlab/.../ Bar Codes %20 and % 20 wild% 20 Potatoes.pdf
3. Dalela, R.C. and Sharma, R.S.(1992). Animal Taxonomy and Museology, Jai Prakash Nath & Co Meerut City U.P (India)
4. Kapoor V.C (1998) Theory and practice of animal taxonomy. Oxford & IBH, Publi.Co New Delhi
5. Kipling, W.W; Brent, D.M and Quentin, D.W.(2005) The perils of DNA bar-coding and the need for Integrative Taxonomy. Syst. Biol. 54(5): 844-851, Downloadable from sysbio.oxfordjournals.org/cgi/reprint/54/5/844.pdf
6. Mayr. E (1969) Principles of Systematic Zoology. McGraw Hill Book Company, Inc, New York
7. Narendran, T.C (2008) An introduction to Taxonomy. Zoological Survey of India
8. Sneath P.H.A.(1973) Numerical Taxonomy: The Principles and Practice of Numerical Classification.W.H. Freeman &Co

Part- B Evolution
1. Coyne, J.A and Allen O.H (2004) Speciation. Sinauer Associates Inc. Massachusetts, USA
2. David, M.H, Craig Moritz and Barbara K.M (1996) Molecular Systematics. Sinauer Associates, Inc. 5. Kipling, W.W; Brent, D.M and Quentin, D.W.(2005) The perils of DNA bar-coding and the need for Integrative Taxonomy. Syst. Biol. 54(5): 844-851, Downloadable from sysbio.oxfordjournals.org/cgi/reprint/54/5/844.pdf
3. McHenry, H.M (2009) Evolution. In Michael Ruse & Joseph Travis. Evolution: The first four Billion Years. Cambridge, Massachusetts: The Belknap Press of Harvard University Press.p 265.

4. Motoo Kimura (1983) The neutral theory of molecular evolution. Cambridge University Press.
5. Roderick D.M. Page and Edward. C.H. (2000) Molecular Evolution: A Phylogenetic Approach: Blackwell Science.
6. Strikberger, M.W. (2000) Evolution, Jones and Bartett Publishers, London. 38
7. Brain,K.Hall and Benedikt, Hallgrinmson (2008). Strickberger‟s Evolution, 4th ed. Jones and Barlett Publishers International ,London.
8. Futuyama, D.J.(2005). Evolution. Sinauer Associates Inc. Sunderland, Massachusetts.

THIRD SEMESTER

ZOL3C07 – IMMUNOLOGY

CO5. The student explore the fundamentals of Immune effector mechanisms, chemical signalling through cytokines, its therapeutic uses and cytokine related diseases.
CO6. The complement system and its components, hypersensitivity and allergic responses, diseases related to hypersensitivity, autoimmune disorders and complement deregulation.

7. Immune effector mechanism. (7 hours)
7.1. Cytokines.
7.2. Properties of cytokines.
7.3. Cytokine antagonists.
7.4. Cytokine secretion by TH1 and TH2-cells.
7.5. Cytokine related diseases. (a) Bacterial septic- shock (b) chaga's disease) (c) lymphoid and myeloid cancers.
7.6. Therapeutic uses of cytokines.
7.7. Toll- like receptors.

8. The Complement system. (6 hours)
8.4. Regulation of complement system.
8.5. Biological consequences of complement activation.
8.6. Complement deficiencies.

9. Major Histocompatibility Complex (MHC) (8 hours).
9.1. General organization and inheritance of MHC.
9.2. MHC molecules and genes.
9.3. Cellular distribution of MHC.
9.4. Antigen- processing and presentation- Exogenous and Endogenous pathways.
9.5. Presentation of non- peptide antigens.

10. Transplantation immunology (8 hours)
10.1. Auto graft, Allograft, Isograft and xenograft
10.2. Immunological basis of graft rejection.
10.3. Role of cell- mediated responses.
10.4. Transplantation antigens.
10.5. General immune suppressive therapy.

11. Hypersensitivity Reactions. (5 hours)
11.1. Allergens.
11.2. IgE- mediated (type- I) hypersensitivity.
11.3. Antibody- mediated cytotoxic (type- II) hypersensitivity.
11.4. Immune complex- mediated (type- III) hypersensitivity.

Procedure / Process of Teaching –

- Lecture

- Power point presentations
- Illustrations
- Videos
- Peer learning – topics divided among students- each of them present their topic and discuss in class.

Procedure/ Process of Assessment –

- Tests
- Seminars
- Individual quiz

References

1. Abdul K Abbas and Andrew H. Lichtman (2004). Basic immunology –Functions and Disorders of
the immune system. (second edition, Elsevier Science, USA)
2. Abdul K Abbas and Andrew H. Lichtman (2003). Cellular and Molecular Immunity (fifth edition,
Elsevier Science, USA).
3. Godkar, P.B (1998): A Text Book of Medical Laboratoy Technology.Bhalani Bhalani Publishing
House Mumbai.
4. Janis Kuby (2000) .Immunology.7th ed. W.H. Freeman& Co. New York.
5. Joshi K. R and Osamo. N. O (1994) : Immunology. Agro Bios Publishers. Jodhpur.
6. Chakraborty ,A.K.(2006).Immunology and Immunotechnology.Oxford University Press.
7. Peter Parham (2004): The immune system (Second edition, Garlands, New York).
8. Ivan .M.Roit(2002). Essentials of Immunology.ELBS, New Delhi.

THIRD SEMESTER
ZOL3C08–DEVELOPMENTAL BIOLOGY & ENDOCRINOLOGY

CO1: The student will gain knowledge on basic concepts in development.
CO2: The student will explain the process of gametogenesis, fertilization and embryonic development.
CO3: The student will appreciate the genetic, cellular and molecular basis of development.
CO8: Summarize the anatomy, regulation, and physiological functions of the hormones of the hypophysis, thyroid, parathyroid, pancreas adrenal, hypothalamus and adrenal glands.

PART A DEVELOPMENTAL BIOLOGY

1. Introduction: Basic concepts of development (6 hrs)
1.1. Cell fate, potency, determination and differentiation.
1.2 Commitment
1.3. Specification - autonomous, conditional, syncytial .
1.4. Genomic equivalence and cytoplasmic determinants
1.5. Morphogenetic gradients
1.6. Genomic Imprinting
1.7. The stem cell concept- Progenitor cells, Adult stem cells, Mesenchymal stem cells, Multipotent adult stem cells, Pluripotent Embryonic stem cells, Stem cell therapy.
2. Gametogenesis, fertilization and early development (10 hrs)
2.1. Production of gametes- Spermatogenesis and Oogenesis, Ultra structure of gamates
2.2 Cell surface molecules in sperm-egg recognition in animals (sea urchin and mammals)
2.3 Zygote formation-
2.3.1. Encounter of sperm and egg
2.3.2. Capacitation
2.3.3. Acrosome reaction
2.3.4. Activation of ovum
2.3.5 Amphimixis
2.3.6. Prevention of Polyspermy (Fast block and Slow block)
2.4 Cleavage and blastula formation
2.5 Gastrulation and formation of germ layers in amphibia
2.6 Embryonic fields
3. Embryogenesis and Organogenesis (10 hrs)
3.1 Axis formation in amphibians - The phenomenon of the Organizer- Nieuwkoop center, primary embryonic induction, mechanism of axis formation
3.2 Anterior posterior patterning in Amphibians - Hox code hypothesis
3.3 Anterior posterior patterning in *Drosophila* – anterior forming genes (bicoid, hunchback),

posterior forming genes (nanos, caudal), terminal forming gene (torso), segmentation genes- gap genes, pair rule genes, segmentation polarity genes, homeotic selector genes, realistor genes
3.4 Dorso- ventral patterning in *Drosophila*- dorsal protein gradient
3.5. Limb development in chick- Formation of the Limb Bud, Generating the Proximal-Distal Axis of the Limb, Specification of the Anterior-Posterior Limb Axis, Generation of the Dorsal-Ventral Axis
3.6. Insect wings and legs formation
3.7. Vulva formation in *Caenorhabditis elegans.*
3.8. Eye lens induction.

8. Developmental Mechanisms of Evolutionary change- (1hrs)
Heterotopy, Heterochrony

Part B- ENDOCRINOLOGY

6. Neurohormones (3 hrs)
6.1. Gases as neural messengers
6.2. Endorphins- physiological roles, mechanism of action and pathophysiology
6.3. Brain hormones and behaviour
6.4. Neuroendocrine pathophysiology

Procedure / Process of Teaching –

- Lecture
- Power point presentations
- Illustrations
- Videos
- Peer learning – topics divided among students- each of them present their topic and discuss in class.

Procedure/ Process of Assessment –

- Tests
- Seminars
- Individual quiz

References
Developmental biology
1. Balinsky, B. I.(1981). An introduction to Embryology. Holt Saunders, Philadelphia
2. Berril, N. J.and Karp.G.(1978). Developmental biology.Tata McGraw Hill., New Delhi.
3. Deuchar, E. M. Cellular interactions in animal development.
4. Gilbert, S. F.(2003). Developmental Biology. 7th ed. Sinauer Associates Inc. Massachusetts.
5. Hodge, R. Developmental Biology: From a Cell to an Organism.
6. Hopper, A. S. & N. H. Hart. Foundation of animal development.
7. Lash, J & J. R. Whittaker. Concepts of development.
8. Muller, W. A. Developmental biology. Springer.

9. Snustad, D. P., J. M. Simmons & J. B. Jenkins. Principles of Genetics.

10. Wolpert, L. Beddington,R.,Jessel,T., Lawrence, P., Meyerowitz,E.and
11. Smith, J.(2002). Principles of Development. Oxford university press, 2nd edition.
12. Slack, J, (2001). Essential Developmental Biology. Blackwell Publishing ,UK.
13. Twyman,R.M.(2001). Instant notes in Developmental Biology. Bios Scientific Publishers Ltd.
Oxford.
14. Vasudeva Rao, K.(1994). Developmental Biology-a modern synthesis. Oxford IBH, New Delhi.

Endocrinology

1. Bentley, P. J. (1998). Comparative vertebrate endocrinology.3rd ed.Cambridge University Press
2. Bern, H. A. Text book of comparative endocrinology
3. Bolander, F. F.(2006). Molecular endocrinology, Academic press, New Delhi.
4. Ganong, W. F. (2005). Review of medical physiology, Mc Graw Hill, New Delhi.
5. Hadley, M. E. (2000). Endocrinology, Pearson education, Inc., New Delhi.
6. 6.Harris, G. W. (1995). Neural control of the pituitary gland, Edward Arnold, London.

Lesson Plan – Dr. Betty K.P

FIRST SEMESTER B Sc. COMPLEMENTARY BOTANY COURSE: 1

ANGIOSPERM ANATOMY AND MICROTECHNIQUE

Semester	Course code	Credits	Hrs/wk
1	BOT1C01T	2	4

COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Explain the types, structure and functions of plant tissues.
2. Explain primary and secondary (normal and anomalous) structures of plant organs.
3. Identify plant organs by observing anatomical features.
4. Illustrate primary and secondary (normal and anomalous) structures of plant organs.
5. Apply the histochemical techniques in laboratory works.

ANGIOSPERM ANATOMY

Module – I (**9** hrs)

1 Tissues - Definition, Kinds - Meristematic & Permanent. (**8** hrs)

1. Meristematic tissues - Classification – based on origin & position; Organization of root apex and differentiation of tissue – Histogen theory; Organization of stem apex and differentiation of tissues - Tunica & Corpus theory.
2. Permanent tissues - Definition - classification; Simple tissues (Parenchyma, Collenchyma and Sclerenchyma), Complex tissues (Xylem & Pholem) Secretory tissues - Glandular tissues (Nectaries in *Euphorbia pulcherrima*, Stinging hairs in *Tragia*) Oil glands in *Citrus, Eucalyptus*; Digestive glands in *Nepenthes*; Laticiferous tissues (Non-articulate latex ducts in *Euphorbia* and articulate latex duct – latex vessels in *Hevea*), Hydathodes.

2 Vascular bundles – types: conjoint - collateral, bicollateral, concentric and radial. (**1** hr)

Module – II (**6** hrs)

1. Primary structure of dicot and monocot root, dicot and monocot stem and leaf in dicot and monocot. (**6** hrs)

Module – III (**12** hrs)

1. Normal secondary thickening in dicot stem (*Vernonia*). (**10** hrs)
   a. Intra stelar thickening: formation of cambial ring, its structure, fusiform and ray initials, storied and non - storied cambium, activity of the cambium, formation and structure of secondary wood, secondary phloem and vascular rays.
   b Extra stelar thickening: formation, structure and activity of the phellogen, formation of periderm in stem and root; bark and lenticel.
   c Growth rings, ring and diffuse porous wood, sapwood and heart wood,

tyloses.d Normal secondary thickening in dicot root (*Tinospora*)

2 Anomalous secondary growth in *Boerhaavia*. (**2** hrs)

PRACTICAL (ANGIOSPERM ANATOMY)

1 Identity simple and complex tissues and determine the type of vascular bundles using microscope.

2 Make suitable micro preparations to study the anatomy of the following:

A Dicot stem: *Cephalandra Centella* (Primary); *Vernonia* (secondary).

b. Monocot stem: Bamboo

c. Dicot root: Tinospora (young –Primary; mature –Secondary)

d. Monocot root: *Colocasia*,

e. Anomalous secondary growth (*Boerhaavia*).

f. Dicot leaf: *Ixora* and Monocot leaf: grass.

REFERENCES: (ANGIOSPERM ANATOMY)

1. Cuttler, EG. 1969. Plant Anatomy - Part I Cells & Tissue. Edward Arnold Ltd., London.
2. Cuttler, E.G. 1971. Plant Anatomy, Part III Organs Edward Arnold Ltd., London.
3. Esau K. 1985. Plant Anatomy (2nd ed.) Wiley Eastern Ltd. New Delhi.
4. Pandey B.P. Plant Anatomy, S. Chand & Co. Delhi.
5. Vasishta P.C. 1974. Plant Anatomy, Pradeep Publication, Jalandhar.
6. Tayal M.S Plant Anatomy. Rastogi Publishers, Meerut.

MICROTECHNIQUE

Module – I (**9** hrs)

1. Microtechnique - Brief Introduction
2. Microscopy: simple, compound and electron microscope
3. Microtomy: Rotary type, serial sectioning, paraffin method, significance.
4. Killing and fixing: Killing and fixing agents and their composition (Farmer's fluid and FAA.)
3. Dehydration and clearing - reagents (mention only)
4. Stains – Saffranin and acetocarmine, preparation and use.

PRACTICAL (MICROTECHNIQUE)

1 Familiarise the structure and working of compound microscope (drawings not required)

2 Preparation of Safranin, FAA and Acetocarmine

REFERENCES (MICROTECHNIQUE)

1. Johansen, D.A. (1940) Plant Microtehnique. Mc Graw – Hill Book Company, Inc. New York.
2. Kanika, S. (2007) Manual of Microbiology – Tools and Techniques. Ane's student edition.
3. Khasim, S.K. (2002) Botanical Microtechnique; principles and Practice, Capital Publishing Company, New Delhi.
4. Toji, T. (2004) Essentials of Botanical Microtechnique. Apex Infotec Publ.

COMPLEMENTARY COURSE: 2
CRYPTOGAMS, GYMNOSPERMS AND PLANT PATHOLOGY

Semester	Course code	Credits	Hrs/wk
2	BOT2C02T	2	4

COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Analyze the role of the lower plants in the process of evolution.
2. Explain the ecological significance of lower plants.
3. Identify plant diseases and take remedial measures to control them.

CRYPTOGAMS & GYMNOSPERMS

Module – I : Virus, Bacteria, BGA (**9** hrs)

1. Virus: General account of viruses, including structure of TMV & Bacteriophage. (**2** hrs)
2. Bacteria: Classification based on shape of flagella, structure, nutrition (brief account), reproduction and economic importance - agriculture, industry and medicine. (**5** hrs)
3. Cyanobacteria: General Account structure, life - history and economic importance of *Nostoc*. (**2** hrs)

Module – II : Phycology, Mycology, Lichenology (**12** hrs)

1. Phycology: General characters, classification, evolutionary trends in algae. (**2** hrs)
2. Structure, reproduction, life history and economic importance of the following classes with suitable examples: (**4** hrs)
   a) Chlorophyceae (*Spirogyra*)
   b) Phaeophyceae (*Sargassum*)
   c) Rhodophyceae (*Polysiphonia*).
3. Mycology: General characters, classification (Alexopoulos, 1979) (brief mention only) and evolutionary trends, economic importance in fungi. (**2** hrs)
4. Important features of the following divisions (brief account only) (**1** hr)
   a) Mastigomycotina
   b) Zyomycotina
   c) Ascomycotina
   d) Basidiomycotina.
5. Structure and life history of *Puccinia* (developmental details not required) (**2** hrs)
6. Lichenology: General account and economic importance of Lichens with special reference to Usn*ea*. (**1** hrs)

Module – III : Bryology, Pteridology , Gymnosperms (**12** hrs)

1. Bryology: General account, morphology and life - history of *Riccia* (**4** hrs)
2. Pteridology: General account, morphology and life history of *Selaginella* (**4** hrs)
3. Gymnosperms: General account, morphology and life history of *Cycas* (**4** hrs)

PRACTICAL (CRYPTOGAMS & GYMNOSPERMS)

1. Make suitable micro preparations of vegetative and reproductive structures of *Sargassum, Puccinia, Riccia, Selaginella* and *Cycas*
2. Identify and draw labeled diagrams of all the types mentioned in the syllabus

REFERENCES (CRYPTOGAMS & GYMNOSPERMS)

1 Fritsch, F.E. (1935). The structure and reproduction of the algae. Vol. 1 and II, Uni. Press. Cambridge.
2 Papenfuss, G.F. (1955) Classification of Algae.
3 B.R. Vasishta. Introduction to Algae
4 Sanders, W.B. (2001) Lichen interface between mycology and plant morphology. Bioscience, 51: 1025-1035.
5 B.R. Vasishta. Introduction to Fungi.
6 P.C. Vasishta Introduction to Bryophytes.
7 B.P. Pandey Introduction to Pteridophytes
8 Chamberlain C.J., (1935) Gymnosperms – Structure and Evolution, Chicago University Press.
9 Vasishta P.C. (1980) Gymnosperms. S. Chand and Co., Ltd., New Delhi.

PLANT PATHOLOGY

Module – I (**3** hrs)

1. Plant Pathology: Study the following plant diseases with special reference to pathogens, symptoms, method of spreading and control measures.
   1) Leaf mosaic of Tapioca 2) Citrus canker 3) Blast of paddy.

PRACTICAL (PLANT PATHOLOGY)

1. Identify the diseases (mentioned in the theory syllabus) on the basis of symptoms and causal organisms. (Drawings can be replaced by photos pasted in the record).

REFERENCES: PLANT PATHOLOGY

1. Agros, G.N. (1997) Plant Pathology (4th ed) Academic Press.
2. Bilgrami K.H. & H.C. Dube. (1976) A textbook of Modern Plant Pathology. International Book Distributing Co. Lucknow.
3. Pandey, B.P. (1999) Plant Pathology. Pathogen and Plant diseases. Chand & Co. New Delhi.

COMPLEMENTARY COURSE : 3
MORPHOLOGY, SYSTEMATIC BOTANY, ECONOMIC BOTANY, PLANT BREEDING AND HORTICULTURE

Semester	Course code	Credits	Hrs/wk
3	BOT3C03T	2	5

COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Appreciate the diverse morphology of angiosperms.
2. Identify and classify plants based on taxonomic principles
3. Make scientific illustrations of vegetative and reproductive structures of plants
4. Identify the economically important plants
5. Understand the basic principles of plant breeding
6. Apply various horticultural practices in the field.

MORPHOLOGY

Module - I

1. Leaf – Structure, simple, compound, venation and phyllotaxy. (**2** hrs)
2. Inflorescence - racemose, cymose , special, types with examples (**3** hrs)
3. Flower - as a modified shoot- structure of flower - floral parts, their arrangement, relative position, cohesion and adhesion of stamens, symmetry of flowers, types of aestivation and placentation. (**3** hrs)

PRACTICAL (MORPHOLOGY)

1. Identify the types of inflorescence mentioned in the syllabus. All the types mentioned must be represented in the photo album. (All drawings in record are replaced by photo album submission).

REFERENCE (MORPHOLOGY)

1 Sporne, K.R. (1974) Morphology of Angiosperms. Hutchinson.

SYSTEMATIC BOTANY

Module- I

1. Introduction, scope and importance (**1** hrs)
2. Herbarium techniques: collection, drying, poisoning, mounting & labeling. Significance of herbaria and botanical gardens; important herbaria and botanical gardens in India. (**3** hrs)
3. Nomenclature - Binomial system of nomenclature, basic rules of nomenclature (validity, effectivity and priority), ICN for algae, fungi and plants. (**4** hrs)
4. Systems of classification - Artificial, Natural of Phylogenetic (Brief account only). Bentham & Hooker's system of classification in detail. (**4** hrs)
5. Modern trends in taxonomy - Chemotaxonomy, Numerical taxonomy and Cytotaxonomy (brief account only) (**4** hrs)

6. Study the following families: Malvaceae, Fabaceae (with sub-families) Rubiaceae, Apocynaceae, Euphorbiaceae and Poaceae. (1**2** hrs)

RACTICAL (SYSTEMATIC BOTANY)

1. Determine the systematic position of local plants comes under the syllabus based on their vegetative and floral characters
2. Students shall be able to describe the plants in technical terms and draw the L.S. of flower of two plants belong to each family and record the same.
3. Familiarization of herbarium techniques (Demonstration only).
4. Mounting of a properly dried and pressed specimen of any wild plant from any one of the families mentioned in the syllabus, with proper herbarium label (to be submitted in the record book).
5. Students shall submit original images of plants, at least one from each family mentioned in the syllabus duly certified by HoD, at time of examination. Web sourced and outsourced images should not be used. The images of plants should be properly identified and they should carry details like systematic position, GPS location, date, name and register no. of the student etc. Habitat, Habit, Inflorescence and single flower should be represented. The images can be submitted along with the photo album containing images of inflorescence mentioned under morphology. Individuality should be strictly maintained while preparing the photo album.

REFERENCES (SYSTEMATIC BOTANY)

1 Sivarajan, V.V. (1991) Introduction to Principles of Plant Taxonomy. Oxford & IBH, New Delhi.
2 Jeffrey, C. (1968) An introduction to Plant Taxonomy, Cambridge University Press, London.
3 Gurucharan Singh, (2019) Plant Systematics - An Integrated Approach, 4th edition. CRC Press. Florida.
4 Sharma O.P. (1990) Plant Taxonomy – Tata McGraw Hills. Publishing company Ltd.
5 Subramanyam N.S. (1999) Modern Plant Taxonomy. Vikas Publishing House Pvt Ltd.
6 Pandey & Misra. (2008) Taxonomy of Angiosperms. Ane books Pvt Ltd.

ECONOMIC BOTANY

Module –I (**4** hrs)

1 Brief account on the various categories of plants based on their economic importance

2. Study the following plants with special reference to their binomial, family, morphology of the useful part and their uses.
    1. Cereals: Paddy, Wheat
    2. Pulses: Black gram, Green gram
    3. Oil: Coconut, Gingelly
    4. Fibre: Cotton
    5. Latex: Rubber
    6. Beverages : Tea, Coffee
    7. Spices: Pepper, Cardamom, Clove
    8. Medicinal plants: *Rauvolfia serpentina, Justicia adhatoda, Santalum album* and

Curcuma longa.

PRACTICAL (ECONOMIC BOTANY)

1 Identify at sight the economically important plant produces and products mentioned in module III, and learn the binomial and family of the source plants, morphology of the useful parts and uses. (Drawing not required)

REFERENCES (ECONOMIC BOTANY)

1. Pandey B. P (1987) - Economic Botany
2. Verma V. (1984) - Economic Botany
3. Hill A.W (1981) - Economic Botany, McGraw Hill Pub

PLANT BREEDING

1. Objectives of plant breeding (**1** hr)

2. Methods of plant breeding: a) Plant introduction b) Selection - Mass, Pure line and clonal, b) Hybridization: intervarietal, interspecific and intergeneric hybridization. d) Mutation breeding e) polyploidy breeding and f) breeding for disease resistance. (**6** hrs)

PRACTICAL (PLANT BREEDING)

1 Demonstration of hybridization techniques.

REFERENCES (PLANT BREEDING)

1 Allard. R.W. (1960) Principles of Plant breeding, John Wiley & Sons, Inc, New York.
2 Singh, B.D. (2005) Plant Breeding - Principles & methods, Kalyani Publishers, New Delhi.
3 Chaudhari. H.K. Elementary Principles of Plant breeding, Publishers. Oxford & IBH

HORTICULTURE

1. Horticulture- introduction: definition, branches, significance (**1** hr)
2. Methods of plant propagation (**6** hrs)
   a. Seed propagation
   b. Vegetative propagation
      1. Cutting – stem, root, leaf
      2. Layering –air layering
      3. Grafting: Approach grafting, Tongue grafting
      4. Budding: Patch and T-budding

PRACTICAL (HORTICULTURE)

1 Demonstration of layering, grafting and budding

REFERENCES (HORTICULURE)

1. K. Manibhushan Rao. (2005). Text book of Horticulture, Macmillan India Ltd.
2. N. Kumar. (1996) Introduction to Horticulture – First Edition, Rajalakshmi Publication,

COMPLEMENTARY COURSE: 4
PLANT PHYSIOLOGY, ECOLOGY AND GENETICS

Semester	Course code	Credits	Hrs/wk
4	BOT4C04T	2	5

COURSE OUTCOMES (COs)

By the end of the course, students are expected to:

1. Explain the physiological processes in plants.
2. Understand the basic principles of heredity and variation.
3. Realize the importance of ecology.
4. Spread awareness of the necessity of conservation of biodiversity and natural resources
5. Solve problems related to classical genetics

PLANT PHYSIOLOGY

Module – I (1**6** hrs)

1. Structure of plant cell and cell organelles (Brief account only)
2. Water relations - Permeability, Imbibition, Diffusion, Osmosis and water potential
3. Absorption of water- Active and passive mechanisms
4. Ascent of sap -Root pressure theory, Transpiration pull or cohesion-tension theory.
5. Transpiration -Types, mechanism of stomatal movement: K^+ ion theory, significance of transpiration, antitranspirants.
6. Mineral nutrition- General account on Micro and macro nutrients. Methods of studying plant nutrition- solution culture-The essential elements - criteria of essentiality. function and deficiency symptoms of the following mineral nutrients: N, P, K, Mg, Fe, Zn, Mn

Module – II (1**0** hrs)

1. Photosynthesis: Introduction, significance, Two pigment systems, red drop, Emerson enhancement effect, action and absorption spectra, Mechanism of photosynthesis - Light reaction, cyclic & non-cyclic photo phosphorylation, Dark reactions–Calvin cycle, C_4 cycle, photorespiration (a brief account only). Factors affecting photosynthesis.

Module – III (**10** hrs)

1. Plant growth: Definition, phases of growth, natural plant hormones, synthetic auxins (Brief account only)
2. Senescence and abscission, Photo-periodism & vernalization.
3. Dormancy of seeds- Factors causing dormancy, photoblastin, techniques to break dormancy, physiology of fruit ripening.

PRACTICAL (PLANT PHYSIOLOGY)

Learn the principle and working of the following apparatus/experiments

1. Thistle funnel osmoscope
2. Ganong's potometer

3. Ganong's light-screen
4. Absorbo transpirometer .
5. Kuhne's fermentation vessel
6. Mohl's half-leaf experiment
7. Experiment to show evolution of O_2 during photosynthesis

REFERENCES (PLANT PHYSIOLOGY)

1 William G. Hopkins (1999). Introduction to Plant Physiology, 2nd edition, John Wiley & Sons, Inc.
2 Frank B. Salisbury and Cleon W. Ross (2002). Plant Physiology 3rd edition. CBS publishers and distributers.
3 G. Ray Noggle and George J.Fritz (1983) Introductory Plant Physiology Prentice Hall.
4 Goodwin Y.W. and Mercer E.I. (2003) Introduction to Plant Biochemistry. 2nd edition. CBS Publishers and distributors.

PLANT ECOLOGY

Module – I (**9** hrs)

1. Ecology-Definition, Ecosystem: ecological factors –biotic and abiotic.
2. Ecological adaptations: Morphological, anatomical and physiological adaptations of the following types: Hydrophyte (*Vallisnaria, Hydrilla*), Xerophyte (*Opuntia, Nerium*), Halophyte (*Avicennia*), Epiphytes (*Vanda*) and parasites. (*Cuscuta*).
3. Ecological succession –Process of succession, types of succession, Hydrosere.

PRACTICAL (PLANT ECOLOGY)

Study the morphological and anatomical adaptations of the hydrophytes, xerophytes, halophytes, epiphytes and parasites mentioned in the syllabus (drawing not required)

REFERENCES (PLANT ECOLOGY)

1 Ambasht R.S. 1988. A text book of Plant Ecology. Students Friends Co. Varanasi.
2 Dash M.C. 1993. Fundamentals of Ecology. Tata McGraw Hill Publishing Company Ltd. New Delhi.
3 Michael S. 1996. Ecology. Oxford University Press, London.
4 Sharma, P.D. 2008-2009. Ecology and Environment. Rastogi Publication.
5 Kumar H.D. 1977. Modern Concepts of Ecology. Vikas Publications. New Delhi.

GENETICS (**9** hrs)

1. Introduction and brief history of genetics
2. Mendel's experiments, symbolisation, terminology, heredity and variation;
3. Monohybrid cross, Dihybrid cross, Laws of Mendel, test cross and back cross.
4. Modified Mendelian ratios : Incomplete dominance in *Mirabilis jalapa.*
5. Gene interactions: Complementary genes -flower colour in *Lathyrus odoratus* (9:7 ratio), Epistasis - Fruit colour in *Cucurbita pepo* (12:3:1 ratio).

PRACTICAL (GENETICS)

1 Students are expected to work out problems related to Monohybrid, Dihybrid, Test cross,

Incomplete dominance and Modified Mendelian ratios and has to be recorded.

REFERENCES (GENETICS)

1. Sinnot, W.L.C. Dunn & J. Dobzhansky (1996) Principles of Genetics. Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Verma, P.S. & Agarwal (1999). Text book of Genetics. S. Chand & Co., New Delhi.
3 RastogiV.B. (2008), Fundamentals of Molecular Biology, Ane Books, India.
4 Gupta, P.K. Text Book of Genetics. Rastogi Publications, Meerut.

Procedure/ Process of Teaching

- Lecture
- Powerpoint presentations
- Videos
- Discussion
- Peer learning
- Assignments

Procedure/ Process of Assessment

- Seminars
- Quiz
- Tests

Course Category	Core Course 1
Course Title and Code	Microeconomics I ECO1 B01
No. of Credits	5

Preamble: This course is designed to expose first semester students, who may be new to Economics, the basic principles of microeconomic theory. The emphasis will be on thinking like an economist and the course will illustrate how microeconomic concepts can be applied to analyze real-life situations.

Module I: Exploring the Subject Matter of Economics

Why study economics? Micro Versus Macro- Concepts of wealth, welfare, scarcity and growth -The scope and method of economics- Induction and deduction-Positive and normative economics-Value judgments- scarcity and choice- the basic problems of an economy- Production Possibility curve- basic competitive model- economic systems.

Module II: Demand and Supply Analysis

Concept of Demand- Law of Demand- Determinants of demand – Types of Demand – Demand Function – Market Demand Curve - Elasticity of Demand – Price, Income and Cross elasticity of demand Measures of Elasticity of Demand. Demand Forecast Meaning- Factors influencing demand forecast. Concept of Supply – Law of Supply – Determinants of Supply – Supply Function – Elasticity of Supply – Market Supply Curve -Market Equilibrium.

Module III: Theory of Consumer Behaviour

Utility Analysis – Cardinal and Ordinal approaches – Law of Diminishing Marginal Utility –Law of Equi-marginal utility, indifference curve, properties of indifference curves – Price (Budget) line – Equilibrium of the Consumer with the help of indifference curves – Price, Income and Substitution effect- Derivation of individual demand curve for normal good – Decomposition of Price effect into income effect and substitution effect – Hicksian and Slutsky‘s methods – Normal, inferior and Giffen goods – Application of Indifference Curves - Theory of Revealed Preference – Revealed Preference axioms - Consumer surplus - Marshall and Hicks.

Module IV: Theory of Production and Costs

Concept of Production – Production Function – Scale of production- short run versus long run production function- Law of Variable Proportions – Law of Returns to Scale – the Isoquant- Isocost Approach-producers equilibrium-expansion path- Internal and External Economies- Cobb-Douglas production function -Cost function and Cost concepts- Traditional theory of costs- Modern theory of costs.

References:

1. Dominick Salvatore (2003): Microeconomics: Theory and Applications- 4thEdition, Oxford University Press.
2. Robert S Pindyck and Daniel L Rubinfeld (2009): Microeconomics- 8th Edition, Pearson India.
3. Watson and Getz (2004): Price Theory and its Uses- 5thEdition, AITBS Publishers and Distributors.
4. A Koutsoyiannis (1979): Modern Microeconomics- 2ndEdition, Macmillan.
5. G S Madalla and Ellen Miller (1989): Microeconomics: Theory and Applications- Tata McGraw-Hill.
6. Robert Y Awh (1976): Microeconomics: Theory and Applications- John Wiley & Sons.
7. H.R Varian (2009) , Intermediate Microeconomics- A Modern Approach., W W Norton & Co Inc; 8 edition
8. Gregory Mankiw (2006) Principles of Microeconomics,(Paperback) South Western Educational Publishing
9. Jhingan,.M.L., (2017)., Micro Economic Theory, Vrinda Publications (P) Ltd, Delhi

OBJECTIVES

To identify the difference between Micro and Macro Economics
To understand the basic principles of the economy
To analyze different concept of demand and supply in Economics
To understand the theory of consumer behaviour using ordinal and cardinal approach.
To identify the theory of production and costs in Economics

COURSE PLAN

Unit/Session / Hours (Time Required)	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Why study economics?, Micro Versus Macro, Concepts of wealth, welfare, scarcity and growth, The scope and method of economics, Induction and deduction, Positive and normative economics, Value judgments, scarcity and choice, the basic problems of an economy, Production Possibility curve, basic competitive model, economic systems.	o Lecture o Group Discussion o Power Point Presentation	Peer Group Discussion on the basis of basic problems in economy	● To identify the concept micro vs macro economics ● To understand the basic problems of economy.	Evaluation through debate
Module II	Concept of Demand-,Law of	o Lecture	Peer Group Discussion	❖ To analyze different	Evaluation through

	Demand, Determinants of demand ,Types of Demand , Demand Function , Market Demand Curve ,Elasticity of Demand ,Price, Income and Cross elasticity of demand ,Measures of Elasticity of Demand. Demand Forecast Meaning, Factors influencingdemand forecast. Concept of Supply ,Law of Supply , Determinants of Supply – ,SupplyFunction ,Elasticity of Supply ,Market Supply Curve ,Market Equilibrium	o Problem solving o Power Point Presentation o Participatory learning o Videos	on the basis of determinants of demands	concept of demand and supply in Economics ❖ To identify basic principles of the economy	MCQ questions.
Module III	Utility Analysis ,Cardinal and Ordinal approaches – Law of Diminishing Marginal Utility – Law of Equi-marginal utility ,indifference curve, properties of indifference curves – Price(Budget) line – Equilibrium of the Consumer with the help of indifference curves – Price, Income and Substitution effect- Derivation of individual demand curve for normal good – Decomposition of Price effect into income effect and substitution effect – Hicksian and Slutsky‘s methods –	o Lecture o Problem Solving o Diagrammatic Representation o Peer Discussion	o Find out the consumer surplus o Peer discussion on the basis of Slutsky’s and Hicksian methods	❖ To understand the theory of consumer behaviour using ordinal and cardinal approach	Evaluation through test paper

	Normal, inferior and Giffen goods – Application of Indifference Curves - Theory of Revealed Preference – Revealed Preference axioms - Consumer surplus - Marshall and Hicks				
Module IV	Concept of Production – Production Function – Scale of production- short run versus long run production function- Law of Variable Proportions – Law of Returns to Scale – the Isoquant- Isocost Approach-producers equilibrium-expansion path- Internal and External Economies- Cobb-Douglas production function -Cost function and Cost concepts- Traditional theory of costs- Modern theory of costs.	o Power Point Presentation o Lecture o Problem Solving	o Find out different costs o Compare Short run versus Long run	To identify the theory of production and costs in Economics	Evaluation through quiz

Course Outcomes

CO1	**To identify the difference between Micro and Macro Economics**
CO2	**To analyze different concept of demand and supply in Economics**
CO3	**To understand the theory of consumer behaviour using ordinal and cardinal approach.**
CO4	**To identify the theory of production and costs in Economics**

Faculty in charge
Dr. Shirley Jose K

Semester II

Course Category	**Core Course 2**
Course Title and Code	**Macroeconomics I ECO2 B02**
No. of Credits	**5**
No. of Contact Hours	**6 Hours per week**

MACROECONOMICS I

Preamble: Macroeconomics emerged as a separate discipline following the failure of classical economics to diagnose the reasons of the Great Depression in the 1930s. 'The General Theory of Employment, Interest and Money' published by John Maynard Keynes in 1936 was the influential book which laid the foundation of Macroeconomics. Today, principles of macroeconomics help us understand the trends in aggregate variables like national income, employment, price level and investment. It also helps us explore and understand the determinants of short run fluctuations and long run movements in these variables. The course is designed to give a rigorous overview of macroeconomics to the undergraduate students. It will give the necessary ideas and tools to understand the working of an economy at the aggregate level. The course is also expected to give an idea about the need for and the way in which government intervention is required in a modern economy. After completing this course, the student will be able to appreciate the context in which Macroeconomics emerged as a separate discipline. The student will be able to explain how output and employment are determined in classical and Keynesian systems. Student should also be able to explain why actual output will fall short of the productive capacity of the economy.

Module I: Introduction to Macroeconomics Nature, scope and limitations of macroeconomics – Macroeconomic model – Types of variables: Stock and flow, endogenous and exogenous, ex-ante and ex-post – static, comparative static and dynamic – equilibrium and disequilibrium - Circular flow of income and outputnational income and its measurement-Production approach, Expenditure approach, Income approach--Real and Nominal GDP.

Module II: Classical macroeconomics Classical Economy – Say's Law of Market – Wage-price flexibility – Classical model of output and employment – Classical theory of price level determination – Quantity theory of Money – Fisher's Equation of Exchange – Cash Balance Approach - Neutrality of

Money – Money illusion-Classical dichotomy-Classicalresponse to the Great Depression-Crisis in the discipline of Economics

Module III: Keynesian macroeconomics Effective demand - Aggregate demand and aggregate supply – Consumption, Investment and Government Expenditure (C+I+G) - Autonomous Consumption and Induced ConsumptionKeynesian Consumption function-investment function-MEC and MEI- Sticky prices and wagesAssumption of fix price-Keynesian Cross model and determination of equilibrium outputMultiplier-Inflationary and Deflationary gaps-Fiscal Policy-Understanding fiscal policy using Keynesian Cross model-tax multiplier-government expenditure multiplier-balanced budget multiplier.

Module IV: Money Nature of money-types-functions-time preference-interest rate: real and nominal-bondrelationship between bond price and interest rate-Theories of Demand for money-Liquidity Preference theory and Keynesian Liquidity Trap-Friedman's re-statement of Quantity Theory of Money. Theories of Supply of money-Measuring supply of money-High powered money-money multiplier.

References:

1. 1.Edward Shapiro – 'Macro economics' Oxford University press.
2. 2.GregoryMankiw – 'Macro economics' – 6th Edn. Tata McGraw Hill.
3. Richard T. Froyen – 'Macro economics', Pearson education.
4. Eugene Diulio – Macro economic Theory, Shaum's Outline series. Tata McGraw Hill
5. Errol D'Souza – 'Macro Economics' – Pearson Education 2008. 6.AbhijitKundu (2009): Methodology and Perspectives of Social Science – Pearson Education 8 7. Dornbusch, Fischer and Startz-Macroeconomics-Tata McGraw –Hill

OBJECTIVES

- To understand the trends in aggregate variables like national income, employment, price level and investment
- To analyze the working of an economy at the aggregate level
- To identify the need for and the way in which government intervention is required in a modern economy.
- To compare how output and employment are determined in classical and Keynesian systems.
- To explain why actual output will fall short of the productive capacity of the economy.
- To understand the importance of money in the economy
- To explain the liquidity preference theory and Keynesian Liquidity Trap

COURSE PLAN

Unit/Session/ Hours (Time Required)	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Nature, scope and limitations of macroeconomics – Macroeconomic model – Types of variables: Stock and flow, endogenous and exogenous, ex-ante and ex-post – static, comparative	• Lecture • Group Discussion • Diagrammatic presentation • Problem solving	• Distinguish between different types of variable • Find out National income	To understand the trends in aggregate variables like national income, employment, price level and investment	Evaluation through test paper

	static and dynamic – equilibrium and disequilibrium - Circular flow of income and output national income and its measurement- Production approach, Expenditure approach, Income approach--Real and Nominal GDP.				
Module II	Classical Economy – Say's Law of Market – Wage-price flexibility – Classical model of output and employment – Classical theory of price level determination – Quantity theory of Money – Fisher's Equation of Exchange – Cash Balance	● Lecture ● Illustrations ● Group Discussion	● Peer discussion about Great Depression ● Complete above illustrations	To identify the need for and the way in which government intervention is required in a modern economy	Evaluation through quiz

	Approach - Neutrality of Money – Money illusion-Classical dichotomy-Classical response to the Great Depression-Crisis in the discipline of Economics				
Module III	Effective demand - Aggregate demand and aggregate supply – Consumption, Investment and Government Expenditure (C+I+G)- -Autonomous Consumption and Induced Consumption Keynesian Consumption function-investment function-MEC and MEI-Sticky prices and wagesAssumption of fix price-Keynesian Cross model and	● Lecture ● Group Discussion ● Diagrammatic presentation ● Problem solving	● Compare the classical and Keynesian model of output and employment ● Find out Multiplier	To analyze the working of an economy at the aggregate level To compare how output and employment are determined in classical and Keynesian systems To explain why actual output will fall short of the productive	Evaluation through test paper

	determination of equilibrium output Multiplier-Inflationary and Deflationary gaps-Fiscal Policy-Understanding fiscal policy using Keynesian Cross model-tax multiplier-government expenditure multiplier-balanced budget multiplier			capacity of the economy	
Module IV	Nature of money-types-functions-time preference-interest rate: real and nominal-bond relationship between bond price and interest rate-Theories of Demand for money-Liquidity Preference theory and Keynesian Liquidity Trap-Friedman's re-statement of Quantity	• Lecture • Participatory Learning • Assignment • Group Discussion	• Compare barter system and Money system • Peer discussion based on liquidity preference among individuals.	To understand the importance of money in the economy To explain the liquidity preference theory and Keynesian Liquidity Trap	Evaluation through Assignment and Group Discussion

	Theory of Money. Theories of Supply of money-Measuring supply of money-High powered money-money multiplier.				

Course Outcomes

CO1	**To understand the trends in aggregate variables like national income, employment, price level and investment**
CO2	**To analyze the working of an economy at the aggregate level .**
CO3	**To identify the need for and the way in which government intervention is required in a modern economy.**
CO4	**To compare how output and employment are determined in classical and Keynesian systems**
CO5	**To explain why actual output will fall short of the productive capacity of the economy.**
CO6	**To understand the importance of money in the economy**
CO7	**To explain the liquidity preference theory and Keynesian Liquidity Trap**

Faculty in charge,
Mr. Nijil Jacobi

Course Category	**Core Course 3**
Course Title and Code	**Quantitative Methods for Economic Analysis - I ECO3 B03**
No. of Credits	**4**
No. of Contact Hours	**5 Hours per week**

SEMESTER III

QUANTITATIVE METHODS FOR ECONOMIC ANALYSIS – I

Preamble: Students of economics should have sound quantitative skills to collect, analyse and interpret empirical data. They also require these skills for advanced studies in quantitative economics. Quantitative skills have become an essential toolkit for most branches of economics. This course is intended to provide students an introduction to quantities methods and tools that are used in the study of economics at the undergraduate level. The aim of this course is to develop skill in statistical and mathematical techniques that are required for a meaningful study of applied economics and for carrying out empirical their further study in most branches of economics.

Module I –Basic Concepts

Exponents and logarithms-Equations –Linear, quadratic and simultaneous equations up to three un knows- Functions –types and their applications in economics –Introduction to co-ordinate geometry, Graphs, Slope and Intercepts, Equations of Straight Lines.

Module II- Basic Matrix Algebra:

Matrix -Meaning and types, Matrix operations, Addition, Subtraction and Multiplication Properties of Matrix multiplication, Transpose of matrix, Determinant and their properties (Up to 3 x 3) – Minor and Cofactors – Rank of a Matrix- Solving linear equations using Matrix Inverse- - Cramer's rule

Module III– Univariate Analysis

Univariate Analysis: -Frequency Tables, Representation of data-Frequency Polygon, Ogives and Pie diagram. Measures of Central tendency - Arithmetic Mean, Median, Mode, Geometric Mean

and Harmonic Mean -. Measures of Dispersion: Absolute and Relative measures of Dispersion – Range, Quartile Deviation, Mean Deviation and Standard Deviation, Coefficient of variation - Lorenz Curve - Gini Coefficient - Skewness and Kurtosis.

Data management using Spread Sheet : Mean, Median, Mode, Dispersion, Coefficient of Variation -Graphical Presentation of Data: Line, bar, pie diagrams.

Module IV: **Correlation and Regression Analysis**

Correlation-Meaning, Types- Methods of Measuring Correlation-Graphical: Scatter Diagram and correlation Graph; Algebraic Methods: Karl Pearson‘s Coefficient of Correlation and Rank Correlation Coefficient -Simple linear regression - Meaning, Principle of Ordinary Least Squares and Regression Lines-Correlation and Regression using spread sheet. 28 BA Economics Curriculum: CBCSS 2019

References:

1. Allen , R.J.D. Mathematical Analysis for Economics ,Macmillan Press, London

2. Dowling Edward T, Mathematical Methods for Business and Economics, SchaumsOutlineSeries, McGraw Hill, 1993

3. Dowling Edaward.T, Introduction to Mathematical Economics, 2nd/3rd Edition, Schaum‘s Outline Series, McGraw-Hill, New York, 2003

4. Taro Yamane, Mathematics for Economists: An Elementary Survey, Prentice Hall of India

5. Sydsaeter K and Hammond P, Essential Mathematics for Economic Analysis, Prentice Hall

6. Haeussler Earnest F, Paul Richard S and Wood Richard, Introductory Mathematical Analysis PearsonEducation ISBN 0131276298

7. Bressler Barry, A Unified Introduction to Mathematical Economics, harper and Row Publishers, ISBN0060409525

8. Anderson, Sweeney and Williams, Statistics for Business and Economics, Thomson Education
9. Lind D.A., W.G. Marchal and S.A Wathen., Statistical Techniques in Business and Economics, Tata McGraw Hill, New Delhi

10. Gupta S. P, Statistical Methods, Sultan Chand and Sons, New Delhi

11. Aczel D Amir and Sounderpandian Jayavel, Complete Business Statistics, Tata McGraw Hill Publishers, Newdelhi ISBN 0070620164

12. Richard I Levin et.al. Statistics for management. India: Pearson Education.

OBJECTIVES

- To inculcate quantitative skills to collect, analyse and interpret empirical data.
- To develop skill in statistical and mathematical techniques that are required for a meaningful study of applied economics
- To understood basic concepts related to quantitative methods in economics
- To create the capability of data management using spread sheet

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module 1	Basic Concepts Exponents and logarithms-Equations –Linear, quadratic and simultaneous equations up to three un knows-Functions –types and their applications in economics –Introduction to co-ordinate geometry, Graphs, Slope and Intercepts, Equations of Straight Lines.	● Lecture ● Participative Learning ● Problem Solving ● Discussion	Peer group discussion on functions, types and their application in economics	To understood basic concepts related to quantitative methods in economics	Evaluation through MCQ
Module 2	Basic Matrix Algebra: Matrix -Meaning and types, Matrix operations, Addition, Subtraction and MultiplicationProperties of Matrix multiplication, Transpose of matrix, Determinant and their properties (Up to 3 x 3) – Minor and Cofactors –	● Lecture ● Participative Learning ● Problem Solving ● Discussion ● Assignment	Assignment on the properties of determinent	To inculcate quantitative skills to collect, analyse and interpret empirical data	Evaluation though Test paper

	Rank of a Matrix- Solving linear equations using Matrix Inverse- - Cramer's rule				
Module 3	Univariate Analysis: -Frequency Tables, Representation of data-Frequency Polygon, Ogives and Pie diagram. Measures of Central tendency - Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean -. Measures of Dispersion: Absolute and Relative measures of Dispersion – Range, Quartile Deviation, Mean Deviation and Standard Deviation, Coefficient of variation - Lorenz Curve - Gini Coefficient - Skewness and Kurtosis. Data management using Spread Sheet : Mean, Median, Mode, Dispersion, Coefficient of Variation -Graphical Presentation of Data: Line, bar, pie diagram	● Lecture ● Participative Learning ● Problem Solving ● Discussion	Assignment on measures of central tendency	To create the capability of data management using spread sheet To inculcate quantitative skills to collect, analyse and interpret empirical data	Evaluation through Practical exam
Module 4	Correlation-Meaning, Types- Methods of Measuring Correlation-Graphical: Scatter Diagram and correlation Graph; Algebraic Methods: Karl Pearson's Coefficient of Correlation and Rank Correlation Coefficient -Simple linear regression - Meaning, Principle of Ordinary Least Squares and	● Lecture ● Power Point Presentation ● Group Discussion ● Assignment	Assignment on correlation meaning and types	To develop skill in statistical and mathematical techniques that are required for a meaningful study of	Evaluation though Test paper

	Regression Lines-Correlation and Regression using spread sheet.			applied economics	

COURSE OUTCOME

CO1	**To understood basic concepts related to quantitative methods in economics**
CO2	**To inculcate quantitative skills to collect, analyse and interpret empirical data**
CO3	**To create the capability of data management using spread sheet**
CO4	**To develop skill in statistical and mathematical techniques that are required for a meaningful study of applied economics**

Faculty in charge,

Ms. Anju PB

Semester III

Course Category	**Core Course 4**
Course Title and Code	**Microeconomics II ECO3 B04**
No. of Credits	**4**
No. of Contact Hours	**4 Hours per week**

MICROECONOMICS II

Preamble: This course is designed to introduce fundamental market concepts and structures. The emphasis of the course is to give conceptual clarity to the student coupled with the use of the principles Micro economic analysis to the decision making of firms and market. After completing this course, the student will be able to apply the principles of micro economics, to the decision making of firms and the functioning of the market.

Module I: Market Structure: Perfect Competition

Market-Functions-Market structure-Types of markets-Perfect competition-Characteristics-Demand AR and MR curves-Price determination in the market period- Short run equilibrium of the firm and industryShut down point-Long run equilibrium of the firm and industry-Constant, increasing and decreasing cost industries- Welfare effects of government intervention- Impact of a tax and subsidy.

Module II: Monopoly

Monopoly- Sources of monopoly-Types of monopoly-AR and MR curve of a monopolist - Short run and long run equilibrium- Supply curve of a monopolist- The multiplant firm- Monopoly power-Measurement of monopoly power-Social cost of monopoly- Regulation of monopoly -Price discrimination-First degree, second-degree and third degree- International price

discrimination (Dumping- types)-Two part tariff, tying and bundling-Peak load pricing-Monopsony- Bilateral monopoly.

Module III: Monopolistic Competition and Oligopoly

Monopolistic competition- Features of monopolistic competition-Short run and long run equilibrium Excess capacity-Product differentiation and selling costs-Oligopoly-Characteristics-Collusive versus non-collusive oligopoly-Cournot model- Kinked demand curve model - Cartel and price leadership.

Module IV: Pricing and Employment of Inputs

Competitive factor markets -Demand curve of the firm for one variable input-Demand curve of the firm for several variable inputs- Market demand curve for an input - Supply of inputs to a firm- The market supply of inputs- Equilibrium in a competitive factor market- Factor market with monopoly power- Factor market with monopsony power-Marginal Productivity theory of input demand.

References:

1. Dominick Salvatore (2003): Microeconomics: Theory and Applications- 4th Edition, Oxford University Press.

2. Robert S Pindyck and Daniel L Rubinfeld (2009): Microeconomics- 8th Edition, Pearson India.

3. Watson and Getz (2004): Price Theory and its Uses- 5th Edition, AITBS Publishers and Distributors.

4. A Koutsoyiannis (1979): Modern Microeconomics- 2nd Edition, Macmillan.

5 .G S Madalla and Ellen Miller (1989): Microeconomics: Theory and Applications- Tata McGraw-Hill.

OBJECTIVES

.

To introduce fundamental market concepts and structures
To apply the principles of micro economics to the decision making of firms and the functioning of the market.
To understood the concept of Price Discrimination in Monopoly
To understood the concept of Product Differentiation in Monopolistic Competition
To identify the pricing and employment of outputs.

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Market-Functions -Market structure-Types of markets-Perfect competition-Characteristics-Demand AR and MR curves-Price determination in the market period-Short run equilibrium of the firm and industry	● Lecture ● Discussion ● Participatory Learning	To find out short run and long run equilibrium in Perfect competition	To introduce fundamental market concepts and structures	Evaluation through quiz

	Shut down point-Long run equilibrium of the firm and industry-Constant, increasing and decreasing cost industries-Welfare effects of government intervention-Impact of a tax and subsidy				
Module II	Monopoly-Sources of monopoly-Types of monopoly-AR and MR curve of a monopolist - Short run and long run equilibrium-Supply curve of a monopolist- The multiplant firm-Monopoly power-Measurement of monopoly power-Social cost of monopoly-Regulation of monopoly -Price discrimination-First degree, second-degree and third degree-International price discrimination (Dumping-types)-Two part tariff, tying and bundling-Peak load pricing-Monopsony-	• Lecture • Discussion • Participatory Learning	To find out short run and long run equilibrium inMonopoly	To apply the principles of micro economics to the decision making of firms and the functioning of the market To understood the concept of Price Discrimination in Monopoly	Evaluation through Test paper

	Bilateral monopoly.				
Module III	Monopolistic competition-Features of monopolistic competition-Short run and long run equilibriumExcess capacity-Product differentiation and selling costs-Oligopoly-Characteristics-Collusive versus non-collusive oligopoly-Cournotmodel- Kinked demand curve model - Cartel and price leadership	● Lecture ● Discussion ● Participatory Learning	To find out short run and long run equilibrium in Monopolistic competition	To understood the concept of Product Differentiation in Monopolistic Competition	Evaluation through Test paper
Module IV	Competitive factor markets -Demand curve of the firm for one variable input-Demand curve of the firm for several variable inputs-Market demand curve for an input - Supply of inputs to a firm- The market supply of inputs-Equilibrium in a competitive factor market- Factor market with monopoly power-Factor market with monopsony	● Lecture ● Discussion ● Participatory Learning	To find out Pricing and employment in outputs	To identify the pricing and employment of outputs	Evaluation through Test paper

	power-Marginal Productivity theory of input demand.				

COURSE OUTCOME

CO1	**To introduce fundamental market concepts and structures .**
CO2	**To apply the principles of micro economics to the decision making of firms and the functioning of the market**
CO3	**To understood the concept of Price Discrimination in Monopoly**
CO4	**To understood the concept of Product Differentiation in Monopolistic Competition**
CO5	**To identify the pricing and employment of outputs**

Faculty in charge
Mr. Nijil Jacobi

Semester IV

Course Category	Core Course 5
Course Title and Code	Quantitative Methods for Economic Analysis II ECO4 B05
No. of Credits	4
No. of Contact Hours	5 Hours per week

QUANTITATIVE METHODS FOR ECONOMIC ANALYSIS – II

Preamble: This course is designed to transmit the body of basic statistics and mathematics that enables the study of economic theory at the undergraduate level. The aim of this course is to equip the students to quantify economic variables and to enable them to apply statistical techniques in Economics. After completing this course, the student will be able to apply statistical and mathematical techniques in Economics.

Module I: Differential Calculus

Limits and Continuity – Differentiation - Rules, Derivative of single variable and multi variable Functions (except Trigonometric and logarithmic Function), Higher Order Derivatives –Partial differentiation- Optimization - Maxima and Minima of Functions. – Economic Application of Derivatives – Marginal Concepts (MU, MR,MP, Elasticity etc)

Module II: Index Numbers and Time Series

Analysis Index Numbers: Meaning and Uses- Unweighted and Weighted Index Numbers: Laspeyre‘s, Paasche‘s, Fisher‘s, Dorbish-Bowley, Marshall-Edgeworth and Kelley‘s Methods - Tests of IndexNumbers: Time Reversal and Factor Reversal tests - Base Shifting, Splicing and Deflating -CPI and WPI - Stock Price Indices: BSE-SENSEX and NSE-NIFTY.Time Series Analysis - Components of Time Series - Measurement of Trend by Moving Average and the Method of Least Squares.

Module III: Vital Statistics

Vital Statistics: Meaning and Uses- Fertility Rates: Crude Birth Rate, General Fertility Rate, Specific Fertility Rate, Gross Reproduction Rate and Net Reproduction Rate - Mortality Rates: Crude Death Rate, Specific Death Rate, Infant Mortality Rate andMaternal Mortality Rate - Sex Ratio and Couple Protection Ratio.

Module IV- Fundamentals of probability

Basic probability concepts: – Mutually exclusive and collectively exhaustive events – statistically independent events, sample space, events. Types of probability –A Priori Classical probability – Empirical Classical Probability – Subjective Probability.

References

1. Allen , R.J.D. Mathematical Analysis for Economics ,Macmillan Press, London
2. Dowling Edward T, Mathematical Methods for Business and Economics, Schaums Outline Series, McGraw Hill, 1993
3. Bressler Barry, A Unified Introduction to Mathematical Economics, harper and Row Publishers, ISBN0060409525
4. Sydsaeter K and Hammond P, Essential Mathematics for Economic Analysis, Prentice Hall
5. Dowling Edaward.T, Introduction to Mathematical Economics, 2nd/3rd Edition, Schaum‘s
6. Outline Series, McGraw-Hill, New York, 2003
7. Anderson, Sweeney and Williams, Statistics for Business and Economics, Thomson Education 8. Lind D.A., W.G. Marchal and S.A Wathen., Statistical Techniques in Business and Economics, Tata McGraw Hill, New Delhi
8. Gupta S. P, Statistical Methods, Sultan Chand and Sons, New Delhi
9. Richard I Levin et.al. Statistics for management. India: Pearson Education

OBJECTIVES

- To equip the students to quantify economic variables
- To apply the index numbers in economic analysis
- To enable them to apply statistical techniques in Economics.
- To apply statistical and mathematical techniques in Economics.

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Limits and Continuity – Differentiation - Rules, Derivative of single variable and multi variable	• Lecture • Participative Learning • Problem Solving	Write a Assignment on the rules of	To equip the students to quantify economic variables	Evaluation through assignments

	Functions (except Trigonometric and logarithmic Function), Higher Order Derivatives –Partial differentiation- Optimization - Maxima and Minima of Functions. – Economic Application of Derivatives – Marginal Concepts (MU, MR,MP, Elasticity etc)	● Discussion	differentiation.		
Module II	Analysis Index Numbers: Meaning and Uses- Unweighted and Weighted Index Numbers:Laspeyre ‘s, Paasche‘s, Fisher‘s, Dorbish-Bowley, Marshall-Edgeworth and Kelley‘s Methods - Tests of IndexNumbers: Time Reversal and Factor Reversal tests - Base Shifting, Splicing and Deflating -CPI and WPI - Stock Price Indices: BSE-SENSEX and NSE-NIFTY.Time Series Analysis - Components of Time Series - Measurement of Trend by Moving	● Lecture ● Participative Learning ● Problem Solving	Identifying different types of Index numbers	To apply the index numbers in economic analysis	Evaluation through quizzes

	Average and the Method of Least Squares				
Module III	Vital Statistics: Meaning and Uses- Fertility Rates: Crude Birth Rate, General Fertility Rate, Specific Fertility Rate, Gross Reproduction Rate and Net Reproduction Rate - Mortality Rates: Crude Death Rate, Specific Death Rate, Infant Mortality Rate andMaternal Mortality Rate - Sex Ratio and Couple Protection Ratio.	● Lecture ● Participative Learning ● Problem Solving ● Group discussion	Peer discussion about the Importance of vital statistics in Economics	To enable them to apply statistical techniques in Economics	Evaluation through Test Paper
Module IV	Basic probability concepts: – Mutually exclusive and collectivelyexhaustive events – statistically independent events, sample space, events. Types of probability –A Priori Classical probability -Empirical Classical ProbabilitySubjective Probability	● Lecture ● Participative Learning ● Problem Solving ● Assignment	To write an assignment on what is probability and different types of probability	To apply statistical and mathematical techniques in Economics	Evaluation through MCQ

COURSE OUTCOME

CO1	To equip the students to quantify economic variables
CO2	To apply the index numbers in economic analysis
CO3	To enable them to apply statistical techniques in Economics.
CO4	To apply statistical and mathematical techniques in Economics.

Faculty in charge,

Mr. Nijil Jacobi

Semester IV

Course Category	**Core Course 6**
Course Title and Code	**Macroeconomics II ECO4 B06**
No. of Credits	**4**
No. of Contact Hours	**4 Hours per week**

MACROECONOMICS – II

Preamble: I S-LM framework is a versatile tool used in understanding the working of modern economies. Hence it is widely used in policy formulation too. Phillips curve also was used widely for policy formulation, until it collapsed following the stagflation of 1970s. New concepts like NAIRU developed afterwards. Market economies have always experienced cyclical fluctuations in economic activity. Fiscal and monetary policies have been effectively employed by governments to fight such fluctuations. The objective of this course is to give a rigorous overview of macroeconomics to the undergraduate students. The course is designed to give the necessary ideas and tools to understand the working of an economy at the aggregate level. The course is also expected to give an idea about the need for and way in which government intervention is required in a modern economy. After completing this course a student should be able to derive IS-LM curves and use the framework to explain the working of an economy. A student should also be able to explain the way fiscal and monetary policy works, using the

ISLM framework. Student should also be able to explain the concept and measurement of inflation and unemployment. Similarly, a student should also be able to explain the trade-off between inflation and unemployment as predicted by the Phillips curve and its collapse after the stagflation of 1970s.

Module I :ISLM Model

Goods market equilibrium using IS curve-derivation and shifts-Money market equilibrium using LM curve-derivation and shifts-equilibrium using IS and LM.

Module II:Theories of Inflation and Unemployment Inflation–

Types of Inflation –Headline and core inflation-Measurement of inflation in IndiaWPI-CPI-PPI-GDP deflator.Effects of inflation- Sacrifice ratio-Theories of inflation- Demandpull versus cost-push inflation-Measures to control inflation.Unemployment – Types of unemployment- Measurement of unemployment-Cost of unemployment and Okun'slaw.Phillips curve –Short Run and Long run Phillips curve – Stagflation of 1970s-reasons-NAIRU.

Module III:Short Run Analysis

Business Cycles-Phases-Theories of trade cycles- Hawtrey's theory- Hayek's theory- Keynesian theory-Monetarist interpretation of trade cycles-Contra-cyclical policy measures-Monetary, fiscal, and incomes policy - Meaning and Instruments.

Module IV:Fiscal and Monetary Policy

Fiscal policy-tools-effectiveness-Monetary policy-tools-effectiveness-Interaction between fiscal and monetary policy.Unconventional Monetary Policy-Quantitative easing-Transmission mechanism.Great recession of 2008 and use of monetary and fiscal policy.

References

1.Edward Shapiro – 'Macro economics' Oxford University press.

2.GregoryMankiw – 'Macro economics' – 6th Edn. Tata McGraw Hill.

3. Richard T. Froyen – 'Macro economics', Pearson education.

4. Eugene Diulio – Macro economic Theory, Shaum's Outline series. Tata McGraw Hill

5.Errol D'Souza – 'Macro Economics' – Pearson Education 2008

. 6.AbhijitKundu (2009) : Methodology and Perspectives of Social Science – Pearson Education

OBJECTIVES

- To identify the necessary ideas and tools to understand the working of an economy at the aggregate level.
- To give an idea about the need for and way in which government intervention is required in a modern economy
- To explain the way fiscal and monetary policy works, using the ISLM framework
- To explain the concept and measurement of inflation and unemployment.

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Goods market equilibrium using IS curve-derivation and shifts-Money	• Lecture • Participative Learning	To identifying the ISLM	To explain the way fiscal and monetary	Evaluation through Test Paper

	market equilibrium using LM curve-derivation and shifts-equilibrium using IS and LM.	• Problem Solving • Group discussion	framework	policy works, using the ISLM framework	
Module II	Types of Inflation –Headline and core inflation-Measurement of inflation in IndiaWPI-CPI-PPI-GDP deflator.Effects of inflation- Sacrifice ratio-Theories of inflation-Demandpull versus cost-push inflation-Measures to control inflation.Unemployment – Types of unemployment-Measurement of unemployment-Cost of unemployment and Okun'slaw.Phillips curve –Short Run and Long run Phillips curve – Stagflation of 1970s-reasons-NAIRU.	• Lecture • Participative Learning • Problem Solving • Group discussion	To identifying the different types of inflation	To explain the concept and measurement of inflation and unemployment.	Evaluation through Quiz
Module III	Business Cycles-Phases-Theories of trade cycles- Hawtrey's theory- Hayek's theory- Keynesian theory-Monetarist	• Lecture • Participative Learning • Group discussion	To understand the different types of businues s cycle	To identify the necessary ideas and tools to understand the working	Evaluation through Test Paper

	interpretation of trade cycles-Contra-cyclical policy measures-Monetary, fiscal, and incomes policy - Meaning and Instruments			of an economy at the aggregate level.	
Module IV	Fiscal policy-tools-effectiveness-Monetary policy-tools-effectiveness-Interaction between fiscal and monetary policy.Unconventional Monetary Policy-Quantitative easing-Transmission mechanism.Great recession of 2008 and use of monetary and fiscal policy.	• Lecture • Participative Learning • Group discussion	Peer discussion about the need of fiscal and monetary policy in India	To give an idea about the need for and way in which government intervention is required in a modern economy	Evaluation through Test Paper

COURSE OUTCOME

CO1	To explain the way fiscal and monetary policy works, using the ISLM framework
CO2	To explain the concept and measurement of inflation and unemployment.
CO3	To identify the necessary ideas and tools to understand the working of an economy at the aggregate level.
CO4	To give an idea about the need for and way in which government intervention is required in a modern economy

Faculty in charge,

Dr. Shirley Jose K

Semester V

Course Category	**Core Course 7**
Course Title and Code	**Fiscal Economics ECO5 B07**
No. of Credits	**4**
No. of Contact Hours	**6 Hours per week**

FISCAL ECONOMICS

Preamble:Fiscal economics deals with the fisc (treasury) of the country. It is related to decision making in the public sector or finance of the government. The basic aim of this course is to introduce students to

the application of the techniques, methods and principles of Economics for decision making in fiscal economics. After completing this course students are expected to learn how the principles of economics can be applied to sound decision making in public finance. They are expected to learn to analyse the financial activities of a government and to understand the important economic issues that government agents face. Training in fiscal economics will help students in higher studies.

Module I:Meaning and scope of fiscal economics

Origin, growth, meaning and scope of public finance- Public and private finance- Principle of MSA-Public goods and private goods-mixed goods and merit goods (concepts only with examples)

Module II: Public expenditure and cost benefit analysis

Meaning and importance of public expenditure with special reference to India-Wagner‘s, Peacock-Wiseman Hypothesis-Canons of Public expenditure-effects of public expenditure on the economy of India-investment evaluation, project evaluation and cost benefit analysis with suitable examples.

Module III: Public revenue and Income tax calculation

Sources of Public revenue-tax and non-tax- classification of taxes-canons and principles of taxation-Ability to pay- cost of service and Benefit- impact, incidence and shifting of tax burden- effects of taxation- major taxes in India like income tax, GST- calculation of personal and corporation income tax(with suitable examples).

Module IV: Public Debt and Budget in India

Public Debt and Debt management in India- Debt redemption- Budgeting in India- importancetypes-Principles- procedures of budgeting- revenue and capital budgets- zero base budgetingperformance budgeting- primary deficit- revenue and capital deficit- budget deficit- fiscal policy with reference to India- contra cyclical fiscal policy- deficit financing and black money in India.

Module V:Federal and local finance in India

Meaning and importance of federal finance - function of finance commissions- jurisdictions of finance commission – Centre, State financial relations- NITI Aayog -Local finances- functions and revenues.

Assignments and Seminars

1. Discuss recent central, state and local governments’ budget.
2. Calculate income tax of an employee.
3. Prepare and calculate corporation tax of a company.
4. Visit any project in the locality and calculate cost benefit analysis.

5. Discuss about local finance and project.
6. Study about war finance.
7. Consider parallel economy of India.
8. Impact of revenue and expenditure of immigrants and emigrants on the economy of Kerala.
9. Fiscal and monetary policy of India.
10. Discuss Railway Budget.
11. Changes in the financial system of post reform in India.
12. Social Audit system
13. Computation of Net price of a commodity or service by using GST

References:

1. Earl R.Rolph, (1954) "The theory of Fiscal Economics University of California Press.
2. Musgrave and Musgrave(1989),"PublicFinance in Theory and Practice",McGraw Hill International Edition.
3. Tyagi B.P. (1992-93) "Public Finance", Jai Prakash,Nath Co.,Meerat, U.P
4. .UmaKapila(2018) "Indian Economy: Performance and Policies", by Academic Foundation
5. H. Rosen, T. Gayer. (2009) "Public Finance", 9th ed., McGraw-Hill/Irwin,
6. Datta / Sundaram, (2009) "Indian Economy",S.Chand and Co. Ltd., New Delhi.
7. Bhatia H.L(1984). "Public Finance", Vikas Publishing House Pvt.Ltd.,New Delhi
8. R.K Lekhi,Jogindersingh, (2015) "Public Finance"– Kalyani publications
9. Jha R, (1998) "Modern Public Economics", Routledge London.
10. Good sand Service Tax (GST) (2019)-Concept& Status.-Central Boardof Indirect Taxesand Customs (CBIC)India.

OBJECTIVES

- To understand the meaning and scope of fiscal economies
- To apply the techniques, methods and principles of Economics for decision making in fiscal economics.
- To learn how the principles of economics can be applied to sound decision making in public finance
- To analyse the financial activities of a government
- To understand the important economic issues that government agents face

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Origin, growth, meaning and scope of public finance-Public and private finance-Principle of MSA-Public goods and private goods-mixed goods and merit goods (concepts only with examples)	● Lecture ● Group Discussion	To identify the meaning and scope of public Finance	To understand the meaning and scope of fiscal economies	Evaluation through Test Paper
Module II	Meaning and importance of public expenditure with special reference to India-Wagner ‘s, Peacock-Wiseman Hypothesis-Canons of Public expenditure-effects of public expenditure	● Lecture ● Assignments ● Group Discussion	To identify the theories of Public Expenditure	To apply the techniques, methods and principles of Economics for decision making in fiscal economics.	Evaluation through Test Paper

	on the economy of India-investment evaluation, project evaluation and cost benefit analysis with suitable examples.				
Module III	Sources of Public revenue-tax and non-tax-classification of taxes-canons and principles of taxation-Ability to pay- cost of service and Benefit-impact, incidence and shifting of tax burden-effects of taxation-major taxes in India like income tax, GST-calculation of personal and corporation income tax(with suitable examples).	● Lecture ● Assignments ● Group Discussion ● Problem solving	To understood the calculation of GST and income tax in India	To learn how the principles of economics can be applied to sound decision making in public finance	Evaluation through Test Paper

Module IV	Public Debt and Debt management in India- Debt redemption- Budgeting in India- importance types- Principles- procedures of budgeting- revenue and capital budgets- zero base budgeting performance budgeting- primary deficit- revenue and capital deficit- budget deficit- fiscal policy with reference to India- contra cyclical fiscal policy- deficit financing and black money in India.	● Lecture ● Assignments ● Group Discussion	To classify different budgeting in India	To analyse the financial activities of a government	Evaluation through Assignments
Module V	Meaning and importance of federal finance - function of finance commissions-	● Lecture ● Assignments ● Group Discussion	Assignment on Financial sector Reforms in India	To understand the important economic issues that	Evaluation through Assignments

	jurisdictions of finance commission – Centre, State financial relations- NITI Aayog -Local finances- functions and revenues.			government agents face	

COURSE OUTCOME

CO1	To understand the meaning and scope of fiscal economies
CO2	To apply the techniques, methods and principles of Economics for decision making in fiscal economics.
CO3	To understand the meaning and scope of fiscal economies

CO4	To learn how the principles of economics can be applied to sound decision making in public finance
CO5	To understand the important economic issues that government agents face

Faculty in charge,
Dr. Shirley Jose K

Semester V

Course Category	**Core Course 8**
Course Title and Code	**Indian Economic Development ECO5 B08**

No. of Credits	**4**
No. of Contact Hours	**6 Hours per week**

INDIAN ECONOMIC DEVELOPMENT

Preamble**:** The course is designed to expose the learners to some of the key issues facing the Indian economy both at national and regional levels. In this process, as young adults, students are expected to be sensitised about these issues, appreciate and learn to critically assess the role of the government in various economic spheres. The learners are also exposed to numerical information relating to various aspects of Indian economy and India's economic policies. They are expected to develop analytical skills, interpret the economic events and visualise the economic future of India. For all these to happen, teachers are requested to take special care to instruct the students to read the suggested reference books, collect clippings and articles from newspapers and magazines and also develop the habit of following economic survey, economic review and RBI Bulletin. Besides, as against the conventional assignments, each module has **'**Suggested Additional Activities' at the end. Teachers need to encourage the learners to explore beyond the texts while attempting these activities.

Report Based on Study Tour: A study tour is recommended because it may add direct experience to learners about different economic culture of the country. All the final year students need to prepare a report of the tour that includes the places they visited, its importance etc and submit it to the Head of the Department soon after the completion of the tour.

Module I : Development Policies And Experience(1947-1990).

Low Level of Economic Development under the Colonial Rule- Development and Structural Change of Indian Economy Since Independence: Economic policies Perused between 1950's and 1980's: Mixed Economic framework; Market intervention policy and import substitution; Objectives and strategy of planning: Failures and achievements of plans – Performance of 11th plan – Current plan.

Suggested Additional Activities

1. Find out and prepare a list of items that India used to import and export during 1950-51 and 1990-91

a. Observe the difference

b. Do you see the impact of self-reliance? Discuss. Details can be collected from latest Economic Survey.

2. Find out the Deputy Chairman and members of the first Planning Commission of India
3. Find out the commodities which India Government permitted to import till1980.
4. Explain how import substitution can protect domestic industry?

Module II : Economic Reforms since 1991

Background for the introduction of New Economic Reforms of 1991; Liberalisation, Privatisation and Globalisation: An Appraisal- Indian Economy during Reforms with Special focus on trends in FDI, FII and Disinvestment- Centre-State Financial Relations: Finance Commission, its structure and Functioning (with emphasis on Latest Finance Commission).Role of NITI Aayog

Suggested Additional Activities

1. Prepare arguments for and against subsidies. Explain your view
2. Do you think only loss making companies should be privatised? Why?
3. Construct a pie chart for the sectoral contribution of GDP for the period1950-51 and 2012-
4. What would you observe? Is there a structural change? Explain in your own words
5. Prepare a list showing the latest data on the number of banks- nationalized,private,foreign and New Generation Banks.
6. Discuss the different formulae used for Finance Commission awards.
7. Find out who all are there in the First Finance Commission of India

Module III: Gross Domestic Product and Sectors.

a. Indian Agriculture: The place of Agriculture in the National Economy; Recent Trends in Investment, Credit and Agricultural Subsidy Policy, Agricultural Marketing and Price- New Agricultural Strategy of 1960s (Green Revolution)- Food Security, PDS and TPDS in India; The Need, Scope and Appraisal of Land Reforms in a Developing Country like India.
b. Indian Industries: Review of Industrial Growth under Planning- Industrial Structure: Traditional, SSI, Village, Cottage and Modern Industries- Industrial Sickness-Industrial Policy Resolutions: 1956, 1977, 1980, 1991; an Analysis of Current Industrial Policy- Infrastructure Development in India.

Suggested Additional Activities.

1. Why, despite the implementation of green revolution, 65% of our population continued to be engaged in the agricultural sector till 1990?
2. Why was public sector given a leading role in industrial development during the plan period?
3. Lossesincurredbypublicsectorundertakingsaretobemetoutofthepublicbudget -Do ‟ you agrees with this statement? Discuss.
4. Find out the method of estimating inflation in India. Compare it with other countries.

Module IV: Current Challenges Facing the Indian Economy

a. Poverty: Who are Poor?, Causes and Measurement of Poverty, Number of Poor in India; Policies and Programmes Towards Poverty Alleviation with Special Emphasis on Recent Policies like- Food as a Right: The Food Security Act of 2013 &MGNREGS.

b. Unemployment: Nature, Trends and Estimates of Unemployment in India, Informalisation of Indian Work Force; Employment Prospective of the latest Five Year Plan; Recent Schemes to Reduce Unemployment and Underemployment.

Suggested AdditionalActivities.

1. Find out from your parents and teachers types of tax payments they are making. Classify the taxes and observe the differences.
2. On the basis of the definition of poverty line, analyse whether categorization of people into BPL/APL is done in the correct way. Explain in your own words.
3. Analyse whether the dream programme of MGNREGP is carrying out in the right way.If.No ,suggest ways to make the programme more effective. ‟
4. In some communities, you might have noticed that even if the males do not earn high income, they do not send women to work. Why?
5. Prepare a list of recent schemes and objectives to strengthen the rural areas from the government website http://www.rural.nic.in

Module V: Kerala's Economic Development Growth and Structure

Primary, Secondary and Tertiary Sectors-Economic Development Vs Social Development-Poverty Profile of Kerala- Indicators of Human Development: PQLI and HDI- Demographic Transition of Kerala- Trends in Employment and Unemployment in KeralaSustainability of ―Kerala Model of Development with a Special Mention on Recent Sen- ǁ Bhagawati Debate- Decentralised Planning and Development of Kerala- Land Reforms in Kerala- Migration: Concepts in Migration- Emigration to the Gulf- Remittance and its Impact on the Economy of Kerala- Return Migration: Causes, Problems and Policies.

Suggested Additional Activities.

1. Find out the history of emigration from Kerala.
2. Foreign remittance is the backbone of Kerala s socio-economic development. Discuss.
3. What is Nitaqat and Saudization? In what ways it is harmful to the economy of Kerala.
4. Find out the reasons for the existing controversy in poverty estimation.
5. Observe the functioning of Ayalkoottams (SHGs) in your locality and write how far it ‟ is successful in empowering women.

References:

1. 1.Economic development in India-Problems and Prospects,N.P.Abdul(Ed), Regal Publications, NewDelhi
2. 2.Indian Economy, Gopalji Gupta, PEARSON, NewDelhi.
3. Ahulwalia, I.J. and I.M.D. Little (Eds) (1999), India's Economic Reformsand

4. Development, (Essays in honour of Manmohan Singh), Oxford University Press, New Delhi.
5. Bardhan, P .K. (1999), The Political Economy of Development in India, Oxford University Press, NewDelhi
6. Chakravarty S, (1987), Development Planning: The Indian Experience, Oxford University Press, and New Delhi

OBJECTIVES

To understand the key issues facing the Indian economy both at national and regional levels

To critically assess the role of the government in various economic spheres.

To classify various aspects of Indian economy and India‘s economic policies.
To develop analytical skills, interpret the economic events and visualise the economic future of India.
To critically evaluate Kerala Model Of Development

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Low Level of Economic Development under the Colonial Rule-Development and Structural Change of Indian Economy Since Independence: Economic policies Perused between 1950‘s and 1980‘s: Mixed Economic framework; Market intervention policy and import substitution; Objectives and strategy of planning: Failures and achievements of plans – Performance of 11th plan – Current plan.	Lecture Peer Discussion Power point Presentation	To critically evaluate Indian economy since Independence	To understand the key issues facing the Indian economy both at national and regional levels .	Evaluation through Peer Discussion
Module II	Background for the introduction of New Economic Reforms of 1991;	Lecture Peer Discussion	To analyse economic REFORM	To develop analytical skills, interpret the	Evaluation through

	Liberalisation, Privatisation and Globalisation: An Appraisal- Indian Economy during Reforms with Special focus on trends in FDI, FII and Disinvestment-Centre-State Financial Relations: Finance Commission, its structure and Functioning (with emphasis on Latest Finance Commission).Role of NITI Aayog	Power point Presentation	S OF 1991 in India	economic events and visualise the economic future of India	Test Paper
Module III	a. Indian Agriculture b. Indian Industries	Lecture Peer Discussion ___Power point Presentation	To compare growth of Indian agriculture and industries	To classify various aspects of Indian economy and India‘s economic policies	Evaluation through Test Paper
Module IV	a. Poverty: b. Unemployment	Lecture Peer Discussion ___Power point Presentation	To understand the concept of poverty and employment through Discussion	To critically assess the role of the government in various economic spheres	Evaluation through Peer Discussion

Module V	Growth and Structure- Primary, Secondary and Tertiary Sectors-Economic Development Vs Social Development-Poverty Profile of Kerala-Indicators of Human Development: PQLI and HDI-Demographic Transition of Kerala- Trends in Employment and Unemployment in KeralaSustainability of ―Kerala Model of Development with a Special Mention on Recent Sen- ǁ Bhagawati Debate-Decentralised Planning and Development of Kerala- Land Reforms in Kerala-Migration: Concepts in Migration-Emigration to the Gulf- Remittance and its Impact on the Economy of Kerala-Return Migration: Causes, Problems and Policies.	Lecture Peer Discussion ___Power point Presentation ___Debate ___Assignments	To write assignment on Human Development Index in Kerala	To critically evaluate Kerala Model Of Development	Evaluation through Debate

COURSE OUTCOME

CO1	To understand the key issues facing the Indian economy both at national and regional levels
CO2	To develop analytical skills, interpret the economic events and visualise the economic future of India
CO3	To classify various aspects of Indian economy and India‘s economic policies
CO4	To critically assess the role of the government in various economic spheres
CO5	To critically evaluate Kerala Model Of Development

Faculty in charge,
Dr. Shirley Jose K

Semester V

Course Category	Core Course 9
Title and Code	Economics of Capital Market ECO5 B09
No. of Credits	4
No. of Contact Hours	5 Hours per week

ECONOMICS OF CAPITAL MARKET

Preamble: In the present Globalised world financial institutions and markets play a significant role. The financial sector liberalization across the world including India has led to unprecedented growth in the financial sector, especially in the capital market, leading to the introduction of new and diversified financial instruments and financial practices, providing ample career opportunities to the students of economics. This course is designed to give an exposure to the students of economics to the changing world of financial markets and to give them an opportunity to familiarize with the basic concepts related to capital market which they read in newspapers and hear and see through electronic media in their daily walks of life. This course also aims at providing a platform to the students of economics in developing the skills required to take up a career in financial sector and to provide them an opportunity to think of higherstudies in finance which may open them vast career opportunities in the field of finance.

Module I:Financial Assets

Financial Assets –Tangible and Intangible Assets – Debt Vs Equity – Properties of Financial assets-Financial markets – Classification of Financial Markets – Financial System and Economic Development – Weakness of Indian Financial System.

References:

1. .FrankJ. Fabozziand Franco Midiglian, ―Capital Markets – Institutions and Instruments , ‖ Pearson Prentice Hall, New Delhi (LatestEdition).
2. GordanK.Natarajan,―FinancialMarketsandServices‖,HimalayaPublishingHouse, Mumbai (LatestEdition).

Module II : Capital Market Capital market –

Meaning, Characteristics and Functions – Importance of Capital Markets in an economy – The structure of Indian capital market – Capital market instruments – Equity shares (rights shares, bonus shares, bluechip shares), Debentures or Bonds (Convertible, nonconvertible, partly convertible, fully convertible, redeemable and irredeemable), Government securities, Euro Issues – GDRs, ADRs, Foreign Currency

Convertible Bonds (FCCB) – Capital Market Institutions-DIIs, FIIs, Mutual Funds – Securities and Exchange Board of India (SEBI) – Objectives, Functions andPowers

References:

1. S. Gurusamy, ‗Capital Markets', Vijay Nicole Imprints Private Limited, Chennai(Latest edition)

2. Shashi K Gupta,Nisha Aggarwal and Neeti Gupta,‗Financial Marketsand Institutions, Kalyani publishers, New Delhi (Latest edition)

3. M.Y. Khan, ‗Indian Financial System', Tata McGraw Hill Education Private Limited, New Delhi (Recentedition)

4. Online Resource : www.sebi.gov.com

Activities/Assignments:

1. Students may be asked to note down the important mutual funds operating in India and different schemes offered by some of them and their descriptions. (eg: Growth Funds, Open end Funds etc.)

Module III : The Primary Market (New Issues Market)

Meaning and Functions of Primary Market – Methods of Floating New Issues – Pure Prospectus method, Private Placement Method, IPO Method, Rights Issue Method, Bonus Issue Method, Book Building Method, Employee Stock Option (ESOP) – Intermediaries in New Issues Market – Merchant Bankers/Lead Managers, Registrars to an Issus, Underwriters, Bankers to an Issue, Brokers to an Issue, Debenture Trustees – Causes for Poor performance of New Issues Market.

References:

1. S. Gurusamy, ‗Capital Markets', Vijay Nicole Imprints Private Limited, Chennai(Latest edition)

2. Shashi KGupta,Nisha Aggarwal and NeetiGupta,‗Financial Markets and Institutions, ‗Kalyani publishers, New Delhi (Latest edition)

3. S. Gurusamy, ‗Financial Markets and Institutions', Vijay Nicole Imprints Private Limited, Chennai (Latestedition)

4. S.N. Sasidharan and S. Aiyappan Pillai, ‗An Introduciton to Capital Market', Right Publishers, Kudavechoor (Latest edition)

5. L.M. Bhole, ‗Financial Institutions and Markets-Structure, Growth and Innovations', Tata McGraw Hill Publishing Company Limited, New Delhi (Latest edition)

Activities/Assignments:

1. Show specimen of share application form (IPO) and ask the students to note down the important terms mentioned in the form. Tell them to write down the meaning of all such terms (eg: QIB, Retail Investor, Cap Price etc) and institutions related to IPO.

2. Ask the students to fill up the share application form so as to acquire some practical skills in the subject.

3. Students may be introduced to a specimen of Demat Account opening Form. (Available with DPs like Geojith Securities, JRG Securities, Stock Holding Corporation of India or other Stock Brokingfirms)

Module IV:The Secondary Market – Stock Exchanges

The Secondary Market – Difference between Primary market and Secondary Market – Listing of Securities – Physical Shares and Demat Shares – Depository Participant (DP) – NSDL and CSDL – Meaning and Definition of Stock Exchanges – Functions of Stock Exchanges – Origi and Development of Stock Exchanges in India – Bombay Stock Exchange (BSE) - National Stock Exchange (NSE) – Over the Counter Exchange of India (OTCEI) – Stock Market Index in India and Abroad: SENSEX and Nifty – NASDAQ, DOWJONES, FTSE, Nikkei.

References:

1. S. Gurusamy, _Capital Markets‘, Vijay Nicole Imprints Private Limited, Chennai(Latest edition)

2. ShashiKGupta,NishaAggarwalandNeetiGupta,_FinancialMarketsandInstitutions, _Kalyani publishers, New Delhi (Latest edition)

3. S. Gurusamy, _Financial Markets and Institutions‘, Vijay Nicole Imprints Private Limited, Chennai (Latestedition)

4. S.N. Sasidharan and S. AiyappanPillai, _An Introduciton to Capital Market‘, Right Publishers, Kudavechoor (Latest edition)

5. L.M. Bhole, _Financial Institutions and Markets-Structure, Growth and Innovations‘, Tata McGraw Hill Publishing Company Limited, New Delhi (Latestedition)

6. Online resources:i)www.nseindia.com ii)www.bseindia.com

Activities/Assignments:

1. Ask students to visit SEBI website and collect data on purchase, sale and net investment in equity and debt instruments by FIIs in Indian Stock Market (Also available in financial dailies like Economic Times, Businessline etc.)

2. Ask students to visit the BSE website and note down the shares of companies included in SENSEX and their relative weightage in the index

. 3. Ask students to visit the NSE website and note down the shares of companies included in NSE Nifty and their relative weightage in the index.

4. Students may be asked to find out other different indices published by BSE and make a short note of these indices from BSE website (eg: BSE PSU Index, BSE TECH Index etc.

5. Students may be directed to study the share holding pattern of some of the shares of companies listed at BSE or NSE. (Available also at www.moneycontrol.com)

Note: 1. Students may be motivated to read financial dailies like Economic Times, Business Line, Business Standard, Dhanam etc regularly in order to get a proper understanding of the terms and concepts and the working of capital markets. 2. Students may be encouraged to watch exclusive financial channels like CNBC TV 18, NDTV PROFIT etc, to get an idea of stock trading and capital market activities. 3. If possible students may be taken to a stock trading terminal so as to get an idea of the online buying and selling of shares.

Additional Reading:

1. M. Y. Khan, _Indian Financial System‘, Tata McGraw Hill Education Private Limited, New Delhi (LatestEdition)

2. L.M. Bhole and JitendraMahakud, _Financial Institutions and Markets – Structure, Growth and Innovations‘, Tata McGraw Hill Educaiton Private Limited, New Delhi (LatestEdition)

3. Bharathi V. Pathak, _The Indian Financial System – Markets, Institutions and Services, Pearson, New Delhi (latest edition)

4. K.L. Garg, _Stock Exchanges in India‘, Bookland Limited,Calcutta.

5. V.A. Avadhani, _Investment and Securities Market in India‘, Himalaya Publishing House, Bombay (Latest edition)

OBJECTIVES

- To understand different finacial assets in the economy
- To introduce new and diversified financial instruments and financial practices
- To providing a platform to the students of economics in developing the skills required to take up a career in financial sector
- To understand the functioning stock market in India

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Tangible and Intangible Assets – Debt Vs Equity – Properties of Financial assets-Financial markets – Classification of Financial Markets – Financial System and Economic Development – Weakness of Indian Financial System.	Lecture Peer Discussion Power point Presentation	To compare tangible and intangible assets	To understand different finacial assets in the economy	Evaluation through Test Paper

Module II	Meaning, Characteristics and Functions – Importance of Capital Markets in an economy – The structure of Indian capital market – Capital market instruments – Equity shares (rights shares, bonus shares, bluechip shares), Debentures or Bonds (Convertible, nonconvertible, partly convertible, fully convertible, redeemable and irredeemable), Government securities, Euro Issues – GDRs, ADRs, Foreign Currency Convertible Bonds (FCCB) – Capital Market Institutions-DIIs, FIIs, Mutual Funds	Lecture Peer Discussion	The students to fill up the share application form so as to acquire some practical skills in the subject.	To introduce new and diversified financial instruments and financial practices	Evaluation Through Test Paper

	– Securities and Exchange Board of India (SEBI) – Objectives, Functions andPowers				
Module III	Meaning and Functions of Primary Market – Methods of Floating New Issues – Pure Prospectus method, Private Placement Method, IPO Method, Rights Issue Method, Bonus Issue Method, Book Building Method, Employee Stock Option (ESOP) – Intermediaries in New Issues Market – Merchant Bankers/Lead Managers, Registrars to an Issus, Underwriters, Bankers to an Issue, Brokers to an Issue, Debenture Trustees –	Lecture Peer Discussion Assignments	to note down the important mutual funds operating in India and different schemes offered by some of them and their descriptions.(eg: Growth Funds, Open end Funds etc.)	To providing a platform to the students of economics in developing the skills required to take up a career in financial sector	Evaluation through Test Paper

	Causes for Poor performance of New Issues Market.				
Module IV	The Secondary Market – Difference between Primary market and Secondary Market – Listing of Securities – Physical Shares and Demat Shares – Depository Participant (DP) – NSDL and CSDL – Meaning and Definition of Stock Exchanges – Functions of Stock Exchanges – Origi and Development of Stock Exchanges in India – Bombay Stock Exchange (BSE) - National Stock Exchange (NSE) – Over	Lecture Peer Discussion Power point Presentation	To find out other different indices published by BSE and make a short note of these indices from BSE website (eg: BSE PSU Index, BSE TECH Index etc.	To understand the functioning stock market in India	Evaluation through Test Paper

	the Counter Exchange of India (OTCEI) – Stock Market Index in India and Abroad: SENSEX and Nifty – NASDAQ, DOWJONES, FTSE, Nikkei.				

COURSE OUTCOME

CO1	To understand different finacial assets in the economy
CO2	To introduce new and diversified financial instruments and financial practices
CO3	To providing a platform to the students of economics in developing the skills required to take up a career in financial sector
CO4	To understand the functioning stock market in India

Faculty in charge,

Mr. Nijil Jacobi

Semester V

Course Category	Core Course 10
Course Title and Code	Mathematical Economics ECO5 B10
No. of Credits	4
No. of Contact Hours	5 Hours per week

MATHEMATICAL ECONOMICS

Preamble: Mathematical economics is an approach where mathematical symbols and theorems are used for economic analysis. Modern economics is analytical and mathematical in structure. Thus the language of mathematics has deeply influenced the whole body of the science of economics. Every student of economics must possess a good proficiency in the fundamental methods of mathematical economics. One of the significant developments in Economics is the increased application of quantitative methods and econometrics. A reasonable understanding of econometric principles is indispensable for further studies in economics. This course is aimed at introducing students to the most fundamental aspects of mathematical economics and econometrics. The objective is to develop skills in these. It also aims at developing critical thinking, and problem-solving, empirical research and model building capabilities of the student which will help them to build and test models in economics and related fields. The course will also assist them in higher studies in economics.

Module I: Introduction to Mathematical Economics

Mathematical Economics: Meaning and Importance- Mathematical Representation of Economic Models- Economic functions: Demand function, Supply function, Utility function, Consumption function, Production function, Cost function, Revenue function, Profit function, saving function, Investment function

Module II: Marginal Concepts

Marginal utility, Marginal propensity to Consume, Marginal propensity to Save, Marginal product, Marginal Cost, Marginal Revenue, Marginal Rate of Substitution, Marginal Rate of Technical Substitution. Relationship between Average Revenue and Marginal Revenue Relationship between Average Cost and Marginal Cost - Elasticity: Price elasticity, Income elasticity, Cross elasticity.

Module III: Optimisation

Optimisation of single / multi variable functions - Constrained optimisation with Lagrange Multiplier – significance of Lagrange Multiplier. Economic applications: Utility Maximisation, Cost Minimisation, Profit Maximisation.

Module IV: Production Function

Linear Programming and Input Output analysis Production function- homogeneous and non-homogeneous. Degree of homogeneity and returns to scale - Properties of Cobb-Douglas production function. Production possibility curve. Linear programming: – Basic concept, Nature of feasible, basic and optimal solution; Graphic solution.Input-output analysis –Matrix of technical coefficients – the Leontief matrix – computation of total demand for a two/ three sector economy.

Module V: Market Equilibrium

Market Equilibrium: Perfect Competition- Monopoly- Discriminating Monopoly

Note to faculty / question paper setter: 1. This course is for B.A. Economics course. The students of this course may not have studied mathematics at higher secondary level. Hence questions may be confined to intermediary level. 2. Kindly give due consideration and adhere to the weightages indicated in the syllabus while setting question paper also.

References:

1. Dowling E.T, Introduction to Mathematical Economics, 2nd Edition, Schaum‘sOutline Series, McGraw-Hill, New York,2003(ETD)

2. Chiang A.C. and K. Wainwright, Fundamental Methods of MathematicalEconomics, Tata McGraw-Hill Education; Fourth edition(2013)

3. Henderson, J. M. and R.E. Quandt (1980), Microeconomic Theory: A MathematicalApproach, McGraw Hill, New Delhi.

4. James Bradfield , Jeffrey Baldani, An Introduction to Mathematical Economics, Cengage Learning India Pvt Ltd (2008)

5.A. Koutsoyiannis, Modern Microeconomics, Palgrave Macmillan; 2nd Revised edition (2003)(– see mathematical appendices for each topic.

OBJECTIVES

To develop a good proficiency in the fundamental methods of mathematical economics
To introduce the most fundamental aspects of mathematical economics and econometrics
To inculcate critical thinking, and problem-solving, empirical research and model building capabilities of the student.
To understand the marginal concepts in economics

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Mathematical Economics: Meaning and Importance- Mathematical Representation of Economic Models- Economic functions: Demand function, Supply function, Utility function, Consumption function, Production function, Cost function, Revenue function,	Lecture Group Discussion Problem Solving	To understand fundamental methods of mathematical economics	To develop a good proficiency in the fundamental methods of mathematical economics	Evaluation through Test Paper

	Profit function, saving function, Investment function				
Module II	Marginal utility, Marginal propensity to Consume, Marginal propensity to Save, Marginal product, Marginal Cost, Marginal Revenue, Marginal Rate of Substitution, Marginal Rate of Technical Substitution. Relationship between Average Revenue and Marginal Revenue Relationship between Average Cost and Marginal Cost - Elasticity: Price elasticity, Income elasticity, Cross elasticity	Lecture Group Discussion Problem Solving	To understand marginal concepts in economics	To understand marginal concepts in economics	Evaluation through Test Paper
Module III	Optimisation of single / multi variable functions - Constrained optimisation	Lecture Group Discussion	To identify optimization of single / multi variable functions	To inculcate critical thinking, and problem-solv ing, empirical	Evaluation through Test Paper

	with Lagrange Multiplier – significance of Lagrange Multiplier. Economic applications: Utility Maximisation, Cost Minimisation, Profit Maximisation.	Problem Solving		research and model building capabilities of the student	
Module IV	Linear Programming and Input Output analysis Production function- homogeneous and non-homogeneous. Degree of homogeneity and returns to scale - Properties of Cobb-Douglas production function. Production possibility curve. Linear programming: – Basic concept, Nature of feasible, basic and optimal solution; Graphic solution.Input-output analysis –Matrix of technical coefficients – the Leontief	Lecture Group Discussion Problem Solving	To find out linear programming in economics	To inculcate critical thinking, and problem-solving, empirical research and model building capabilities of the student	Evaluation through Test Paper

	matrix – computation of total demand for a two/ three sector economy.				
Module V	Market Equilibrium: Perfect Competition- Monopoly- Discriminating Monopoly	Lecture Peer Discussion Problem Solving	To find out market equilibrium in different markets	To critically evaluate Market Equilibrium in different marets	Evaluation through Test Paper

COURSE OUTCOME

CO1	To develop a good proficiency in the fundamental methods of mathematical economics
CO2	To understand marginal concepts in economics
CO3	To inculcate critical thinking, and problem-solving, empirical research and model building capabilities of the student
CO4	To critically evaluate Market Equilibrium in different markets

Faculty in charge,

Mr. Nijil Jacobi

Semester VI

Course Category	Core Course 11
Course Title and Code	Financial Economics ECO6 B11
No. of Credits	4
No. of Contact Hours	5 Hours per week

FINANCIAL ECONOMICS

Preamble: This course intends to familiarize the students with the basic concepts in financial economics along with some of the basic models which are used to benchmark valuation of assets and derivatives. These include the CAPM, and the Binomial Option Pricing models. After completing this course, the student will be able to develop comprehensive knowledge on the role of finance in the operation of an economy. It also enables them to know the operation of the Indian Financial System and activities in the financial markets.

Module I: Investment Theory and Structure of Interest rates

Introduction to financial economics, Time Value of Money: Future Value, Present Value, Future value of an annuity, Present value of annuity, Present rate of perpetuity. Investment Criteria: Net Present Value, Benefit Cost Ratio, Internal Rate of Return, Modified Internal Rate of Return.

Module II: Valuation of Bonds and Securities

Fundamentals of Valuation of Securities: Valuation of Bonds and Stocks; Bond Yield, Yield to Maturity. Equity Valuation: Dividend Discount Model, The P/E Ratio Approach; Irrelevance of Dividends: Modigliani and Miller Hypothesis.

Module III: Risk and Return Types of risk

, Historical returns and Risk, computing historical returns, average annual returns, variance of returns, Measurement of Risk and Return of an asset, Measurement of Risk and Return of a Portfolio, Determinants of Beta, Risk-Return trade off.

Module IV: Cost of Capital and Capital Asset Pricing Model

The Cost of Capital: Debt and equity; Cost of Debt, Cost of Preference Capital and Equity Capital. The capital market line; the capital asset pricing model; the beta of an asset and of a portfolio; security market line; use of the CAPM model in investment analysis and as a pricing formula.

Module V:Derivative Markets

An introduction to financial derivatives: Types and uses of derivatives; Forward Contracts: determination of forward prices, Futures Contract: theories of future prices- the cost of carry model, the expectation model, capital asset pricing model. Relation between Spot and Future Prices, forward vs future contract, Hedging in Futures; Options: types, value of an option, the Pay-Offs from Buying and Selling of Options; the Put Call Parity Theorem; Binomial option pricing model (BOPM) and Black-Scholes option pricing model.

References

1. L. M. Bhole and J. Mahukud, Financial Institutions and Markets, Tata McGraw Hill, 5th edition, 2011.
2. 2. Hull, John C., Options, Futures and Other Derivatives, Pearson Education, 6th edition, 2005.

Additional Reading List

1. David G. Luenberger, Investment Science, Oxford University Press, USA, 1997.

2. Thomas E. Copeland, J. Fred Weston and KuldeepShastri, Financial Theory and Corporate Policy, Prentice Hall, 4th edition, 2003.

3. Richard A. Brealey and Stewart C. Myers, Principles of Corporate Finance, McGrawHill, 7th edition, 2002.

4. Stephen A. Ross, Randolph W. Westerfield and Bradford D. Jordan, Fundamentals of Corporate Finance.McGraw-Hill, 7th edition, 2005.

OBJECTIVES

- To develop comprehensive knowledge on the role of finance in the operation of an economy.
- To critically evaluate Modigliani and Miller hypothesis
- To know the operation of the Indian Financial System and activities in the financial markets.
- To know the operation of the capital market in India
- To understand concept of financial derivatives in India

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Introduction to financial economics, Time Value of Money: Future Value, Present Value, Future value of an annuity, Present value of annuity, Present rate of perpetuity. Investment Criteria: Net Present Value, Benefit Cost Ratio, Internal Rate of Return, Modified Internal Rate of Return.	• Lecture • Peer Discussion	To understand the concept of financial economics	To develop comprehensive knowledge on the role of finance in the operation of an economy	Evaluation through Test Paper

Module II	Fundamentals of Valuation of Securities: Valuation of Bonds and Stocks; Bond Yield, Yield to Maturity. Equity Valuation: Dividend Discount Model, The P/E Ratio Approach; Irrelevance of Dividends: Modigliani and Miller Hypothesis	• Lecture • Peer Discussion	To identify the fundamentals of valuation of securities.	To critically evaluate Modigliani and Miller hypothesis	Evaluation through Test Paper
Module III	Historical returns and Risk, computing historical returns, average annual returns, variance of returns, Measurement of Risk and Return of an asset, Measurement of Risk and Return of a Portfolio, Determinants of Beta, Risk-Return trade off.	• Lecture • Peer Discussion	To know measurement of risk and return of portfolio	To know the operation of the Indian Financial System and activities in the financial markets.	Evaluation through Test Paper
Module IV	The Cost of Capital: Debt and equity; Cost of Debt, Cost of Preference Capital and	• Lecture • Peer Discussion	To critically evaluate CPAM model in investment analysis and as a pricing formula	To know the operation of the capital market in India	Evaluation through Test Paper

	Equity Capital. The capital market line; the capital asset pricing model; the beta of an asset and of a portfolio; security market line; use of the CAPM model in investment analysis and as a pricing formula				
Module V	An introduction to financial derivatives: Types and uses of derivatives; Forward Contracts: determination of forward prices, Futures Contract: theories of future prices- the cost of carry model, the expectation model, capital asset pricing model. Relation between Spot and Future Prices, forward vs future contract, Hedging in Futures; Options: types, value of an option, the	• Lecture • Peer Discussion	To understand financial derivatives in India	To understand concept of financial derivatives in India	Evaluation through Test Paper

	Pay-Offs from Buying and Selling of Options; the Put Call Parity Theorem; Binomial option pricing model (BOPM) and Black-Scholes option pricing model.				

COURSE OUTCOME

CO1	To develop comprehensive knowledge on the role of finance in the operation of an economy.
CO2	To critically evaluate the Modigliani and Miller hypothesis.
CO3	To know the operation of the Indian Financial System and activities in the financial markets
CO4	To know the operation of the capital market in India
CO5	To understand concept of financial derivatives in India

Faculty in charge,

Ms. Anju PB

Semester VI

Course Category	Core Course 12
Course Title and Code	International Economics ECO6 B12
No. of Credits	4
No. of Contact Hours	5 Hours per week

INTERNATIONAL ECONOMICS

Preamble: International economics deals with the economic relations among nations --- both trade and financial relations—A good understanding in international economics is necessary for a student of economics and those who wish to work in these areas or governmental organizations. The basic aim of this introductory course on international economics is to present before the students the questions, and answers, related to international economic relations. The students are expected to acquire skill that will help them to take rational decisions in issues related to international economics.

Module I: Introduction to International Economics

Subject matter and importance of International Economics - Internal trade and International trade - Importance of International trade – International trade and economic development – Basicconcepts- Terms of trade.

Module II :Theories of International Trade:

Mercantilist approach to trade -ClassicalTheory: Absolute and Comparative Cost Advantage theories - Hecksher – Ohlin Theory and LeontiefParadox.

Module III: Theory of Commercial Policy:

Free trade - Arguments for and against free trade – Protection - Arguments for and against protection - Methods of Trade Restriction : Tariff and non-tariff trade barriers - Types of tariffs – New protectionism - export subsidy and countervailing duties - Dumping and anti-dumping duties – Economic Integration – WTO, EU, NAFTA, ASEAN, SAARC.

Module IV: Foreign Exchange

Foreign exchange market – functions - Defining foreign exchange and exchange rate – Exchange rate concepts – exchange rate changes (devaluation, revaluation, depreciation, appreciation- over valuation and undervaluation) – Different systems of exchange rate determination - fixed and flexible exchange rate

– Hybrid exchange rate systems – Managed floating – Theories of exchange rate – Mint Parity theory – Purchasing Power Parity Theory – Balance of Payments Theory - Components of Foreign exchange .

Module V: Balance of Payments

Defining Balance of Trade and Balance of Payments - Structure of balance of payments – Equilibrium and disequilibrium in BOP – Measures to correct BOP disequilibrium – India‘s BOP since 1991 – International financial flows – Foreign Direct Investment and Porfolio Investment – Currency Convertibility – IMF-Role and Functions.

References

1. Salvatore, Dominick, _International Economics‘, Weily India, NewDelhi.

2. C.P. Kindle Berger, _International Economics‘

3. Bo Soderstein and Geoffrey Reed, _International Economics‘,Macmillan 4. Carbaugh, _International Economics‘, CengageLearning

4. Francis Cherumilam - _International Economics‘

5. Mannur, H.G. _International Economics‘

6. Errol D‘Souza, _Macro Economics‘, Pearson Education 2008 (For BOP in India)

7. RBI Bulletin, Various issues. 49

OBJECTIVES

- To understand the different terms related to international economics
- To explain the theories of international trade
- To analyze the different theories of commercial policies.
- To acquire skills related to interpret functioning of foriegn exchange
- To distinguish between BOT and BOP

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Subject matter and importance of International Economics - Internal trade and International trade - Importance of International trade – International trade and economic development – Basicconcepts- Terms of trade	● Lecture ● Peer Discussion	To know the differnt terms in international economics especially Terms of Trade	To understand the different terms related to international economics	Evaluation through Test Paper
Module II	Mercantilist approach to trade -ClassicalTheory: Absolute and Comparative	● Lecture ● Peer Discussion	To diffrentiate the differnt theories in	To explain the theories of international trade	Evaluation through Test Paper

	Cost Advantage theories - Hecksher – Ohlin Theory and LeontiefParadox.		internationa l trade		
Module III	Free trade - Arguments for and against free trade – Protection - Arguments for and against protection - Methods of Trade Restriction : Tariff and non-tariff trade barriers - Types of tariffs – New protectionism - export subsidy and countervailing duties - Dumping and anti-dumping duties – Economic Integration – WTO, EU, NAFTA, ASEAN, SAARC	● Lecture ● Peer Discussio n	To critically evaluate the theories of commercial policies	To analyze the different theories of commercial policies.	Evaluation through Test Paper
Module IV	Foreign exchange market – functions - Defining foreign exchange and	● Lecture ● Peer Discussio n	To identify the functioning of foriegn exchange markets	To acquire skills related to interpret functioning	Evaluation through Quizz

	exchange rate – Exchange rate concepts – exchange rate changes (devaluation, revaluation, depreciation, appreciation- over valuation and undervaluation) – Different systems of exchange rate determination - fixed and flexible exchange rate – Hybrid exchange rate systems – Managed floating – Theories of exchange rate – Mint Parity theory – Purchasing Power Parity Theory – Balance of Payments Theory - Components of Foreign exchange .			of foriegn exchange	
Module V	Defining Balance of Trade and Balance of Payments - Structure of balance of payments – Equilibrium and	• Lecture • Peer Discussio n	To compare BOT and BOP	To distinguish between BOT and BOP	Evaluation through Test Paper

	disequilibrium in BOP – Measures to correct BOP disequilibrium – India‘s BOP since 1991 – International financial flows – Foreign Direct Investment and Porfolio Investment – Currency Convertibility – IMF-Role and Functions				

COURSE OUTCOME

CO1	To understand the different terms related to international economics
CO2	To explain the theories of international trade
CO3	To analyze the different theories of commercial policies.
CO4	To acquire skills related to interpret functioning of foriegn exchange
CO5	To distinguish between BOT and BOP

Faculty in charge,

Mr. Nijil Jacobi

Semester VI

Course Category	Core Course 13
Course Title and Code	Development of Economic Thought ECO6 B13
No. of Credits	4
No. of Contact Hours	5 Hours per week

DEVELOPMENT OF ECONOMIC THOUGHT

Preamble: This course presents review of the history of economic thinking and economic analysis.: The main goal of this course is to provide students with understanding of historical evolution of economic thought. In addition students are also led to familiarize with i) Developments in major field of economics, ii) Schools of thought in economics iii) Works of some great economist from antiquity to contemporary times. By the end of this course student will be able to identify the major ideas associated with each group or thinker studied, and thereby the origins of contemporary theory are better comprehended. They are expected to place the theories and ideas studied within the context of the times in which they developed, evaluate different streams of economic thinking as well some personalities who had a major impact on the history of economic thought. Students are also expected to identify theories that radically differ from modern mainstream theory, and thereby recognize that the theoretical basis of economics has been, and continues to be, contested.

Module I: Mercantilism &Physiocrats Mercantilism-

Main characteristics - Limitations of national resources. Importance of Foreign Conquest, Colonization and Trade, Role of State in Foreign Trade, Definition of Wealth and the ways in which to augment it, Importance of the Balance of Trade, Works of Francis Bacon, Thomas Mum, Josiah Child, John Cary, Charles Davenant, John Stuart Mill Age of Enlightenment – France, Italy, Scotland. The Physiocratic school.Definition of surplus.The organization of economic activities and transactions.The Tableau Economique Works of Jacques Turgot, Francois Quesnay, Richard Cantillon.

Module II:British Political Economy

Nature of the Surplus, Source of Value, Measure of Value, Market Prices and Natural Prices, Profits and Wages, Gross and Net Revenue (national income), Income Distribution, Works of Adam Smith, David Ricardo, Robert Malthus, Objections raised by J. B. Say, Charles Dupuit, W Stanley Jevons, and Leon Walras, J.M. Keynes

Module III:Socialism

Rise of Socialist ideas, Political background, Ricardian Theory of Rent, Nationalization of Land, French Socialists, Marxism, Marx's writings in theoretical economics. The Marxian twist, Marxism post – 1991 - Schumpeter's Critique

Module IV:Indian Economic Thought

Early Indian economic thought - Chanakya'sArthashastra - Colonial Economic policies, Unfair treatment of the colonies, Nationalist response, Swadeshi Movement. Economic ideas of M. G. Ranade, DadabhayNaorojee, Gopal Krishna Gokhale, Dr. B. R. Ambedkar, M.K. Gandhi

References:

1. Loganathan. V A, A History of Economic Thought, S Chand & Company,New Delhi(1987)

2. Srivastava S K - History of Economic Thought S Chand & Company,New Delhi(2002)

3. Ganguly B.N - Indian Economic Thought,A Nineteenth Century Perspective,McGraw Hill(1977)

4. Grid and Rist , A History of Economic Doctrines,George Harrop,London (1956)

5. Louis Haney - History of Economic Thought,Surjit Publications,New Delhi(1977)

6. Ernesto Screpanti and Stefano Zamagni,An Outline of History of Economic Thought, Oxford University Press,Second Edition (2005)

7. Grey and Thomson, The Development of Economic Doctrine, Longman Group, London(1980)

OBJECTIVES

- To understand historical evolution of economic thought.
- To critically evaluate the contribution of british political economist
- To critically evaluate the concept of socialism
- To critically evaluate the contribution of Indian economic thought

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Main characteristics - Limitations of national resources. Importance of Foreign Conquest,	• Lecture • Peer Discussion	To know the contribution of	To understand historical evolution	Evaluation through Test Paper

	Colonization and Trade, Role of State in Foreign Trade, Definition of Wealth and the ways in which to augment it, Importance of the Balance of Trade, Works of Francis Bacon, Thomas Mum, Josiah Child, John Cary, Charles Davenant, John Stuart Mill Age of Enlightenment – France, Italy, Scotland. The Physiocratic school.Definition of surplus.The organization of economic activities and transactions.The Tableau Economique Works of Jacques Turgot, Francois Quesnay, Richard Cantillon.		different economist	of economic thought.	
Module II	Nature of the Surplus, Source of Value, Measure of Value, Market Prices and Natural Prices, Profits and Wages, Gross and Net Revenue (national income), Income Distribution, Works of Adam Smith, David Ricardo, Robert Malthus, Objections raised by J. B. Say, Charles Dupuit, W Stanley Jevons, and Leon Walras, J.M. Keynes	• Lecture • Peer Discussion	To know the contribution of different british economist	To critically evaluate the contribution of british political economist	Evaluation through Test Paper

Module III	Rise of Socialist ideas, Political background, Ricardian Theory of Rent, Nationalization of Land, French Socialists, Marxism, Marx's writings in theoretical economics. The Marxian twist, Marxism post – 1991 - Schumpeter's Critique	• Lecture • Peer Discussion	To know the concept of socialism	To critically evaluate the concept of socialism	Evaluation through Test Paper
Module IV	Early Indian economic thought - Chanakya'sArthashastra - Colonial Economic policies, Unfair treatment of the colonies, Nationalist response, Swadeshi Movement. Economic ideas of M. G. Ranade, DadabhayNaorojee, Gopal Krishna Gokhale, Dr. B. R. Ambedkar, M.K. Gandhi	• Lecture • Peer Discussion	To know the contribution of different Indian economist	To critically evaluate the contribution of Indian economic thought	Evaluation through Test Paper

COURSE OUTCOME

CO1	To understand historical evolution of economic thought.
CO2	To critically evaluate the contribution of british political economist
CO3	To critically evaluate the concept of socialism

CO4	To critically evaluate the contribution of Indian economic thought

Faculty in charge,
Dr. Shirley Jose K

Semester VI

Course Category	Core Course 14
Course Title and Code	Economics of Growth and Development ECO6 B14
No. of Credits	4
No. of Contact Hours	5 Hours per week

ECONOMICS OF GROWTH AND DEVELOPMENT

Preamble: This course is designed to introduce students to the exciting and challenging subject of economics of growth and development, which draws from several branches of economics. It intends to provide the theoretical framework for growth and development discourses under different schools of economic thoughts and also into better insights and knowledge on issues and challenges on economic development. It also aims to equip students with the ability to analyze the factors affecting the long run economic growth, both from a positive and negative sense.. After completing this course the student should also be able use theories of growth and development to analyze the problems of the developing world. The students are expected to develop an interrelated to approach to resource use.

Module I: Development and Underdevelopment-

An Overview Background and beginning of 'Development Economics' in the post-world war era, its elements Defining economic development - Alternative measures of development –PQLI, HDI and its extensions, Development and growth- income as a measure of growth - Human development-Sens capability approach, development as freedom, Structural features of underdeveloped economies-International variations – development gap- Underdevelopment as a low level equilibrium in a multiple equilibrium situation – low level equilibrium trap

Module II: Perceptions about Development and Underdevelopment

Vicious circle of poverty- Rostow's stages of growth-big push, balanced and unbalanced growth, Low level equilibrium models, Critical Minimum effort thesis- Dual economy models- Lewis model and its extensions, Harris- Todaro migration model - Poverty and Inequality: Definitions, Measures and Mechanisms - Concept of poverty and its measures - Inequality meaning – axioms - commonly used inequality measures, Kuznets curve - Impact of poverty and inequality on process of development.

Module III: Facts about economic growth

Neoclassical growth model- Solow model of growth- Production function, investment function, capital accumulation and steady state.Dynamics of the model-change in saving rate, population growth, Technological progress.Convergence in the Solow model. Endogenous growth theoryAK model.

Module IV: Development and environment.

Sustainable development. The environmental Kuznets curve. Global warming.Limits to growthEarth summit.

References:

1) Charles I Jones & Dietrich Vollreth (2013) – Introduction to economic growth, 3rd edition. W W Norton &Co

2) David N Weil (2012) – Economic growth, 3rdedition , Pearson.
3) A P Thirlwall (2011) – Economics of Development, 9th edition, Palgrave.
4) Todaro & Smith (2017) – Economic Development, 12th edition. Pearson.
5) Subrata Ghatak (2003) – Introduction to development economics,4th edition, Routledge.
6) Debraj Ray (1999) – Development economics,1st edition, OUP.
7) Hendrik Van Den Berg (2016) - Economic growth and development,3rd edition. World scientific publishing Co.
8) .E Wayne Nafziger (2005) – Economic Development, 4th edition, Cambridge University Press.

OBJECTIVES

- To undestand the concept of development and underdevelopment
- To provide the theoretical framework for growth and development
- To analyze the factors affecting the long run economic growth, both from a positive and negative sense.

- To use theories of growth and development to analyze the problems of the developing world.
- To critically evaluate the development and environment

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	An Overview Background and beginning of 'Development Economics' in the post-world war era, its elements Defining economic development - Alternative measures of development –PQLI, HDI and its extensions, Development and growth- income as a measure of growth - Human development-Sens capability approach, development as freedom, Structural features of underdeveloped economies-International variations – development gap-Underdevelopment as a low level equilibrium in a multiple equilibrium	• Lecture • Peer Discussion	to identify different development indices	To undestand the concept of development and underdevelopment	Evaluation through Test Paper

	situation – low level equilibrium trap				
Module II	Vicious circle of poverty- Rostow's stages of growth-big push, balanced and unbalanced growth, Low level equilibrium models, Critical Minimum effort thesis- Dual economy models- Lewis model and its extensions, Harris- Todaro migration model - Poverty and Inequality: Definitions, Measures and Mechanisms - Concept of poverty and its measures - Inequality meaning – axioms - commonly used inequality measures, Kuznets curve - Impact of poverty and inequality on process of development.	● Lecture ● Peer Discussion	To distinguish different growth and development theories	To provide the theoretical framework for growth and development	Evaluation through Test Paper
Module III	Neoclassical growth model- Solow model of growth- Production function, investment function, capital accumulation and steady	● Lecture ● Peer Discussion	To explain neoclassical growth model	To use theories of growth and development to analyze the problems of the developing world. To analyze the factors	Evaluation through Test Paper

	state.Dynamics of the model-change in saving rate, population growth, Technological progress.Convergence in the Solow model. Endogenous growth theoryAK model.			affecting the long run economic growth, both from a positive and negative sense.	
Module IV	Sustainable development. The environmental Kuznets curve. Global warming.Limits to growthEarth summit.	• Lecture • Peer Discussion	To know the importance of sustainable development in economics	To critically evaluate the development and environment	Evaluation through Test Paper

Course outcome

CO1	To undestand the concept of development and underdevelopment
CO2	To provide the theoretical framework for growth and development

CO3	To analyze the factors affecting the long run economic growth, both from a positive and negative sense
CO4	To use theories of growth and development to analyze the problems of the developing world
CO5	To critically evaluate the development and environment

Faculty in charge,
Mr. Nijil Jacobi

COMPLEMENTARY COURSES

Introductory Economics SEMESTER I

Course Category	Complementary Course
Course Title and Code	Introductory Economics I ECO1(2) C01
No. of Credits	4
No. of Contact Hours	6 Hours per week

INTRODUCTORY ECONOMICS I

Module I: Basics of Economics

Economics-Definitions- Importance of economics-relation with other social sciences-Basic Problems of an economy - Micro versus Macro

Module II: Demand and supply

Utility,utility function, marginal utility, law of diminishing marginal utility- demand, law of demand. Elasticity of demand-Cost, cost function, opportunity cost, variable cost, fixed cost, total cost, marginal cost, average cost, supply, supply function, supply curve, Elasticity of supply- Equilibrium price, market and its classification

Module III: Production and distribution

Factors of Production-Production function, types of production function (short run and long run), economies of scale- Distribution-Marginal productivity theory.

Module IV: National Income Concepts and Meaning

National Income-Meaning and Significance- Concepts of National Income- Importance of the estimation of national income-difficulties in estimation of national income.

Module V: Classical Vs Keynesian economics

Assumptions of Classical economists-Say‘s Law of Market, Full employment, wage-price flexibility -Keynesian revolution-major concepts of Keynes, Post-Keynesian developments (Brief introduction only).

References

1. Diwedi DN - Macroeconomics Theory and Policy, Tata McGraw Hill Education Pvt. Ltd, New Delhi,
2. Salvetor D and EA Diulio – Principals of Economics Schuam’s Outline Series
3. Salvetor D – International Economics, Schuam’s Outline Series
4. Gregory Mankiw, Principles of Macroeconomics
5. Sangita VaishaliKapoor, (2017) Introductory Macro Economics,
6. Gregory Mankiw, Principles of Microeconomics
7.Pradeepkumar Mehta and Meena Singh (2017) , Introductory Microeconomics, Taxmann’s Paperback. Paul Samuelson and William D Nordhaus(2010), Economics, Tata McGraw Hill Education

OBJECTIVES

- To understand the basic problems in an economy
- To understand the concept of demand and supply
- To know the production function in an economy
- To undestand the ntional income concepts and meaning
- To distiguish between Classicals and Keynesian economics

COURSE PLAN

Unit/Session / Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Economics-Definitions-Importance of economics-relation with other social sciences-Basic Problems of an economy - Micro versus Macro	● Lecture ● Group Discussion	To distinguish between Micro and Macro economics	To understand the basic problems in an economy	Evaluation through Test Paper
Module II	Utility,utility function, marginal utility, law of diminishing marginal utility-demand, law of demand. Elasticity of demand-Cost, cost	● Lecture ● Group Discussion	To differentiate different types of Elasticity of demand	To understand the concept of demand and supply	Evaluation through Test Paper

	function, opportunity cost, variable cost, fixed cost, total cost, marginal cost, average cost, supply, supply function, supply curve, Elasticity of supply-Equilibrium price, market and its classification				
Module III	Factors of Production-Production function, types of production function (short run and long run), economies of scale-Distribution-Marginal productivity theory.	● Lecture ● Group Discussion	To identify different types of factors of production	To know the production function in an economy	Evaluation through Test Paper
Module IV	National Income-Meaning and Significance-Concepts of National Income-	● Lecture ● Group Discussion	To f know the different methods of national	To undestand the ntional income concepts and meaning	Evaluation through Test Paper

	Importance of the estimation of national income-difficulties in estimation of national income.		income calculation		
Module v	Assumptions of Classical economists-Say's Law of Market, Full employment, wage-price flexibility -Keynesian revolution-major concepts of Keynes, Post-Keynesian developments (Brief introduction only).	• Lecture • Group Discussion	To compare the classical and keynesian economics.	To distiguish between Classicals and Keynesian economics	Evaluation through Test Paper

COURSE OUTCOME

CO1	To understand the basic problems in an economy
CO2	To understand the concept of demand and supply
CO3	To know the production function in an economy
CO4	To undestand the ntional income concepts and meaning
CO5	To distiguish between Classicals and Keynesian economics

Faculty in charge,

Ms. Anju PB

SEMESTER IV

Course Category	Complementary
Course Course Title and Code	Introductory Economics II ECO4(3) C01
No. of Credits	4
No. of Contact Hours	6 Hours per week

INTRODUCTORY ECONOMICS II

Module I: Money and Banking

Definitions and functions of money- demand for and supply of money- Fischer's quantity theory of money- inflation and deflation (Only concepts, Types and Causes)- Role and functions of commercial banks and Central Bank-monetary policy and its instruments.

Module II: Public Finance Meaning and Significance

- Public and private finance-Principle of Maximum Social AdvantagePublic revenue- public expenditure-public debt- budget- Fiscal Policy-FRBM Act- Finance Commission- Terms of References and Recommendations of 14th and 15th Finance Commission.

Module III: Trade Internal and External Trade

-balance of trade and balance of payments-foreign exchange rate, devaluation-revaluation-depreciation-appreciation.

Module IV: India as a Developing Economy

Indian economy- growth and development under different policy regimes-Demographic trends and issues-education- health and malnutrition - Trends and policies on poverty; inequality and unemployment - Role of NITI Aayog.

References

1. Diwedi DN - Macroeconomics Theory and Policy Tata Magrawhill ‖

2. Salvetor D and EA Diulio – Principals of Economics Schuam's Outline Series

3. Salvetor D – International Economics, Schuam's Outline Series

4. Gregory Mankiw, Principles of Macroeconomics

5. Sangita VaishaliKapoor, (2017) Introductory Macro Economics,

6. Datt and AshwaniMahajan (2018), Indian Economy, S. Chand, New Delhi

7. Uma Kapila, (2017), Indian Economy-Performance and Policies,

8. Manoranjan Sharma (2017), Leading Issues in Indian Economy

9. R. K. Lekhi and Joginder Singh, (2016) Public Finance, Kalyani Publishers

10. H.L. Bhatia, Public Finance (29th Edition), Vikas Publishing House, New Delhi

OBJECTIVES

- To understand demand for and supply of money
- To critically evaluate the functions of finance commission
- To distinguish between BOP and BOT
- To critically evaluate the India as a developing economy

COURSE PLAN

Unit/Session/ Hours (Time Required	Topics to be Taught	Procedure Student Centric Methods of Teaching	Activity	Learning Outcome	Assessment
Module I	Definitions and functions of money- demand for and supply of money- Fischer's quantity theory of money- inflation and deflation (Only concepts, Types and Causes)- Role and functions of commercial banks and Central Bank-monetary policy and its instruments.	• Lecture • Group Discussion	To explain the importance of money supply n an economy	To understand demand for and supply of money	Evaluation through Test Paper
Module II	Public and private finance-Principle of Maximum Social	• Lecture • Group Discussion	To write an essay on topic Evaluate the	To critically evaluate the functions	Evaluation through Test Paper

	AdvantagePublic revenue-public expenditure-public debt- budget-Fiscal Policy-FRBM Act- Finance Commission-Terms of References and Recommendations of 14th and 15th Finance Commission.		functions of finance commission in india	of finance commission	
Module III	-balance of trade and balance of payments-foreign exchange rate, devaluation-revaluation-depreciation-appreciation.	● Lecture ● Group Discussion	To undestand the importance of internal and external trade	To distinguish between BOP and BOT	Evaluation through Test Paper
Module IV	Indian economy-growth and development under different policy regimes-Demographic trends and issues-education - health and malnutrition - Trends and policies on poverty; inequality and	● Lecture ● Group Discussion	To critically evaluate the position of India as a developing economy	To critically evaluate the India as a developing economy	Evaluation through Test Paper

	unemployment - Role of NITI Aayog.				

COURSE OUTCOME

CO1	To understand demand for and supply of money
CO2	To critically evaluate the functions of finance commission
CO3	To distinguish between BOP and BOT
CO4	To critically evaluate the India as a developing economy

Faculty in charge,
Mr. Nijil Jacobi

Lesson Plan - B.Sc. Physics

(2020-21)

PHY1 B01: MECHANICS – I

Semester: 1
Course Number: I
Number of hours of Lectures per week: 2
Number of Credits: 2
Number of Contact Hours: 36
Course Evaluation: Internal – 15 Marks + External – 60 Marks

OBJECTIVES

- To get a general idea about basic concepts of Newtonian Mechanics and how to apply these concepts to Physical Systems.
- To understand and apply the basic idea of work-energy theorem to physical systems.
- To understand the basic concept of rotational dynamics of rigid bodies and its applications in real life situations.

Prerequisites: Background of the basic science at +2 level

COURSE OUTLINE

Unit I– Newton's Laws

Newton's First Law, Second Law and Third Law – Astronauts in space : Inertial systems and fictitious forces – Standards and units – Some applications of Newton's laws – The astronauts' tug of war, Freight train, Constraints, Block on string, The whirling block, The conical pendulum – The everyday forces of physics – Gravity and Weight; Gravitational force of a sphere; Turtle in an elevator; Gravitational field – Electrostatic force – Contact forces; Block and string; Dangling rope; Whirling rope; Pulleys; Tension and Atomic forces; Normal force; Friction; Block and wedge with friction; Viscosity – Linear restoring force; Spring and block : The equation for simple harmonic motion; Spring and gun : Illustration of initial conditions – Dynamics of a system of particles – The Bola – Centre of mass – Drum major's baton – Centre of mass motion – Conservation of momentum – Spring Gun recoil

Unit II – Work and Energy

Integrating the equation of motion in one dimension – Mass thrown upward in a uniform gravitational field; Solving the equation of simple harmonic motion – Work-energy theorem in one dimension – Vertical motion in an inverse square field – Integrating the equation of motion in several dimensions – Work-energy theorem – Conical pendulum; Escape velocity – Applying the work-energy theorem – Work done by a uniform force; Work done by a central force; Potential energy – Potential energy of a uniform force field; Potential energy of an inverse square force – What potential energy tells us about force – Stability – Energy diagrams – Small oscillations in a bound system – Molecular vibrations – Nonconservative forces – General law of conservation of energy – Power

Unit III – Angular Momentum

Angular momentum of a particle – Angular momentum of a sliding block; Angular momentum of the conical pendulum – Torque – Central force motion and the law of equal areas – Torque on a sliding block; Torque on the conical pendulum; Torque due to gravity – Angular momentum and fixed axis rotation – Moments of inertia of some simple objects – The parallel axis theorem – Dynamics of pure rotation about an axis – Atwood's machine with a massive pulley – The simple pendulum – The physical pendulum – Motion involving both translation and rotation – Angular momentum of a rolling wheel – Drum rolling down a plane – Work-energy theorem for a rigid body – Drum rolling down a plane : energy method – The vector nature of angular velocity and angular momentum – Rotation through finite angles – Rotation in the xy-plane – Vector nature of angular velocity – Conservation of angular momentum

Books of Study :

1. An Introduction to Mechanics, 1stEdn. – Daniel Kleppner and Robert J. Kolenkow – McGraw-Hill

Reference Book :

1. Berkeley Physics Course : Vol.1 : Mechanics, 2ndEdn. – Kittelet al. – McGraw-Hill

COURSE OUTCOMES

CO1	Understand and apply the basic concepts of Newtonian Mechanics to Physical Systems
CO2	Understand and apply the basic idea of work-energy theorem to physical systems
CO3	Understand and apply the rotational dynamics of rigid bodies

LESSON PLAN

Unit/ session/ hours (timerequired)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
UNIT I (16 Hours)	Newton's Law, Applications of Newton's Law, The everyday forces of physics, Conservation of momentum	Lecture, Numerical problem solving	Discussion Assignment	Understanding basic laws of nature , observing the physics in real life	Class participation , test papers

UNIT II (8 Hours)	Work-energy theorem,Applying the work-energy theorem, Potential Energy, Energy diagrams, Nonconservative forces	Lecture, Numerical problem solving discussion	Assignment seminar\presentation	Understanding the concepts of work and energy in Mechanics	Class participation Quiz Test papers
UNIT III (12 Hours)	Angular momentum, Central force motion and the law of equal areas, Dynamics of pure rotation about an axis, Motion involving both translation and rotation, Conservation of angular momentum	● Lecture ● Discussion ● Numerical problem solving	● Assignment ● Seminar	Understanding the rotational motion and the mechanics involved in it.	● Test papers ● Assignment ● class participation

Faculty In-charge
Dr.Nijo Varghese & Fency K F

PHY 2 B02: MECHANICS – II

Semester: 2
Course Number: II
Number of hours of Lectures per week: 2
Number of Credits: 2
Number of Contact Hours: 36
Course Evaluation: Internal – 15 Marks + External – 60 Marks

OBJECTIVES

- To Learn the basics of non-inertial systems and analyze different fictitious forces in such systems.
- To get a basic idea about central force, its general properties and analyze the features

of central forces with respect to planetary forces.
- To Learn the fundamentals of harmonic oscillator model, including damped and forced oscillators and grasp the significance of terms like quality factor and damping coefficient.
- To get the basic concepts of wave motion.

Prerequisites: Background of the basic science at +2 level

COURSE OUTLINE

Unit I – Noninertial Systems and Fictitious Forces

Galilean transformations – Uniformly accelerating systems – The apparent force of gravity – Pendulum in an accelerating car – The principle of equivalence – The driving force of the tides – Physics in a rotating coordinate system – Time derivatives and rotating coordinates Acceleration relative to rotating coordinates – The apparent force in a rotating coordinate system – The Coriolis force – Deflection of a falling mass – Motion on the rotating earth – Weather systems – Foucault's pendulum

Unit II – Central Force Motion

Central force motion as a one-body problem – General properties of central force motion – Motion is confined to a plane – Energy and angular momentum are constants of the motion – The law of equal areas – Finding the motion in real problems – The energy equation and energy diagrams – Noninteracting particles – Planetary motion – Hyperbolic orbits – Satellite orbit – Kepler's laws – The law of periods – Properties of the ellipse

Unit III – Harmonic Oscillator

Introduction and review – Standard form of the solution – Nomenclature – Initial conditions and the frictionless harmonic oscillator – Energy considerations – Time average values – Average energy – Damped harmonic oscillator – Energy and Q-factor – Q factor of two simple oscillators – Graphical analysis of a damped oscillator – Solution of the equation of motion for the undriven damped oscillator – Forced harmonic oscillator – Undamped forced oscillator – Resonance

Unit IV – Waves

What is a wave ? – Normal modes and travelling waves – Progressive waves in one direction – Wave speeds in specific media – Superposition – Wave pulses – Motion of wave pulses of constant shape – Superposition of wave pulses – Dispersion; Phase and Group Velocities – Energy in a mechanical wave – Transport of energy by a wave – Momentum flow and mechanical radiation pressure – Waves in two and three dimensions

Books of Study :

1. An Introduction to Mechanics, 1stEdn. – Daniel Kleppner and Robert J. Kolenkow – McGraw-Hill
2. Vibrations and Waves – A. P. French – The M.I.T. Introductory Physics Series – CBS

Publishers & Distributors

Reference Book :

1. Berkeley Physics Course : Vol.1 : Mechanics, 2ndEdn. – Kittel et al. – McGraw-Hill

COURSE OUTCOMES

CO1	Understand the features of non-inertial systems and fictitious forces
CO2	Understand and analyze the features of central forces with respect to planetary forces
CO3	Understand the basic ideas of Harmonic Oscillations
CO4	Understand the analyze the basic concepts of wave motion

LESSON PLAN

Unit/ session/ hours (timerequired)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
UNIT I (8 Hours)	Galilean transformations, Uniformly accelerating systems, Physics in a rotating coordinate system,The apparent force in a rotating coordinate system, Motion on the rotating earth,Foucault's pendulum	Lecture and discussions Problem solving	assignment	Understanding the the concept of inertial and non inertial frames	Test papers
UNIT II (10 Hours)	General properties of central force	Lecture and	Seminar assignment	To understan	Test paper Viva-voce

	motion, Energy and angular momentum are constants of the motion, The energy equation and energy diagrams, Noninteracting particles, Kepler's laws	discussion Problem solving		d the central forces and laws governing the planetary motion	
UNIT III (8 Hours)	Initial conditions and the frictionless harmonic oscillator, Damped harmonic oscillator, Energy and Q-factor, Undamped forced oscillator	Lecture Discussion Problem solving	assignment	Understanding the basics of harmonic oscillation and its features	Test paper
UNIT IV (10 Hours)	Normal modes and travelling waves,Superposition, Dispersion; Phase and Group Velocities, Waves in two and three dimensions	Lecture Discussion Problem solving	assignment	Understanding the basic mechanics involved in wave motion	Test paper

Faculty In-charge
Dr.Nijo Varghese & Ms. Libi Prakash

PHY3B03: ELECTRODYNAMICS I

Semester: 3
Course Number: III
Number of hours of Lectures per week: 3
Number of Credits: 3
Number of Contact Hours: 54
Course Evaluation: Internal – 15 Marks + External – 60 Marks

OBJECTIVES

- To understand mathematical methods physicists often use, including differential Calculus,The operator ∇- Gradient, Divergence, Curl, integral calculus, matrices and curvilinear coordinates.

- To Understand and analyze the electrostatic properties of physical systems.
- To Understand the mechanism of electric field in matter.
- To Understand and analyze the magnetic properties of physical systems
- To Understand the mechanism of magnetic field in matter.

Prerequisites: Background of the basic science at +2 level

COURSE OUTLINE

Unit 1 – Vector Calculus

Vector Algebra: Vector operations - Vector algebra: Component form – Triple products – Position, Displacement and Separation vectors – How vectors transform. Differential Calculus: "Ordinary" derivatives – Gradient – The Del operator – Divergence – Curl – Product rules – Second derivatives. Integral Calculus: Line integral, surface integral and volume integral – Fundamental theorem of calculus – Fundamental theorem for Gradients – Fundamental theorem for divergences: Gauss's Divergence Theorem (no proof needed) – Fundamental theorem for curls: Stoke's theorem (no proof needed). Spherical polar coordinates – Cylindrical coordinates – Their relationship to Cartesian coordinates – Expressing differential displacement vector, differential area vectors, differential volume element, gradient operator, divergence operator and curl operator in spherical polar and cylindrical coordinates. Dirac delta function: Divergence of $r\hat{}\ r2$ – One-dimensional delta function – Three-dimensional delta function. Helmholtz theorem (no proof needed) – Divergenceless vector fields – Curl-less vector fields – Potentials.

Unit 2 – Electrostatics

Electrostatic field – Coulomb's law, Electric field, Continuous charge distributions - Divergence and curl of electrostatic field, Field lines and Gauss's law, The divergence of E, Applications of Gauss law, Curl of E – Electric potential – Comments on potential, Poisson's equation and Laplace's equation, The potential of a localized charge distribution, Electrostatic boundary conditions – Work and energy in electrostatics, The work done in moving a charge, The energy of point charge distribution, The Energy of a continuous charge distribution, Comments on Electrostatic energy – Conductors, Basic properties of conductors, Induced charges, The Surface charge on a conductor, The force on surface charge, Capacitors.

Unit 3 – Electric fields in matter

Polarization – Dielectrics, Induced dipoles, Alignment of polar molecules, Polarization – The field of a polarized object , Bound charges, Physical interpretation of bound charges, The field inside a dielectric – The electric displacement – Gauss's law in presence of dielectrics, Boundary conditions for D – Linear dielectrics, Susceptibility, Permittivity, Dielectric constant, Boundary value problems with linear dielectrics, Energy in dielectric systems, Forces on dielectrics.

Unit 4 – Magnetostatics

The Lorentz force law – Magnetic fields, Magnetic forces, cyclotron motion, cycloid motion, Currents, Linear, Surface and Volume current density – Biot -Savart law, The magnetic field of steady current – Divergence and curl of B, Straight line currents, Applications of Ampere's law, Magnetic field of a toroidal coil, Comparison of magnetostatics and electrostatics – Magnetic vector potential , Vector potential, Magnetostatic boundary conditions.

Unit 5 – Magnetostatic fields in matter

Magnetization – Diamagnets, Paramagnets and Ferromagnets, Torques and forces on magnetic dipoles, Effect of a magnetic field on atomic orbits, Magnetization – Field of a magnetised object, Bound Currents, Physical interpretation of bound currents, Magnetic field inside matter – Auxiliary field H, Ampere's law in magnetized materials, Boundary conditions – Linear and nonlinear media, Magnetic susceptibility and permeability, Ferromagnetism.

Books of Study:

1. Introduction to Electrodynamics, 4th Edn. – David J Griffiths – Prentice Hall India Learning Pvt. Ltd
2. Berkeley Physics Course: Vol.2: Electricity and Magnetism, 2nd Edn. – Edward M. Purcell – McGraw-Hill

Reference Books:

1. Electricity and magnetism by Arthur F Kip
2. Physics Vol. II by Resnick and Halliday
3. Electricity and Magnetism-Hugh D Young and Roger A Freedman
4. Vector Analysis M R Spiegel,S Lipschutz,D Spellman -Schaum's outline-McGraw Hill
5. Div, Grad, Curl and all that ; An informal text on vector calculus H M Schey (Norton)
6. Electromagnetics by Edminister – Schaum's Outline – Tata McGraw Hill
7. NPTEL video lectures available online

COURSE OUTCOMES

CO1	Understand and apply the fundamentals of vector calculus
CO2	Understand and analyze the electrostatic properties of physical systems
CO3	Understand the mechanism of electric field in matter.
CO4	Understand and analyze the magnetic properties of physical systems
CO5	Understand the mechanism of magnetic field in matter

LESSON PLAN

Unit/ session/ hours (timerequired)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
UNIT I (10 Hours)	Vector Algebra,Differential Calculus, Integral Calculus,Fundamental theorem for divergences, Fundamental theorem for curls, Spherical polar coordinates, Cylindrical coordinates, Dirac delta function	Lecture Numerical problem solving	Discussion Assignment	Understanding the mathematical methods in physics	Class participation , test papers
UNIT II (16 Hours)	Coulomb's law, Gauss's law, Applications of Gauss law, Electric potential, Work and energy in electrostatics, Conductors, Capacitors	Lecture Numerical problem solving discussion	Assignment seminar\presentation	Understanding basic concepts of Electrostatics	Class participation Quiz Test papers
UNIT III (8 Hours)	Polarization, The electric displacement, Gauss's law in presence of dielectrics, Linear dielectrics, Susceptibility, Permittivity, Energy in dielectric systems, Forces on dielectrics	Lecture and discussion Numerical problem solving	Assignment Seminar	Understanding electric field in matter	Test papers Assignment class participation
UNIT IV (12 Hours)	The Lorentz force law, Biot -Savart law, Applications of Ampere's law, Comparison of magnetostatics and electrostatics,	Lecture Numerical problem solving	Discussion Assignment	Understanding the concepts of Magnetostatics	Class participation , test papers

	Magnetostatic boundary conditions.				
UNIT V (8 Hours)	Magnetization – Diamagnets, Paramagnets and Ferromagnets, Bound Currents, Boundary conditions – Linear and nonlinear media, Magnetic susceptibility and permeability, Ferromagnetism	Lecture Numerical problem solving discussion	Assignment seminar\presentation	Understanding basic concepts of magnetic field	Class participation Quiz Test papers

Faculty In-charge
Dr.Nijo Varghese & Fency K F

PHY4B04: ELECTRODYNAMICS II

Semester: 4
Course Number: IV
Number of hours of Lectures per week: 3
Number of Credits: 3
Number of Contact Hours: 54
Course Evaluation: Internal – 15 Marks + External – 60 Marks

OBJECTIVES

- To enable to solve a variety of problems related to Faraday's law of induction and Maxwell's equations.
- To understand the relevance of displacement current in the context of electromagnetic wave propagation.
- To study in depth the transient current response of CR, LC, CR and LCR circuits, which is essential in designing as well as understanding the working of electronic circuits.
- To solve complex problems involving linear electrical networks employing the symmetry concepts together with various network theorems .

Prerequisites: Background of the basic science at +2 level

COURSE OUTLINE

Unit 1 – Electrodynamics

Electromotive force – Ohm's law, electromotive force, motional emf – Electromagnetic induction - Faraday's law, induced electric field, inductance, energy in magnetic fields – Maxwell's equations – Electrodynamics before Maxwell, Maxwell's modification of Ampere's law, Maxwell's equations, Magnetic charge, Maxwell's equations inside matter, Boundary conditions – Continuity equation – Poynting's theorem

Unit 2 – Electromagnetic waves

Waves in one dimension, The wave equation, sinusoidal waves, boundary conditions :reflection and transmission, Polarization – Electromagnetic waves in vacuum , Wave equation for E and B, monochromatic plane waves in vacuum, energy and momentum ofE.M. waves, Poynting vector - Electromagnetic waves in matter, Propagation through linear media, reflection and transmission at normal incidence.Potential formulation – Scalar and vector potentials, Gauge transformations, Coulomb gauge and Lorentz gauge.

Unit 3 – Transient currents

Types of transients – DC transient currents in R-L circuits – Short circuit current – Time constant – DC transient currents in R-C circuits – Double energy transients – Theory of BG

Unit 4 – AC circuits

A resonant circuit – Alternating current – Alternating current networks – Admittance and impedance – Power and energy in AC circuits

Unit 5 – Network theorems

Kirchhoff's laws, Voltage sign and current direction, Solution of simultaneous equations using determinants, Source conversion, Superposition theorem, Ideal equivalent circuits,Thevenin's theorem, Reciprocity theorem, Delta / Star transformation – Star / Delta transformation – Norton's theorem, Maximum power transfer theorem.

Books of Study :

1. Introduction to Electrodynamics, 4thEdn. – David J Griffiths – Prentice Hall India Learning Pvt. Ltd
2. Berkeley Physics Course: Vol.2: Electricity and Magnetism, 2nd Edn. – Edward M. Purcell – McGraw-Hill
3. A Text Book of Electrical Technology Vol. 1 – B. L. Theraja, A. K. Theraja – S. Chand Publishers, 1997

Reference Books :

1. Electricity and magnetism by Arthur F Kip
2. Physics Vol. II by Resnick and Halliday
3. Electricity and Magnetism by D.N Vasudeva (12th revised edition)
4. Introductory AC Circuit theory – K Mann & G J Russell- Universities Press

5. NPTEL video lectures available online

COURSE OUTCOMES

CO1	Understand the basic concepts of electrodynamics
CO2	Understand and analyze the properties of electromagnetic waves
CO3	Understand the behavior of transient currents
CO4	Understand the basic aspects of ac circuits
CO5	Understand and apply electrical network theorems

LESSON PLAN

Unit/ session/ hours (timerequired)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
UNIT I (15 Hours)	Electromotive force – Ohm's law, Electromagnetic induction, Maxwell's equations, Boundary conditions – Continuity equation – Poynting's theorem	● Lecture ● Demonstrations	● Assignment ● Discussion ● Simplifications	To learn about waves	Class test Questioning
UNIT II (15 Hours)	Waves in one dimension, The wave equation, Polarization, Wave equation for E and B, energy and momentum ofE.M. waves,	● Lecture ● Demonstrations	● Assignment ● Discussion ● Simplifications	To know more about transient currents	Class test Questioning

	Electromagnetic waves in matter, Potential formulation, Gauge transformations				
UNIT III (8 Hours)	Types of transients, DC transient currents in R-L circuits, Time constant, DC transient currents in R-C circuits, Theory of BG	● Lecture ● Demonstrations	● Assignment ● Discussion ● Simplifications	● To acquire knowledge about AC, Power and energy	● Class test ● Questioning
UNIT IV (8 Hours)	A resonant circuit, Alternating current, Alternating current networks, Admittance and Impedance, Power and energy in AC circuits	● Lecture ● Demonstrations	● Assignment ● Discussion ● Simplifications	● To acquire knowledge about Kirchhoff's Laws, norton's , maximum power transfer theorem etc	● Class test ● Questioning
UNIT V (8 Hours)	Kirchhoff's laws, Thevenin's theorem, Reciprocity theorem, Delta / Star transformation, Star / Delta transformation, Norton's theorem, Maximum power transfer theorem	● Lecture ● Demonstrations	● Assignment ● Discussion ● Simplifications	● To learn about waves	● Class test ● Questioning

Faculty In-charge
Dr.Nijo Varghese & Fency K F

PH4B05 Practical-I (Credit 5)

Semester: 1,2,3 &4
Course Number: V
Number of hours of Lectures per week: 4
Number of Credits: 5
Number of Contact Hours: 36 hours in each semester
Course Evaluation: Internal – 20 Marks + External – 80 Marks

Objectives

- To Apply and illustrate the concepts of properties of matter through experiments.
- To Apply and illustrate the concepts of electricity and magnetism through experiments.
- To Apply and illustrate the concepts of optics through experiments.
- To Analyze and apply the principles of electronics through experiments

Prerequisites: Background of the basic practical knowledge at +2 level

Course Outline

(Any 20 experiments)

1. Young‟s modulus-non uniform bending-using pin and microscope-(load-extension graph)
2. Young‟s modulus-Uniform bending-using optic lever
3. Moment of inertia-Flywheel (Calculate percentage error and standard deviation)
4. Moment of Inertia-Torsion Pendulum
5. Rigidity modulus-static torsion
6. Compound pendulum-acceleration due to gravity, Radius of gyration
7. Katers pendulum- Acceleration due to gravity
8. Liquid lens-Refractive index of liquid and glass -a) determine R using a)water& b) Buoy‟s method
9. Spectrometer-solid prism-Refractive index of the material of the prism , measuring angle of minimum deviation
10. Spectrometer-solid prism- Dispersive power
11. a. Searle‟s vibration magnetometer- ratio of moments b. Searle‟s and box type vibration magnetometers-m & Bh.
12. Melde‟s string arrangement-Frequency, relative density of liquid and solid (both modes)
13. Mirror Galvanometer-figure of merit
14. Potentiometer-calibration of ammeter
15. Ballistic Galvanometer- BG constant using HMS-then find Bh.
16. Ballistic galvanometer-Comparison of capacitance- Desauty‟s method

17. Spectrometer- i-d curve
18. Verification of Thevenin‟s theorem and maximum power transfer theorem
19. Lissajous figures – Measurement of frequency and phase shift of sinusoidal signals using CRO
20. Cantilever –scale and telescope /pin and microscope
21. Single slit diffraction using LASER
22. Determination of dielectric constant of liquid/thin sheet
23. Thermo emf measurement using digital multimeters - study of Seebeck effect
24. Thermal conductivity of a good conductor by Searle‟s method.

Books of Study:

1. Electronics lab manual- K A Navas (vol 1 &2)
2. B.Sc Practical Physics- C L Arora
3. Practical Physics- S L Gupta & V Kumar

Reference Books:

1. Advanced Practical Physics for students – B L Worksnop and H T Flint

COURSE OUTCOMES

CO1	Apply and illustrate the concepts of properties of matter through experiments
CO2	Apply and illustrate the concepts of electricity and magnetism through experiments
CO3	Apply and illustrate the concepts of optics through experiments
CO4	Apply and illustrate the principles of electronics through experiments

LESSON PLAN

Experiments to be done (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment

1. Young‟s modulus-non uniform bending-using pin and microscope-(load-extension graph) 2. Young‟s modulus-Uniform bending-using optic lever 3. Moment of inertia-Flywheel (Calculate percentage error and standard deviation) 4. Moment of Inertia-Torsion Pendulum 5. Rigidity modulus-static torsion 6. Compound pendulum-acceleration due to gravity, Radius of gyration 7. Katers pendulum-Acceleration due to gravity 8. Liquid lens-Refractive index of liquid and glass -a) determine R using a)water& b) Buoy‟s method 9. Spectrometer-solid prism-Refractive index of the material of the prism ,	● Demonstrations ●Comparative Study	● Assignment ● Seminars	Getting practical knowledge about Physics Experiments	● Practical exams ● Assignment

measuring angle of minimum deviation 10. Spectrometer-solid prism- Dispersive power 11. a. Searle‟s vibration magnetometer-ratio of moments b. Searle‟s and box type vibration magnetometers-m & Bh. 12. Melde‟s string arrangement-Frequency, relative density of liquid and solid (both modes) 13. Mirror Galvanometer-figure of merit 14. Potentiometer-calibration of ammeter 15. Ballistic Galvanometer-BG constant using HMS-then find Bh. 16. Ballistic galvanometer-Comparison of capacitance-Desauty‟s method 17. Spectrometer- i-d curve 18. Verification of Thevenin‟s theorem and maximum power transfer theorem				

19. Lissajous figures – Measurement of frequency and phase shift of sinusoidal signals using CRO 20. Cantilever –scale and telescope /pin and microscope 21. Single slit diffraction using LASER 22. Determination of dielectric constant of liquid/thin sheet 23. Thermo emf measurement using digital multimeters - study of Seebeck effect 24. Thermal conductivity of a good conductor by Searle‟s method.				

Faculty In-charge
Dr.Nijo Varghese & Fency K F

PH5 B06: ELECTRODYNAMICS-II

Semester: 5
Course Number: VI
Number of hours of Lectures per week: 3
Number of Credits: 3
Number of Contact Hours: 54
Course Evaluation: Internal – 20 Marks + External – 80 Marks

OBJECTIVES

- To enable to solve a variety of problems related to Faraday's law of induction and Maxwell's equations.
- To understand the relevance of displacement current in the context of electromagnetic wave propagation.
- To study in depth the transient current response of CR, LC, CR and LCR circuits, which is essential in designing as well as understanding the working of electronic circuits.
- To solve complex problems involving linear electrical networks employing the symmetry concepts together with various network theorems

Prerequisites: Background of the basic science at +2 level

COURSE OUTLINE

Unit 1 – Electrodynamics

Electromotive force – Ohm's law, electromotive force, motional emf – Electromagnetic induction - Faraday's law, induced electric field, inductance, energy in magnetic fields – Maxwell's equations – Electrodynamics before Maxwell, Maxwell's modification of Ampere's law, Maxwell's equations, Magnetic charge, Maxwell's equations inside matter, Boundary conditions – Continuity equation – Poynting's theorem

Unit 2 – Electromagnetic waves

Waves in one dimension, The wave equation, sinusoidal waves, boundary conditions :reflection and transmission, Polarization – Electromagnetic waves in vacuum , Wave equation for E and B, monochromatic plane waves in vacuum, energy and momentum ofE.M. waves, Poynting vector - Electromagnetic waves in matter, Propagation through linear media, reflection and transmission at normal incidence.Potential formulation – Scalar and vector potentials, Gauge transformations, Coulomb gauge and Lorentz gauge.

Unit 3 – Transient currents

Types of transients – DC transient currents in R-L circuits – Short circuit current – Time constant – DC transient currents in R-C circuits – Double energy transients – Theory of BG

Unit 4 – AC circuits

A resonant circuit – Alternating current – Alternating current networks – Admittance and impedance – Power and energy in AC circuits

Unit 5 – Network theorems

Kirchhoff's laws, Voltage sign and current direction, Solution of simultaneous equations using determinants, Source conversion, Superposition theorem, Ideal equivalent circuits,Thevenin's

theorem, Reciprocity theorem, Delta / Star transformation – Star / Delta transformation – Norton's theorem, Maximum power transfer theorem.

Textbooks for study

1. Introduction to Electrodynamics by David J Griffiths, 3rd ed.
2. Electricity and Magnetism by R.Murugeshan (Third revised edition)
3. Electrical technology by Theraja

References

1. Electricity and magnetism by Arthur F Kip
2. Physics Vol. II by Resnick and Halliday
3. Electricity and Magnetism by D.N Vasudeva (Twelfth revised edition)
4. Introductory AC Circuit theory – K Mann & G J Russell- Universities Press
5. Electrical Circuit analysis –K Sureshkumar,NIT

COURSE OUTCOMES

CO1	Understand the basic concepts of electrodynamics
CO2	Understand and analyze the properties of electromagnetic waves
CO3	Understand the behavior of transient currents
CO4	Understand the basic aspects of ac circuits
CO5	Understand and apply electrical network theorems

LESSON PLAN

Unit/ session/ hours (timerequired)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
UNIT I (15 Hours)	Electromotive force – Ohm's law, Electromagnetic induction, Maxwell's	● Lecture ● Demonstrations	● Assignment ● Discussion	● To acquire knowledge about emf, Ohm's law,	● Class test ● Questioning

	equations, Boundary conditions – Continuity equation – Poynting's theorem		• Simplifications	poynting theorem	
UNIT II (15 Hours)	Waves in one dimension, The wave equation, Polarization, Wave equation for E and B, energy and momentum ofE.M. waves, Electromagnetic waves in matter, Potential formulation, Gauge transformations	• Lecture • Demonstrations	• Assignment • Discussion • Simplifications	To learn about waves	Class test Questioning
UNIT III (8 Hours)	Types of transients, DC transient currents in R-L circuits, Time constant, DC transient currents in R-C circuits, Theory of BG	• Lecture • Demonstrations	• Assignment • Discussion • Simplifications	To know more about transient currents	Class test Questioning
UNIT IV (8 Hours)	A resonant circuit, Alternating current, Alternating current networks, Admittance and Impedance, Power and energy in AC circuits	• Lecture • Demonstrations	• Assignment • Discussion • Simplifications	To acquire knowledge about AC, Power and energy	Class test Questioning
UNIT V (8 Hours)	Kirchhoff's laws, Thevenin's theorem, Reciprocity theorem, Delta / Star transformation, Star / Delta transformation, Norton's theorem, Maximum power transfer theorem	• Lecture • Demonstrations	• Assignment • Discussion • Simplifications	To acquire knowledge about Kirchhoff's Laws, norton's , maximum power transfer theorem etc	Class test Questioning

Faculty In-charge
Dr.Nijo Varghese

PH5 B07: QUANTUM MECHANICS

Semester: 5
Course Number: VII
Number of hours of Lectures per week: 3
Number of Credits: 3
Number of Contact Hours: 54
Course Evaluation: Internal – 20 Marks + External – 80 Marks

OBJECTIVES

- To become familiar with Blackbody radiation, Ultraviolet catastrophe,PhotoElectric effect and Compton Effect
- To gain a clear knowledge about wave properties of particles,De Broglie waves and its implications on the uncertainty principle.
- To Study the Bohr Atom model in detail and understand about atomic excitations
- To grasp the idea of Wave Mechanics and gain the concept of eigen values, eigen functions and learn the basic postulates of quantum mechanics
- To find solution to Schrödinger's equation for many systems such as particle in a box, Hydrogen Atom and familiarize with different quantum numbers.

Prerequisites: Background of the basic science at +2 level

COURSE OUTLINE

UNIT 1

1. Particle Properties of Waves

Electromagnetic waves, black body radiation, ultraviolet catastrophe, Photoelectric effect, nature of light, wave particle duality, Compton Effect & its demonstration. Pair production, photons & gravity.

2. Wave Properties Of Particles

De Broglie waves, waves of probability, phase velocity & group velocity, particle diffraction, Davisson And Germer experiment, Electron Microscope, Uncertainty principle I, Uncertainty principle II, Applying the uncertainty principle, Energy & time uncertainty.

3. Atomic Structure

The Bohr atom-energy levels and spectra, correspondence principle, nuclear motion, atomic excitation, Frank-Hertz experiment

UNIT 2

4. Wave Mechanics

Classical mechanics is an approximation of quantum mechanics, wave function, Schrodinger equation-time dependant form, linearity & super position, expectation values, operators, Schrodinger equation-steady state form, eigen values & eigen functions, postulates of quantum mechanics, particle in a box, finite potential well, tunnel effect scanning tunneling microscope, harmonic oscillator wave function, energy levels, zero point energy.

5. Hydrogen Atom

Schrodinger equation for the hydrogen atom, separation of variables, quantum numbers, principal quantum number, orbital quantum number, magnetic quantum number, electron probability density, radiative transitions, selection rules, Zeeman effect, electron spin, exclusion principle, Stern-Gerlach experiment.

Textbooks for study

Concepts of Modern Physics 6th Edition-By Arthur Beiser

References

1. Modern Physics(II Edn.)-Kenneth Krane
2. Quantum Physics Of Atom, Molecules, Solids, Nuclei & Particles By R.Eisberg & R. Resnick (John Wiley)
3. Quantum Mechanics By G. Aruldhas
4. Berkeley Physics Course: Quantum Physics By Wichmann
5. University Physics – Zemansky
6. Quantum Mechanics – Trilochan Pradhan – Universities Press
7. Advanced Physics Second Edition – Keith Gibbs – Cambridge University Press
8. Introduction to Vector spaces in Physics - K A I L Wijewardena Gamalath – Foundation Books
9. Quatum Mechanics –Iswarsingh Thyagi
10. Feynman Lectures

COURSE OUTCOMES

CO1	Understand the particle properties of electromagnetic radiation
CO2	Describe Rutherford – Bohr model of the atom
CO3	Understand the wavelike properties of particles
CO4	Understand and apply the Schrödinger equation to simple physical systems
CO5	Apply the principles of wave mechanics to

	the Hydrogen atom

LESSON PLAN

Unit/ session/ hours (timerequired)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
UNIT I (24 Hours)	1. Particle like Properties of Electromagnetic Radiation - Review of electromagnetic waves , Photoelectric effect, Blackbody radiation, Compton effect, Other photon processes 2. Wavelike Properties of Particles- De Broglie hypothesis, Uncertainty relationships for classical waves, Heisenberg uncertainty relationships 3. Rutherford-Bohr Model of the Atom - Basic properties of atoms, Thomson model, Rutherford nuclear atom, Line spectra, Bohr Model, Frank-Hertz experiment, Correspondence principle	● Lecture ● Demonstrations	● Assignment ● Discussion ● Simplifications	● To understand particle like properties of em radiation ● To understand wave like properties of particles ● To learn Atom model and its properties	● Class test ● Questioning
UNIT II (16 Hours)	4. The Schrodinger Equation -The Schrodinger recipe, Probabilities and Normalization, Applications, Free particle, Particle in a box 5. Hydrogen Atom in	● Lecture ● Demonstrations	● Assignment ● Discussion ● Simplifications	● To understand Schrodinger equation, Hydrogen atom	● Class test ● Questioning

	Wave Mechanics -Schrodinger equation in spherical coordinates, Radial probability densities,Zeeman effect				

Faculty In-charge
Dr.Nijo Varghese & Ms. Libi Prakash

PH5 B08: PHYSICAL OPTICS AND MODERN OPTICS

Semester: 5
Course Number:VIII
Number of hours of Lectures per week: 3
Number of Credits: 3
Number of Contact Hours: 56
Course Evaluation: Internal – 20 Marks + External – 80 Marks

OBJECTIVES

1. To give the idea about the basic Fermat's Principle
2. To empower students to understand the concept of interference
3. To understand the concept of diffraction.
4. To give a thorough understanding about holography and its applications
5. To acquire the basic knowledge Fibre optics

.

Prerequisites: Background of the basic science at +2 level

Course Outline

Unit 1

Fermat's Principle, verification of laws of reflection and refraction
Refraction and reflection by spherical surfaces : Refraction and reflection at a single spherical surfaces. The thin lens, The Principal Foci, and Focal length of a lens, The Newton formula, Lateral magnification.
Unit 2

2. Interference by division of wave front - Superposition of two sinusoidal waves, Interference, coherence ,conditions for interference, the interference patterns, intensity distribution .Fresnel's two mirror arrangement, Fresnel's Biprism, Determination of λ and dλ of Sodium Light

3. Interference by division of amplitude - Interference by a plane film illuminated by a plane wave, cosine law, non reflecting films (the subsections excluded), interference by a film with two nonparallel reflecting surfaces, colours of thin films, Newton's rings, The Michelson interferometer, white light fringes-

Unit 3

4. Fraunhofer Diffraction - Preliminaries, single slit diffraction pattern, diffraction by circular aperture, limit of resolution, two slit Fraunhofer diffraction pattern, N slit diffraction pattern, plane diffraction grating, resolving power.

5. Fresnel Diffraction - Preliminaries, Fresnel half period zones, explanation of rectilinear propagation of light, zone plate

Unit 4

6. Polarization - Huygene's explanation of double refraction, positive and negative uniaxial crystals, quarter and half wave plates, types of polarized light, production and analysis of plane, circularly and elliptically polarized light, optical activity, Laurentz half shade polarimeter

Unit 5

7. Holography- Principles of holography, theory of construction and reconstruction of Hologram, Applications of Holography.

Unit 6

8. Fibre Optics - Optical fibre, Numerical aperture, step index fibre, pulse dispersion, graded index fibre, fibre optic sensors.

References

1. Optics by Ajoy Ghatak
2. Optics by Subramaniam, Brijlal & Avadhanulu – New edition
3. Optics by Mathur
4. Nonlinear Optics- B.B.Laud
5. Laser Fundamentals- Silfast
6. Wave Optics and its Applications – Rajpal S Sirohi – Orient Longman
7. Optical Communications – M Mukunda Rao – Universities Press
8. 8 Optics – Hetch and A RGanesan

COURSE OUTCOMES

CO1	Understand the fundamentals of Fermat's principles and geometrical optics
CO2	Understand and apply the basic ideas of interference of light
CO3	Understand and apply the basic ideas of diffraction of light

CO4	Understand the basics ideas of polarization of light
CO5	Describe the basic principles of holography and fibre optics

LESSON PLAN

Unit/ session/ hours (timerequire d)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
UNIT I (5 Hours)	1.Fermat's Principle, verification of laws of reflection and refraction, Refraction and reflection by spherical surfaces	● Lecture ● Demonstrations ● Numerical problem solving	● Assignment ● Discussion ● Simplifications	● To understand the Fermat's principle, refraction and reflection	● Class test ● Questioning
UNIT II (14 Hours)	2. Interference by division of wave front - conditions for interference, the interference patterns, intensity distribution .Fresnel's two mirror arrangement, Fresnel's Biprism 3. Interference by division of amplitude - Interference by a plane film illuminated by a plane wave, cosine law, non reflecting films	● Lecture ● Demonstrations	● Assignment ● Discussion	● To understand the different concepts of interference	● Class test ● Questioning
UNIT III	4. Fraunhofer	● Lecture	● Assignm	● To	● Class

(13 Hours)	Diffraction- single slit diffraction pattern, diffraction by circular aperture, limit of resolution, two slit Fraunhofer diffraction pattern, 5. Fresnel Diffraction - Fresnel half period zones, explanation of rectilinear propagation of light, zone plate	● Demonstrations	ent ● Discussion	understand the fraunhofer diffraction and fresnel diffraction	test ● Questioning
UNIT IV (8 Hours)	6. Polarization -Huygene's explanation of double refraction, quarter and half wave plates,Laurentz half shade polarimeter	● Lecture ● Demonstrations	● Assignment ● Discussion	● To understand the concept of polarization	● Class test ● Questioning
UNIT V (6 Hours)	7. Holography -Principles of holography, theory of construction and reconstruction of Hologram, Applications of Holography	● Lecture ● Demonstrations	● Assignment ● Discussion	● To understand the holography and its applications	● Class test ● Questioning
UNIT VI (8 Hours)	8. Fibre Optics - Optical fibre, Numerical aperture, step index fibre, pulse dispersion, graded index fibre, fibre optic sensors.	● Lecture ● Demonstrations	● Assignment ● Discussion	● To understand the concepts of Fibre optics	● Class test ● Questioning

Faculty In-charge
Ms. Libi Prakash

PH5 B09: ELECTRONICS (ANALOG & DIGITAL)

Semester: 5
Course Number: IX
Number of hours of Lectures per week: 4

Number of Credits: 4
Number of Contact Hours: 72
Course Evaluation: Internal – 20 Marks + External – 80 Marks

OBJECTIVES

The objectives are to study

1. To give the idea about the basic principles of rectifiers and dc power supplies.
2. To empower students to understand the principles of transistors.
3. To prepare students to perform the designing of transistor amplifiers and oscillators.
4. To give a thorough understanding of the basic operation of Op –Amp and its applications.
5. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.

Prerequisites: Background of the basic science at +2 level

Course Outline

Unit 1

1. Semiconductor rectifiers and DC Power supplies - Preliminaries of rectification- Bridge rectifier- Efficiency- Nature of rectified output- Ripple factor- different types of filter circuits- voltage multipliers- Zener diode- voltage stabilization

2. Transistors - Different transistor amplifier configurations:- CB, CE, CC and their characteristics- amplification factors- their relationships- Load line Analysis- Expressions for voltage gain- current gain and power gain of C.E amplifier- cut-off and saturation points- Transistor biasing- Different types of biasing - Base resistor, voltage divider bias method- single stage transistor amplifier circuit- load line analysis- DC and AC equivalent circuits

3. Multistage Transistor amplifiers - R.C coupled amplifier- frequency response and gain in decibels- Transformer coupled Amplifiers -Direct Coupled Amplifier-Comparison

4. Feedback Circuits and Oscillators - Basic principles of feedback- negative feedback and its advantages- positive feedback circuits- Oscillatory Circuits-LC, RC oscillators- tuned collector oscillator- Hartley, Colpitt's, phase shift oscillators - their expressions for frequency

UNIT II

5. Digital Communication

Transmission and reception of radio waves, types of modulation, AM, FM their comparison advantages, demodulation, pulse code modulation

6. Special Devices and Opamp

LED, basic idea of UJT, FET, MOSFET, OP-amp: basic operation, application, inverting, Noninverting, summing amplifiers, Differentiator integrator

7. Number systems - Binary number system, conversions from one system to another (Binary, octal, Hexa decimal), Binary arithmetic, Compliments and its algebra.

8. Logic gates and circuits - Fundamental gates, Universal gates, De Morgan's theorem, Exclusive OR gate, Boolean relations, Half adder, Full adder, RS Flip Flop, JK Flip flop

Text books for study

1. Principles of electronics - VK Mehta - 2008 edition (S. Chand)
2. Introduction to Microprocessors - Aditya P Mathur (Tata McGarw Hill)
3. Digital principles and applications - Leach and Malvino (Tata McGraw Hill)

References

1. Digital Computer Fundamentals (Thomas.C. Bartee)
2. Electronics principles - Malvino
3. Physics of Semiconductor Devices- Second Edition – Dilip K Roy – Universities Press
4. Digital Fundamentals –Thomas L Floyd
5. Digital Technology-Principles and Practice-Virendrakumar
6. The Art of Electronics-Paul Herowitz & Winfield Hill
7. Electronic Principles and applications-A B Bhattacharya
8. Electronics-Classical and Modern-KAR

COURSE OUTCOMES

CO1	Understand the basic principles of rectifiers and dc power supplies
CO2	Understand the principles of transistor
CO3	Understand the working and designing of transistor amplifiers and oscillators
CO4	Understand the basic operation of Op – Amp and its applications
CO5	Understand the basics of digital electronics

LESSON PLAN

Unit/ session/ hours (timerequired)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment

UNIT I (34 Hours)	1. Semiconductor rectifiers and DC Power supplies - Bridge rectifier, different types of filter circuits- voltage multipliers- Zener diode 2. Transistors -CB, CE, CC, Load line Analysis, Transistor biasing- Different types of Biasing, single stage transistor amplifier circuit 3. Multistage Transistor amplifiers - R.C coupled amplifier, Transformer coupled Amplifiers -Direct Coupled Amplifier 4. Feedback Circuits and Oscillators - negative feedback and its advantages, positive feedback circuits- Oscillatory Circuits	● Lecture ● Demonstrations ● Numerical problem solving	● Assignment	To Understand the basic principles of rectifiers and dc power supplies To Understand the principles of transistor	● Test papers ● Assignment ● Quiz
UNIT II (38 Hours)	5. Digital Communication Transmission and reception of radio waves, types of modulation, AM, FM their comparison 6. Operational amplifier and its applications - OP-amp: basic operation, application7. Number systems- Binary number system, conversions from one system to another 8. Logic gates and	● Lecture ● Demonstrations ● Numerical problem solving	● Assignment ● Discussion ● Simplifications ● Designing Circuits	● To Understand the basic operation of Op – Amp and its applications ● To Understand the basics of digital electronics	● Evaluating Problem-Solutions ● Test

	circuits - Fundamental gates, Universal gates, De Morgan's theorem, Exclusive OR gate, Boolean relations, Half adder, Full adder, RS Flip Flop, JK Flip flop				

Faculty In-charge
Fency K F

PH5 D01(2): AMATEUR ASTRONOMY AND ASTROPHYSICS

Semester: 5
Course Number: Open course I
Number of hours of Lectures per week: 2
Number of Credits: 2
Number of Contact Hours: 36
Course Evaluation: Internal – 10 Marks + External – 40 Marks

OBJECTIVES

1. To Demonstrate the generation of electricity from various Non-Conventional sources of energy
2. To Estimate the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.
3.To Explore the concepts involved in the wind energy conversion system by studying its components, types and performance.
4. To Illustrate ocean energy and explain the operational methods of their utilization.
5. To Acquire the knowledge on Geothermal energy.

Prerequisites: Background of the basic science at +2 level

Course Outline

Unit 1. Introduction and Development of Astronomy, Introduction & Brief history of Astronomy Astronomy & Astrology-Fascinations of Astronomy- Two important Branches of Astronomy-Amateur observational AstronomyDifferent types of Amateur Observing- Ancient Astronomy & modern astronomy-Indian & western

Unit 2. Earth

Earth The zones of earth-longitude and latitude-shape of earth. Keplers laws-perihelionAphelion perigee and apogee, year-month-Day. Seasons-causes of seasons

Unit 3 . Sun

Solar system sun-structure-photosphere-chromosphere-solar constant-sun temperature-sun spots solar eclipse corona- (planets-surface conditions and atmosphere, size, period & distance) mercury venus- earth mars-jupiter-saturn-uranus-neptune-comets-asteroids meteors

Unit 4. Stars 12

The stars Unit of distance-Astronomical units--parsec-light year-Magnitudes of stars apparent magnitude absolute magnitude-Three categories of stars-Main sequence stars Dwarfs-Giants-star formation life cycle of stars-Chandrasekher limit- Novae-Binary stars neutron star-black holes. Expanding universe-Big bang theory

Text books:

1. A Text book on Astronomy- K K Dey, Book Syntricate Pvt. Ltd.
2. Introduction to Astrophysics - Baidanath Basu, PHI, India
3. Elements of Cosmology- Jayant Narlikar, University Press,

References

1. Astrophysics of Solar System - K D Abhyankar, University press
2. Chandrasekhar and his limit- G Venkataraman, University Press
3. The Big & The small (Volume II) - G Venkatararnan, University Press
4. Joy of Sky Watching- Biman Basu, National Book Trust
5. Astronomy- Principles & practices, A E Roy & D Clarke, Institute of Physics

COURSE OUTCOMES

CO1	Describe the history and nature of astronomy as a science
CO2	Understand the motion of earth in space and the cause of seasons
CO3	Understand the basic elements of solar system
CO4	Understand the elementary concepts of solar system

LESSON PLAN

Unit/ session/ hours (timerequired)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
UNIT I (18 Hours)	Introduction and Development of Astronomy,	• Lecture • Demonstrations	• Assignment	To understand basic idea about solar	• Test papers • Assignment

	Introduction & Brief history of Astronomy Astronomy & Astrology-Fascinations of Astronomy-Two important Branches of Astronomy-Amateur observational AstronomyDifferent types of Amateur Observing- Ancient Astronomy & modern astronomy-Indian & western			energy	
UNIT II (12 Hours)	Earth The zones of earth-longitude and latitude-shape of earth. Keplers laws-perihelionAphelion perigee and apogee, year-month-Day. Seasons-causes of seasons	● Lecture ● Demonstrations	● Assignment	To acquire knowledge about wind energy	● Test papers ● Assignment
UNIT III (12 Hours)	Solar system sun-structure-photosphere-chromosphere-solar constant-sun temperature-sun spots solar eclipse corona-(planets-surface conditions and atmosphere, size, period & distance) mercury venus-earth mars-jupiter-saturn-uranus-neptune-comets-asteroids meteors	● Lecture ● Demonstrations	● Assignment	To study important aspects of Geothermal energy	● Test papers ● Assignment
UNIT IV (12 Hours)	The stars Unit of distance-Astronomic	● Lecture ● Demonst	● Assignment	To understand	● Test papers ● Assignment

	al units--parsec-light year-Magnitudes of stars apparent magnitude absolute magnitude-Three categories of stars-Main sequence stars Dwarfs-Giants-star formation life cycle of stars-Chandrasekher limit- Novae-Binary stars neutron star-black holes. Expanding universe-Big bang theory	rations	• Discussion	the concepts of OCean energy	

Faculty In-charge
Fency K F & Dr. Nijo Varghese

PH6 B10: THERMAL AND STATISTICAL PHYSICS

Semester: 6
Course Number: X
Number of hours of Lectures per week: 4
Number of Credits: 4
Number of Contact Hours: 72
Course Evaluation: Internal – 20 Marks + External – 80 Marks

Objectives

- To Become familiar with various thermodynamic processes and work done in each of these processes.
- To Have a clear understanding about Reversible and irreversible processes and also working of a Carnot engine, and knowledge of calculating change in entropy for various processes.
- To Realize the importance of Thermo dynamical functions and applications of Maxwell's relations.
- To Familiarize in depth about statistical distribution and have basic Ideas about Maxwell Boltzmann,Bose-Einstein and Fermi Dirac Statistics and their applications

Prerequisites: Background of the basic science at +2 level

Course Outline
Unit- I

Thermodynamic system- Thermal equilibrium-zeroth law-concept of heat and temperature - thermodynamic equilibrium- quasistatic process -extensive and intensive variables-thermodynamic process (cyclic and non cyclic)-indicator diagram- workdone in isothermal, adiabatic, isobaric and isochoric –cyclic processes- concept ofpath and point functions-internal energy- first law of thermodynamics-relation between P,T,V,in adiabatic process-slope of adiabatic and isothermal process -application of first law to heat capacities-(relation between Cp and Cv) and latent heat– adiabatic and isothermal elasticity of a gas)

UNIT 2
Reversible and irreversible processes , Conditions for reversibility-second law of thermodynamics-heat engine, Carnot engine, derivation for expression for efficiency, efficiency, Carnot's refrigerator-thermodynamic scale of temperature- Carnot's theorem and its proof.-application of second law(Clausius-Clapyron equation)- internal combustion engine-otto engine ,diesel engine -its efficiencies

UNIT 3
Entropy and adiabatics- definition of entropy-Change of entropy in a Carnot cycle-Change of entropy in an reversible cycle (Claussius theorem) -Change of entropy in an irreversible cycle (Claussius inequality)- Change in entropy of a perfect gas during a process-Change in entropy in a irreversible process-change in entropy due to free expansion-Change in entropy due to spontaneous cooling by conduction, radiation….etc, - Principle of increase of entropy-Entropy and available energy-Entropy and disorder-Nernst heat theorem entropy temperature diagrams

UNIT 4.

Thermodynamic functions-Enthalpy, Helmhlotz function, Gibbs function-Maxwell's thermodynamic relations-TdS relations-application of Maxwell's thermodynamical relations-1.variation of intrinsic energy with volume-2.Joule-Kelvin coefficient-3.Claussius-Clapeyron equation from Maxwell's thermodynamic relations- changes of phase.

UNIT 5

Statistical distributions-Maxwell-Boltzmann statistics (no derivation)-Distribution of molecular energies in an ideal gas-Average molecular energy- Equi partition theorem- Maxwell-Boltzmann speed distribution law-Expressions for rms speed, most probable speed and mean speed.

UNIT 6

Bose Einstein and Fermi Dirac distribution laws (no derivations)- Application of BE distribution law to black body radiation-Planck's radiation law-Stefan's law-Wien's displacement law-Fermi energy-Expression for Fermi energy of electron system-electron energy distribution- average electron energy at absolute zero-Degeneracy pressure and its astrophysical significance.

Text book of study

Heat and Thermodynamics by D S Mathur- Revised fifth edition)

References:

1. Heat and Thermodynamics-DS Mathur (V Edn.)
2. Statistical Mechanics – An Elementary Outline – Avijit Lahiri – Universities Press
3. Physics- Resnick and Halliday
4. Heat and Thermodynamics-Zemansky
5. Thermodynamics – Y V C Rao – Universities Press
6. Advanced Physics Second Edition – Keith Gibbs – Cambridge University Press
7. Thermodynamics and statistical mechanics-Brijlal Subramanium
8. Heat and Thermodynamics- A Manna

COURSE OUTCOMES

CO1	Understand the zero and first laws of thermodynamics
CO2	Understand the thermodynamics description of the ideal gas
CO3	Understand the second law of thermodynamics and its applications
CO4	Understand the basic ideas of entropy
CO5	Understand the concepts of thermodynamic potentials and phase transitions

LESSON PLAN

Unit/ session/ hours (timerequired)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
UNIT I (18 Hours)	Zeroth Law and First Law of Thermodynamics - Thermal equilibrium	● Lecture ● Demonstrations	● Assignment	To understand the laws of thermodynam	● Test papers ● Assignment

	and Zeroth Law, Intensive and extensive coordinates, PV diagram, Mathematical formulation of First Law, Differential form of the First Law			ics	
UNIT II (11 Hours)	Reversible and irreversible processes , Conditions for reversibility-second law of thermodynamics-heat engine, Carnot engine, derivation for expression for efficiency, efficiency, Carnot's refrigerator-thermodynamic scale of temperature-Carnot's theorem	● Lecture ● Demonstrations	● Assignment	To acquire knowledge about Carnot engine	● Test papers ● Assignment
UNIT III (14 Hours)	Entropy – Entropy of the ideal gas – TS diagram – Entropy and reversibility – Entropy and irreversibility- Entropy and disorder – Exact differentials	● Lecture ● Demonstrations	● Assignment	To study important aspects of entropy	● Test papers ● Assignment
UNIT IV (10 Hours)	Thermodynamic Potentials and Phase Transitions - Enthalpy – Joule-Thomson expansion – Helmholtz and Gibbs functions, Maxwell's relations – TdS equations, First-order phase transitions, Clausius-Clapeyron equation and phase diagrams	● Lecture ● Demonstrations	● Assignment	To understand basic idea about Enthalpy, Maxwell's reations	● Test papers ● Assignment

UNIT V (8 Hours)	Statistical distributions-Maxwell-Boltzmann statistics (no derivation)-Distribution of molecular energies in an ideal gas-Average molecular energy	● Lecture ● Demonstrations	● Assignment	To acquire knowledge about MB Statistics	● Test papers ● Assignment
UNIT VI (11 Hours)	Bose Einstein and Fermi Dirac distribution laws (no derivations)-Application of BE distribution law to black body radiation-Planck's radiation law-Stefan's law-Wien's displacement law-Fermi energy-Expression for Fermi energy of electron system	● Lecture ● Demonstrations	● Assignment	To study important aspects of BE and FD statistics	● Test papers ● Assignment

Faculty In-charge
Fency K F

PH6 B11 : SOLID STATE PHYSICS, SPECTROSCOPY AND LASER PHYSICS

Semester: 6
Course Number: XI
Number of hours of Lectures per week: 4
Number of Credits: 4
Number of Contact Hours: 72
Course Evaluation: Internal – 20 Marks + External – 80 Marks

Objectives

- To Have a clear picture of crystal structures and a clear understanding about x-ray diffraction
- To gain knowledge of superconductivity,,its underlying principles and its applications in modern world
- To Become familiar with molecular spectroscopy and have gained basic ideas regarding microwave spectroscopy, infrared spectroscopy and Raman Spectroscopy.
- To gain basic knowledge of laser and working of different type of lasers

Prerequisites: Background of the basic science at +2 level

Course Outline

SOLID STATE PHYSICS

UNIT 1.Crystal Physics

Lattice Point & Space Lattice-Basis and crystal structure, unit cells and lattice Parameters, Unit cells v/s primitive cells, Crystal systems, crystal symmetry. The symmetry elements in a cubical crystal, rotation axis and inversion. Symmetry elements, Bravais space lattices-metallic crystal structure , sodium chloride, diamond, zinc sulphide, hexagonal and closed packed structure, directions, planes and Miller indices.

UNIT 2. X-ray Diffraction:

Bragg's law – Braggs X-ray spectrometer-Rotating Crystal method

UNIT 3. Super conductivity

A survey of superconductivity-Mechanism of Superconductors-Effects of Magnetic Field-Meissner Effect-isotope Effect-Energy Gap -Coherence Length- Josephson effect-BCS Theory (Qualitative idea only) -Application of Superconductivity, Type I and Type II superconductors.

MOLECULAR SPECTROSCOPY

UNIT 4 . Basic Elements of Spectroscopy

Quantum of Energy-Regions of Spectrum-Representation of Spectrum-Basic Elements of Practical Spectroscopy-Signal to Noise Ratio-Resolving Power-Width & Intensity of Spectral Transitions

UNIT 5. Microwave Spectroscopy

Classification of Molecules-Interaction of Radiation with Rotating Molecules-Rotational Spectrum of Rigid Diatomic Molecule-Example of CO-Selection Rule-Intensity-Spectrum of non –rigid Rotator-Example of HF- Spectrum of symmetric Top molecule- Example of Methyl chloride-Enformation derived from Rotational Spectrum.

UNIT 6. Infra Red Spectroscopy:

Vibrational Energy of an Anharmonic Oscillator-Diatomic Molecule (Morse Curve)-IR Spectra-Spectral Transitions & Selection Rules-Example of HCL-Vibration-Rotation Spectra of Diatomic Molecule-Born Oppenheimer Approximation-Instrmentation for Infra Red Spectroscopy

UNIT 7. Raman Spectroscopy

Raman Effect, Elements of Quantum theory & Applications-Pure Rotational Raman Spectrum-Examples of Oxygen and carbon-dioxide-Rotational Raman spectrum of symmetric Top molecule-Example of chloroform.Vibrational Raman spectrum of Symmetric Top Molecule-Example of Chloroform. (Molecular Structures & Spectroscopy by G Aruldhas &

UNIT 8. Laser Physics

Induced Absorption-Spontaneous Emission & Stimulated Emission-Einstein Coefficients Principle of Laser-Population inversion-Pumping-Properties of Laser-Types of Laser- Principle & working of Ruby laser, Helium Neon Laser & Semiconductor Laser- -Yag Lasers (Qualitative ideas only). Application of Lasers

Text Books for Study :

1. Solid State Physics by S O Pillai
2. Fundamentals of Molecular Spectroscopy by Banwell & Elaine M Mccash
3. Molecular Structure & Spectroscopy by G Aruldhas

References

1. Solid Sate Physics by M A Wahab
2. Introduction to Molecular Spectroscopy by G M Barrow
3. Raman Spectroscopy by Long D A
4. Modern Physics by R Murugeshan
5. Optical Communications – M Mukunda Rao – Universities Press
6. Principles of Condensed Matter Physics – P M Chaikin & T C Lubensky – Cambridge University Press

COURSE OUTCOMES

CO1	Understand the basic principles of statistical physics and its applications
CO2	Understand the basic aspects of crystallography in solid state physics
CO3	Understand the basic elements of spectroscopy
CO4	Understand the basics ideas of microwave and infra red spectroscopy
CO5	Understand the fundamental ideas of Laser physics

LESSON PLAN

Unit/ session/ hours (timerequired)	Topics to be taught (input)	Procedure (process) Student centric Method	Activity	Learning outcome (output)	Assessment

		of teaching			
UNIT I (15 Hours)	Lattice Point & Space Lattice-Basis and crystal structure, unit cells and lattice Parameters, Unit cells v/s primitive cells, Crystal systems, crystal symmetry.	● Lecture ● Demonstrations	● Assignment	To understand the Crystal structures	● Test papers ● Assignment
UNIT II (5 Hours)	Bragg's law – Braggs X-ray spectrometer-Rotating Crystal method	● Lecture ● Demonstrations	● Assignment	To acquire knowledge about X ray Diffraction	● Test papers ● Assignment
UNIT III (8 Hours)	Mechanism of Superconductors-Effects of Magnetic Field-Meissner Effect-isotope Effect-Energy Gap -Coherence Length-Josephson effect-BCS	● Lecture ● Demonstrations	● Assignment	To study important aspects of Superconductivity	● Test papers ● Assignment
UNIT IV (5 Hours)	Quantum of Energy-Regions of Spectrum-Representation of Spectrum-Basic Elements of Practical Spectroscopy-Signal to Noise Ratio-Resolving Power-	● Lecture ● Demonstrations	● Assignment	To understand basic idea about Spectroscopy	● Test papers ● Assignment
UNIT V (8 Hours)	Microwave Spectroscopy- Bond length of CO Molecule,	● Lecture ● Demonstrations	● Assignment	To understand basic idea about Microwave spectroscopy	● Test papers ● Assignment
UNIT VI (9 Hours)	Infra Red Spectroscopy-Simple harmonic	● Lecture ● Demonstrations	● Assignment	To understand basic idea	● Test papers ● Assignment

	oscillator – Anharmonic oscillator, Born-Oppenheimer approximation			about Infrared spectroscopy	
UNIT VII (10 Hours)	Raman Effect, Elements of Quantum theory & Applications-Pure Rotational Raman Spectrum-Examples of Oxygen and carbon-dioxide-Rotational Raman spectrum of symmetric Top molecule	● Lecture ● Demonstrations	● Assignment	To understand Raman Spectroscopy	● Test papers ● Assignment
UNIT VIII (12 Hours)	Spontaneous Emission & Stimulated Emission-Einstein Coefficients Principle of Laser-Population inversion-Pumping-Properties of Laser-Types of Laser-Principle & working of Ruby laser, Helium Neon Laser	● Lecture ● Demonstrations	● Assignment	To understand basic idea about Laser Physics	● Test papers ● Assignment

Faculty In-charge
Dr.Salini Jose

PH6 B12 : NUCLEAR PHYSICS, PARTICLE PHYSICS & ASTROPHYSICS

Semester: 6
Course Number: XII
Number of hours of Lectures per week: 4
Number of Credits: 4
Number of Contact Hours: 72
Course Evaluation: Internal – 20 Marks + External – 80 Marks

Objectives

- To get a clear picture of nuclear composition and various nuclear models.
- To get deep knowledge about Radioactivity,nuclear Fission and Nuclear Fusion,the relevance of nuclear transformation.
- To Understand the working of nuclear detectors and counters,realize the importance of Cosmic rays and its effects on earth
- To familiarize with nuclear particles and different particle accelerators.
- To get Peripheral ideas about astronomy and astrophysics

Prerequisites: Background of the basic science at +2 level

Course Outline

UNIT: 1 Nuclear Structure

Nuclear composition – nuclear electrons – discovery of neutron, Nuclear properties – nuclear radii –spin and magnetic moment - nuclear magnetic resonance, Stable nuclei, Binding energy, Liquid drop model -semi empirical binding energy formula- mass parabolas, Shell model, Meson theory of nuclear forces – discovery of pion.

UNIT 2. Nuclear Transformations

Elementary ideas of radio activity- Alpha decay-tunnel theory of alpha decay-derivation for the formula for decay constant-Beta decay-negatron emission-positron emission electron capture -inverse beta decay and the discovery of neutrino, Gamma decay fundamental ideas of nuclear isomerism and internal conversion, The concept of interaction cross section--reaction rate-nuclear reactions-center of mass frame of reference and Q value of a nuclear reaction, Nuclear fission, Nuclear reactors-breeder reactors, Nuclear fusion-nuclear fusion in stars-proton-proton cycle-carbon nitrogen cycleformation of heavier elements, Fusion reactors-confinement methods.

UNIT 3. Nuclear Detectors And Counters
Interactions of radiation with matter – fundamental ideas, Gas filled counters- ionization chamber – proportional counter – G.M. counter, Cloud chamber, Bubble chamber, Semi conductor detectors and scintillation counters

UNIT 4. Cosmic Rays
Nature of Cosmic rays, the origin of cosmic rays, geomagnetic effects, Cosmic ray showers

UNIT 5. Particle Physics
Leptons –electron and positron-neutrinos and anti-neutrinos-other leptons, Hadronsresonance particles, Elementary particle quantum numbers-baryon number- lepton number - strangeness - isospin-electric charge-hyper charge-basic ideas on symmetries and conservation laws, Quarks -color and flavor, Fundamental interactions

UNIT 6. Particle Accelerators

Classification of accelerators-electrostatic accelerators-cyclic accelerators, the linear accelerator, the cyclotron, the betatron, the electron synchrotron .

UNIT 7. Astrophysics and astronomy

Stellar magnitudes an sequences, Absolute magnitude, The bolometric magnitude - Different magnitude standards, The colour index of a star, Luminosities of stars, Stellar parallax and the units of stellar distances, Stellar positions: The celestial co-ordinates. A Qualitative study on stellar positions and constellations

Text books for study

1. Concepts of Modern Physics – Arthur Beiser (5th Edition),
2. Nuclear Physics – Irving Kaplan (17.8)
3. Nuclear Physics-An Introduction: T.A. Littlefield and N. Thorley)
4. An introduction to AstroPhysics-Baidyanath Basu)

References

1. Nuclear Physics: D.G. Tayal
2. Atomic Physics: J.B. Rajam
3. Atomic Physics: John Yarwood
4. Introduction to Astrophysics: H L Duorah & Kalpana Duorah
5. Mayer – Jensen Shell Model and Magic Numbers: R Velusamy, Dec 2007
6. The Enigma of Cosmic Rays: Biman Nath, Resonance – Feb 2004, March 2004
7. Black body radiation: G.S. Ranganath, Resonance – Feb. 2008.
8. Advanced Physics Second Edition – Keith Gibbs – Cambridge University Press

COURSE OUTCOMES

CO1	Understand the basic aspects of nuclear structure and fundamentals of radioactivity
CO2	Describe the different types of nuclear reactions and their applications
CO3	Understand the principle and working of particle detectors
CO4	Describe the principle and working of particle accelerators
CO5	Understand the basic principles of elementary particle physics

LESSON PLAN

Unit/ session/ hours (timerequire	Topics to be taught (input)	Procedure (process) Student	Activity	Learning outcome (output)	Assessment

d)		**centric Method of teaching**			
UNIT I (12 Hours)	Nuclear Structure and Radioactivity - Liquid drop model – Shell model - Nuclear force – Radioactive decay –Conservation laws in radioactive decay – Alpha decay – Beta decay – Gamma decay	● Lecture ● Demonstrations	● Assignment	To understand the Nuclear structures	● Test papers ● Assignment
UNIT II (16 Hours)	.Nuclear Reactions and Applications -Fission – Fission reactors – Fusion – Fusion processes in stars – Fusion reactors – Applications of nuclear physics Semiconductor Counters – Spark Chamber – Cerenkov Counter	● Lecture ● Demonstrations	● Assignment	To acquire knowledge about Nuclear transformations	● Test papers ● Assignment
UNIT III (7 Hours)	Particle Detectors- Wilson Cloud Chamber – Bubble Chamber – Ionization Chambers– Proportional Counter – Geiger-Muller Counter – Scintillation Counters and I	● Lecture ● Demonstrations	● Assignment	To study important aspects of Particle detectors	● Test papers ● Assignment
UNIT IV (4 Hours	Nature of Cosmic rays, the origin of cosmic rays, geomagnetic effects, Cosmic ray showers	● Lecture ● Demonstrations	● Assignment	To acquire knowledge about cosmic rays	● Test papers ● Assignment

UNIT V (15 Hours	Elementary Particles - Particles and antiparticles – Families of particles – Conservation laws, Particle interactions and decays – Resonance particles, The Quark Model – The Standard Mode	● Lecture ● Demonstrations	● Assignment	To understand the Particle physics	● Test papers ● Assignment
UNIT VI (8 Hours	Classification of accelerators-electrostatic accelerators-cyclic accelerators, the linear accelerator, the cyclotron, the betatron, the electron synchrotron	● Lecture ● Demonstrations	● Assignment	To study important aspects of particle accelerators	● Test papers ● Assignment
UNIT VII (10 Hours	Stellar magnitudes an sequences, Absolute magnitude, The bolometric magnitude - Different magnitude standards, The colour index of a star, Luminosities of stars	● Lecture ● Demonstrations	● Assignment	To understand the concepts of Astrophysics	● Test papers ● Assignment

Faculty In-charge
Fency K F & Dr. Nijo Varghese

PH6 B13(E1): Elective- Computational Physics

Semester: 6
Course Number: XIII
Number of hours of Lectures per week: 3
Number of Credits: 3
Number of Contact Hours: 54
Course Evaluation: Internal – 20 Marks + External – 80 Marks

Objectives

- To get a clear picture of Python programming
- To get deep knowledge about Numerical methods in Physics
- To Introduce computational approach in Physics

Prerequisites: Background of the basic computer knowledge at +2 level

Course Outline

UNIT I.

Introduction to Python Programming:

Concept of high level language, steps involved in the development of a Program – Compilers and Interpreters - Introduction to Python language, Advantages of Python in comparison with other Languages - Different methods of using python: Using python as a calculator, Writing python programs and execution - Inputs and Outputs - Variables, operators, expressions and statements -- Strings, Lists, list functions (len, append, insert, del, remove, reverse, sort, +, *, max, min, count, in, not in, sum), sets, set functions(set, add, remove, in, not in, union, intersection, symmetric difference)-Tuples and Dictionaries, Conditionals, Iteration and looping - Functions and Modules - File input and file output, Pickling.

UNIT II.

Numerical Methods in physics

General introduction to numerical methods, Comparison between analytical and numerical techniques - Curve Fitting: Principle of least squares, fitting a straight line - Interpolation: Finite difference operator, Newton's forward difference interpolation formula, Solution of algebraic equations: Newton-Raphson method - Numerical differentiation and integration: Difference table, Trapezoidal and Simpson's (1/3) method - Solution of differential equations :Runge Kutta method (Second order) -Taylor's Series : Sin(x) and Cos(x).

UNIT III

Introduction to Computational approach in physics

One Dimensional Motion: Falling Objects: Introduction – Formulation: from Analytical methods to Numerical Methods - Euler Method, Freely falling body, Fall of a body in viscous medium - Simulation of free fall and numerical integration, Two dimensional motion: Projectile motion (by Euler method)-Motion under an attractive Inverse Square- law force Accuracy considerations .

References:

1. www.python.org
2. Python Essential Reference, David M. Beazley, Pearson Education
3. Core Python Programming, Wesley J Chun, Pearson Education
4. Python Tutorial Release 2.6.1 by Guido van Rossum, Fred L. Drake, Jr., editor. This Tutorial can be obtained from website (http://www.altaway.com/resources/python/tutorial.pdf)
5. How to Think Like a Computer Scientist: Learning with Python, Allen Downey , Jeffrey Elkner , Chris Meyers, http://www.greenteapress.com/thinkpython/thinkpython.pdf
6. Numerical Methods in Engineering and Science, Dr. B S Grewal, Khanna Publishers, Newdelhi (or any other book)
7. Numerical methods for scientists and engineers, K. Sankara Rao, PHI
8. Introductory methods of numerical analysis, S.S.Shastry , (Prentice Hall of India,1983)

9. Computational Physics, V.K.Mittal, R.C.Verma & S.C.Gupta-Published by Ane Books,4821,Pawana Bhawan,first floor,24 Ansari Road,Darya Ganj,New Delhi-110 002 (For theory part and algorithms. Programs must be discussed in Python)

COURSE OUTCOMES

CO1	Introduction to programming language Python
CO2	Applying Numerical Methods in physics
CO3	Understanding Computational approach in physics

LESSON PLAN

Unit/ session/ hours (timerequired)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
UNIT I (20 Hours)	Introduction to Python language, Advantages of Python in comparison with other Languages - Different methods of using python: Using python as a calculator, Writing python programs and execution - Inputs and Outputs - Variables, operators, expressions and statements	● Lecture ● Demonstrations ●ComparativeStudy	● Assignment	To understand the Python Programming	● Test papers ● Assignment
UNIT II (22 Hours)	Comparison between analytical and numerical techniques - Curve Fitting: Principle of least squares, fitting a straight line - Interpolation: Finite difference operator,	● Lecture ● Demonstrations	● Assignment	To acquire knowledge about Numerical methods in physics	● Test papers ● Assignment

	Newton's forward difference interpolation formula, Solution of algebraic equations: Newton-Raphson method				
UNIT III (12 Hours)	Analytical methods to Numerical Methods - Euler Method, Freely falling body, Fall of a body in viscous medium - Simulation of free fall and numerical integration, Two dimensional motion: Projectile motion	● Lecture ● Demonstrations	● Assignment	To study important aspects of computational methods in Physics	● Test papers ● Assignment

Faculty In-charge
Dr. Nijo Varghese

PH6B14 - Practical II & PHY6B16: PRACTICAL III

Semester: 5 & 6
Course Number: XV & XVI
Number of hours of Lectures per week: 4
Number of Credits: 5
Number of Contact Hours:72 + 72
Course Evaluation: Internal – 30 Marks + External – 120 Marks

Objectives

- To Apply and illustrate the principles of semiconductor diode and transistor through experiments
- To Apply and illustrate the principles of transistor amplifier and oscillator through experiment
- To Apply and illustrate the principles of digital electronics through experiments
- To Analyze and apply computational techniques in Python programming

Prerequisites: Background of the basic practical knowledge at +2 level

Course Outline
Practical II
(Any 20)
1. Spectrometer- i1-i2 curve
2. Spectrometer-Cauchy's constants
3. Spectrometer-Diffraction Grating-Normal incidence
4. Laser-wavelength using transmission grating

5. Diffraction Grating-minimum deviation
6. Spectrometer-Quartz prism-Refractive indices of quartz for the ordinary and extraordinary rays
7. Newton's rings-wavelength of sodium light
8. Air wedge-angle of the wedge, radius of a thin wire
9. Lee's Disc –thermal conductivity
10. Potentiometer-calibration low range and high range voltmeters
11. Potentiometer- Reduction factor of TG
12. Variation of field with distance-Circular coil-moment of magnet & Bh
13. Carey Foster's bridge-resistance & resistivity
14. Carey Foster's bridge-Temperature coefficient of Resistance
15. Conversion of Galvanometer to voltmeter and calibrating using Potentiometer.
16. Conversion of Galvanometer to ammeter and calibrating using Potentiometer.
17. BG Absolute Capacity
18. BG-High resistance by leakage method
19. BG Mutual inductance
20. Planck's constant using LED's (3no.s)
21. Polarimeter-Specific rotation of sugar solution.
22. Searls and Box vibration magnetometers- m & Bh.
23. Numerical aperture of an optical fibre by semiconductor laser
24. Frequency of AC using sonometer

Practical III
Unit 1 (Any 15 experiments)

1. Construction of full wave, Centre tapped and Bridge rectifiers
2. Characteristics of Zener diode and construction of Voltage regulator.
3. Transistor characteristics and transfer characteristics in Common Base Configuration- current again
4. Transistor characteristics and transfer characteristics in Common Emitter Configuration- current again
5. CE Transistor Amplifier-Frequency response.
6. Full adder using NAND gates-construction & verification
7. Negative feedback amplifier
8. LC Oscillator (Hartley or Colpitts)
9. Phase shift oscillator
10. Operational Amplifier –inverting, non inverting, Voltage follower
11. LCR circuits-Resonance using CRO
12. Construction of basic gates using diodes(AND, OR) & transistors (NOT), verification by measuring voltages
13. Voltage multiplier (doubler, tripler)
14. Multivibrator using transistors.
15. Flip-Flop circuits –RS and JK using IC's
16. Verification of De-Morgan's Theorem using basic gates.
17. Half adder using NAND gates

Unit : II Numerical Methods Using Python :All programmes to be done.

18. Solution of equations by bisection and Newton-Raphson methods
19. Least square fitting – straight line fitting.
20. Numerical differentiation using difference table.
21. Numerical Integration – Trapezoidal and Simpson's 1/3 rd rule.
22. Taylor series - Sin θ, Cos θ
23. Solution of differential equation Runge-Kutta method (Harmonic Oscillator).
24. Simulation of freely falling body. Tabulation of position, velocity and acceleration as a function of time.
25. Simulation of projectile – Tabulation of position, velocity and acceleration as a function of time – Plot trajectory in graph paper from tabulated values

Books of Study:

1. Electronics lab manual- K A Navas (vol 1 &2)
2. B.Sc Practical Physics- C L Arora
3. Practical Physics- S L Gupta & V Kumar
4.Computational Physics, V.K.Mittal, R.C.Verma & S.C.Gupta-Published by Ane Books
5. Introductory methods of numerical analysis, S.S.Shastry , (Prentice Hall ofIndia,1983)
6.Introduction to Python for Engineers and Scientists by Dr.Sandeep Nagar, Apress publications.
7.Python for Education by Dr. B P Ajithkumar, IUAC, New Delhi; e-book freely downloadable from www.expeyes.in/documents/mapy.pdf

Reference Books:

1. Advanced Practical Physics for students – B L Worksnop and H T Flint

COURSE OUTCOMES

CO1	Apply and illustrate the principles of semiconductor diode and transistor through experiments
CO2	Apply and illustrate the principles of transistor amplifier and oscillator through experiments
CO3	Apply and illustrate the principles of digital electronics through experiments
CO4	Analyze and apply computational techniques in Python programming

LESSON PLAN

Experiments to be done (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Practical II 1. Spectrometer-Cauchy's constants 2. Spectrometer-Diffraction Grating-Normal incidence 3. Laser-wavelength using transmission grating 4. Diffraction Grating-minimum deviation 5. Spectrometer-Quartz prism-Refractive indices of quartz for the ordinary and extraordinary rays 6. Newton's rings-wavelength of sodium light 7. Air wedge-angle of the wedge, radius of a thin wire 8. Lee's Disc –thermal conductivity 9. Potentiometer-calibration low range and high range voltmeters 10. Potentiometer-Reduction factor of TG 11. Variation of field with distance-Circular coil-moment of magnet & Bh 12. Carey Foster's bridge-resistance & resistivity 13. Carey Foster's bridge-Temperature coefficient of Resistance 14. Conversion of Galvanometer to voltmeter and calibrating using Potentiometer. 15. BG Absolute Capacity	● Demonstrations ●ComparativeStudy	● Assignment ● Seminars	To get practical knowledge about Physics Experiments	● Practical exams ● Assignment

16. BG-High resistance by leakage method 18. Planck's constant using LED's (3no.s) 19. Polarimeter-Specific rotation of sugar solution. 20. Searls and Box vibration magnetometers- m & Bh. 21. Numerical aperture of an optical fibre by semiconductor laser 22. Frequency of AC using sonometer Construction of full wave, Centre tapped and Bridge rectifiers 2. Characteristics of Zener diode and construction of Voltage regulator. 3. Transistor characteristics and transfer characteristics in Common Base Configuration- current again 4. CE Transistor Amplifier-Frequency response. 5. Full adder using NAND gates-construction & verification 6. Negative feedback amplifier 7. LC Oscillator (Hartley or Colpitts) 8. Phase shift oscillator 9. Operational Amplifier –inverting, non inverting, Voltage follower 10. Construction of basic gates using diodes(AND, OR) & transistors (NOT), verification by measuring voltages 11. Voltage multiplier (doubler, tripler)				

12. Multivibrator using transistors. 13. Flip-Flop circuits –RS and JK using IC's 14. Verification of De-Morgan's Theorem using basic gates. 15. Half adder using NAND gates **Unit : II Numerical Methods Using Python** 16. Solution of equations by bisection and Newton-Raphson methods 17. Least square fitting – straight line fitting. 18. Numerical differentiation using difference table. 19. Numerical Integration – Trapezoidal and Simpson's 1/3 rd rule. 20. Taylor series - Sin θ, Cos θ 21. Solution of differential equation Runge-Kutta method (Harmonic Oscillator). 22. Simulation of a freely falling body. Tabulation of position, velocity and acceleration as a function of time.				

Faculty In-charge
Fency K F, Dr. Nijo Varghese, Dr. Sr. Irene & Ms. Libi Prakash

MSC PHYSICS

Course Outcomes

Semester I **Paper name: CLASSICAL MECHANICS** **Code: PHY1C01**
Course Outcomes: ● **TheLagrangian and Hamiltonian approaches in classical mechanics.** ● **The classical background of Quantum mechanics and get familiarized with Poisson brackets and Hamilton -Jacobi equation** ● **Kinematics and Dynamics of rigid body in detail and ideas regarding Euler's equations of motion** ● **Theory of small oscillations in detail along with the basis of Free vibrations.** ● **Basic ideas about Non linear equations and chaos.**
Semester I **Paper name: MATHEMATICAL PHYSICS** **Code: PHY1C02**
Course Outcomes: ● **Learn about Gradient, Divergence and Curl in orthogonal curvilinear and their typical applications in physics.** ● **Learn about special types of matrices that are relevant in physics and then learn about tensors.** ● **Get introduced to Special functions like Gamma function, Beta function, Delta function, Dirac delta function, Bessel functions and their recurrence relations** ● **Learn different ways of solving second order differential equations and familiarize with singular points and the Frobenius method.** ● **Learn the fundamentals and applications of Fourier series, Fourier and Laplace transforms,their inverse transforms etc**
Semester I **Paper name: ELECTRODYNAMICS AND PLASMA PHYSICS** **Code: PHY1C03**

Course Outcomes:

- **have gained a clear understanding of Maxwell's equations and electromagnetic boundary conditions.**
- **know that laws of reflection, refraction are outcomes of electromagnetic boundary conditions. They will also be able design dielectric coatings which act like antireflection coatings. They will be able to distinguish between a good metal and a good dielectric.**
- **have grasped the idea of electromagnetic wave propagation through waveguides and transmission lines.**
- **extend their understanding of special theory of relativity by including the relativistic electrodynamics.**
- **understand the rather complex physical phenomena observed in plasma.**

Semester I
Paper name: ELECTRONICS
Code: PHY1C04

Course Outcomes:

- **Field Effect Transistors, their principles and applications**
- **Photonic devices like LED, Laser diode, photodetectors, solar cells etc and their working in detail**
- **Basic operational amplifier characteristics, OPAMP parameters ,applications as inverter, integrator, differentiator etc**
- **Digital electronics baiscsusing logic gates and working of major digital devices like flip flops, CMOS ,CCD etc**
- **Karunaghmaps,flipFlops,counters and working of Microprocessors in detail.**

Semester II
Paper name: QUANTUM MECHANICS-I
Code: PHY2C05

Course Outcomes:

- **Linear vector spaces, Hilbert space, concepts of basis and operators and bra and ket notation**
- **Both schrodinger and Heisenberg formulations of time development and their applications**
- **Theory of angular momentum and spin matrices, orbital angular momentum and Clebsch Gordan Coefficient**
- **Space-time symmetries and conservation laws, theory of identical particles**
- **Theory of scattering and calculation of scattering cross section, optical theorem ,Born and Elkonal approximation, partial wave analysis etc.**

Semester II
Paper name: MATHEMATICAL PHYSICS-II

Code: PHY2C06

Course Outcomes:

- **know the method of contour integration to evaluate definite integrals of varying complexity.**
- **have gained the ability to apply group theory to physics problems, which is a prerequisite for deeper understanding of crystallography, particle physics, quantum mechanics and energy bands in solids.**
- **be able to apply calculus of variations to diverse problems in physics including isoperimetric problems. Another interesting aspect is the use of Lagrange multipliers in solving physics problems.**
- **to become familiar with the method of Green's function to solve linear differential equations with inhomogeneous term**
- **to find solutions to integral equations using different methods.**

Semester II
Paper name: STATISTICAL MECHANICS
Code: PHY2C07

Course Outcomes

- **Explain statistical physics and thermodynamics as logical consequences of the postulates of statistical mechanics**
- **Apply the principles of statistical mechanics to selected problems**
- **Grasp the basis of ensemble approach in statistical mechanics to a range of situations**
- **To learn the fundamental differences between classical and quantum statistics and learn about quantum statistical distribution laws**
- **Study important examples of ideal Bose systems and Fermi systems**

Semester II
Paper name: COMPUTATIONAL PHYSICS
Code: PHY2C08

Course Outcomes:

- **Have a strong base in Python language regarding different data types such as list,sets,dictionary etc.**
- **It helps to understand the different modules like NUMPY, Matplotlib Etc**
- **Understand Arrays and matrices and enables data visualization**
- **Gets a wide knowledge of numerical methods in computational Physics that can be used to solve many problems which does not have an analytic solution**
- **Solve problems in physics such as standing waves, central field motion, Kirchoff's law etc using python language.**

Semester I & II
Paper name: GENERAL PHYSICS (Practicals)
Code: PHY1P01 & PHY2P03

Course Outcomes:

- **Learn various experimental and computational tools thereby developing analytical abilities to address real world problems.**
- **Adopt the skills related to research, education, and industry- academia**

Semester I & II
Paper name: ELECTRONICS (Practicals)
Code: PHY1P02 & PHY2P04

Course Outcomes:

- **Understand the behaviour of electronic components and perform analysis and design of bias circuits for diodes, transistors etc.**
- **Set up testing strategies and select proper instruments to evaluate performance characteristics of electronic circuits.**
- **Choosing testing and experimental procedures on different types of electronic circuit and analyse their operation under different operating conditions.**

Semester III
Paper name: QUANTUM MECHANICS –II
Code: PHY3C09

Course Outcomes:

- **Approximation methods for time-independent problems like the WKB approximation**
- **The variational equation and its application to ground state of the hydrogen and Helium atom**
- **Perturbation theory and Interaction of an atom with the electromagnetic field**
- **To get an idea of Scattering, its parameters and its application**
- **Relativistic Quantum Mechanics using Dirac equation, Dirac matrices,. The Klein Gordon equation etc**

Semester III
Paper name: NUCLEAR AND PARTICLE PHYSICS
Code: PHY3C10

Course Outcomes:

- **have a basic knowledge of nuclear size ,shape , binding energy.etc and also the characteristics of nuclear force in detail.**
- **be able to gain knowledge about various nuclear models and potentials associated.**
- **acquire knowledge about nuclear decay processes and their outcomes. Have a wide understanding regarding beta and gamma decay.**
- **Grasp knowledge about Nuclear reactions, Fission and Fusion and their characteristics.**
- **understand the basic forces in nature and classification of particles and study in detail conservations laws and quark models in detail**

Semester III
Paper name: SOLID STATE PHYSICS
Code: PHY3C11

Course Outcomes:

- **have a basic knowledge of crystal systems and spatial symmetries ,- be able to account for how crystalline materials are studied using diffraction, including concepts like reciprocal lattice and Brillouin zones**
- **know what phonons are, and be able to perform estimates of their dispersive and thermal properties , be able to calculate thermal and electrical properties in the free-electron model**
- **know Bloch's theorem and what energy bands are and know the fundamental principles of semiconductors**
- **know the fundamentals of dielectric and ferroelectric properties of materials**
- **know basic models of dia, para and ferro magnetism**
- **be able to explain superconductivity using BCS theory**

Semester IV
Paper name: ATOMIC AND MOLECULAR SPECTROSCOPY
Code: PHY4C12

Course Outcomes:

- **know about different atom model and will be able to differentiate different atomic systems, different coupling schemes and their interactions with magnetic and electric fields.**
- **Have gained ability to apply the techniques of microwave and infrared spectroscopy to elucidate the structure of molecules**
- **Be able to apply the principle of Raman spectroscopy and its applications in the different field of science & Technology.**
- **To become familiar with different resonance spectroscopic techniques and its applications**
- **to find solutions to problems related to different spectroscopic systems.**

Semester III & IV
Paper name: MODERN PHYSICS (Practicals)
Code: PHY3P05 & PHY4P06

Course Outcomes:

- **This laboratory course focuses on the advanced physics experiments chosen from Atomic and Molecular Physics, Experimental techniques, Nuclear Physics andCommunication Electronics.**
- **It provides an insight to students about experimental techniques, data analysis, error analysis while investigating physical phenomena.**
- **This course provides practical knowledge to students as they perform experiments and correlate it to theory.**

Semester IV
Paper name: COMPUTATIONAL PHYSICS PRACTICAL
Code: PHY4P07

Course Outcomes:

- **For modern day technology students need to learn programming and Python is a very useful one for Physics students.**
- **In this laboratory course students get the lessons in computer programming using Python.**

ELECTIVE COURSES

Semester III
Paper name: EXPERIMENTAL TECHNIQUES
Code: PHY3E05

Course Outcomes:

- **Have gained a clear understanding of different vacuum pumps and the production and maintenance of vacuum systems and its uses and needs in Physics**
- **Understands in depth about thin film preparation and production controlling techniques and the application of thin films in the field of science & Technology**
- **Have grasped the idea of Cryogenics technology and its applications**
- **Extend their understanding of various particle accelerators and its industrial uses.**
- **understand about different material analysis techniques and applications.**

Semester IV
Paper name: LASER SYSTEMS, OPTICAL FIBERS AND APPLICATIONS
Code: PHY4E14

Course Outcomes:

- **Understand the basic laser theory and the important laser systems.**
- **Analyse the fundamentals of non linear optics and its applications.**
- **Identify the applications of lasers in various disciplines.**
- **Learn the importance of materials in nanoscale region and the quantum effect of nanomaterials.**
- **Identify applications of lasers in various disciplines.**
- **Understand the basics of Optical Fibers and its applications.**

Semester IV
Paper name: MICROPROCESSORS AND APPLICATIONS
Code: PHY4E20

Course Outcomes:

- **Study the Organization and internal architecture of the Intel 8085,**
- **learn assembly language programming and arithmetic**
- **Aware of Memory interfacing, and different Data transfer schemes, CO4**
- **Learn interfacing with peripheral I/O devices**
- **Learn common applications of microprocessors like E Analog to Digital convert,7 segment LED displays,; Temperature measurement and control using a microprocessor etc**

Department of Physics

Course Plan for Post Graduation in Physics (2019 Admissions onwards)

PHY1C01:CLASSICAL MECHANICS

Semester: 1
Course Number: 1
Contact Hours: 4T
Number of Credits: 4
Number of Contact Hours: 72
Course Evaluation: Internal & External: 1:4

Objectives of the Course:
To demonstrate knowledge and understanding of the following fundamental concepts in:

- the dynamics of system of particles,
- motion of rigid body,
- Lagrangian and Hamiltonian formulation of mechanics

To represent the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulation of classical mechanics

Prerequisites: Background of the mechanics I at degree level.

Course Outline

1. Lagrangian and Hamiltonian Formulation:
Constraints and Generalized coordinates,D'Alembert's principle and Lagrange's equation, Velocity dependent potentials, Simple applications, Hamilton's Principle, Lagrange's equation from Hamilton's principle, Kepler problem,Scattering in a central force field, Transformation to lab coordinates, Legendre Transformation, Hamilton's canonical equations, Principle of least action, Canonical transformations, examples (17 hours)
Text : Goldstein, Sections 1.3 – 1.6, 2.1 – 2.3, 3.10, 3.11, 8.1, 8.5, 8.6, 9.1, 9.2

2. The classical background of quantum mechanics:
Equations of canonical transformations, Examples, Poisson brackets and other canonical invariants, Equation of motion in Poisson bracket form, Angular momentum Poisson brackets, Hamilton-Jacobi equation, Hamilton's principle and characteristic function, H-J equation for the linear harmonic oscillator, Separation of variables, Action-angle variables, H-J formulation of the Kepler problem, H-J equation and the Schrödinger equation. (19 hours)
Text : Goldstein, Sections 9.1, 9.2, 9.4 - 9.6, 10.1 – 10.5, 10.7, 10.8

3. The Kinematics and Dynamics of Rigid Bodies:
Space-fixed and body-fixed systems of coordinates, Description of rigid body motion in terms of direction cosines and Euler angles, Infinitesimal rotation, Rate of change of a vector, Centrifugal and Coriolis forces, Moment of inertia tensor, Euler's equation of motion, Force free motion of a rigid bodies. (14 hours)
Text : Goldstein, Sections 4.1, 4.4, 4.8 – 4.10

4. Small Oscillations:
Formulation of the problem, Eigenvalue equation, Eigenvectors and Eigenvalues, Orthogonality, Principal axis transformation, Frequencies of free vibrations, Normal coordinates, Free vibrations of a linear triatomic molecule.(9 hours)
Text : Goldstein, Sections 6.1 – 6.4

5. Nonlinear Equations and Chaos:
Introduction, Singular points of trajectories, Nonlinear oscillations, Limit cycles, Chaos : Logistic map,
Definitions, Fixed points, Period doubling, Universality. (13 hours)
Text : Bhatia, Sections10.1, 10.2, 10.3, 10.4, 10.5, 10.51

Textbooks :
1. Goldstein “Classical Mechanics” (Addison Wesley)
2. V.B.Bhatia : “Classical Mechanics” (Narosa Publications, 1997)
Reference books :
1. Michael Tabor : “Chaos and Integrability in Nonlinear Dynamics” (Wiley, 1989)
2. N.C.Rana and P.S.Joag : “Classical Mechanics” (Tata McGraw Hill)
3. R.G.Takwale and P.S.Puranik : “Introduction to Classical Mechanics” (Tata McGraw Hill)
4. Atam P. Arya : "Introduction to Classical Mechanics, (2nd Edition)" (Addison Wesley1998)
5. Laxmana : “Nonlinear Dynamics” (Springer Verlag, 2001)

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**

Unit I (17 hours)	Constraints and Generalized coordinates,D'Alembert's principle and Lagrange's equation, Velocity dependent potentials, Simple applications, Hamilton's Principle, Lagrange's equation from Hamilton's principle, Kepler problem, Scattering in a central force field, Transformation to lab coordinates, Legendre Transformation, Hamilton's canonical equations, Principle of least action, Canonical transformations, examples	● Lecture ●Problem-Solving	● To understand the idea of generalised coordinates. ● To establish the Lagrangian and to derive and solve the equations of motion for many systems subject to the principle of least action. ● To be familiar with Canonical and Legendre transformation	Evaluation of problems ● Q and A
Unit II (19hours)	Equations of canonical transformations, Examples, Poisson brackets and other canonical invariants, Equation of motion in Poisson bracket form, Angular momentum Poisson brackets, Hamilton-Jacobi equation, Hamilton's principal and characteristic function, H-J equation for the linear harmonic oscillator, Separation of variables, Action-angle variables, H-J formulation of the Kepler problem, H-J equation and the Schrödinger equation.	● Lecture ●Problem-Solving	● To understand the fundamentals of Hamilton's Jacobi theory. ● To acquire a deep knowledge of the Hamiltonian formalism that is crucial for the formulation and understanding of Quantum mechanics.	● problem solving ● Q and A

UnitIII (14 hours)	Space-fixed and body-fixed systems of coordinates, Description of rigid body motion in terms of direction cosines and Euler angles, Infinitesimal rotation, Rate of change of a vector, Centrifugal and Coriolis forces, Moment of inertia tensor, Euler's equation of motion, Force free motion of rigid bodies.	●Lecture ●Problem-Solving ● Seminar ● Powerpoint presentation	● To get an idea on underlying kinematics and kinetics of Rigid body. ● To acquire a knowledge of inertia Tensor and Euyler's Equation of motion.	● Q & A ● Evaluation problem solving skill
Unit IV (9 hours)	Formulation of the problem, Eigenvalue equation, Eigenvectors and Eigenvalues, Orthogonality, Principal axis transformation, Frequencies of free vibrations, Normal coordinates, Free vibrations of a linear triatomic molecule.	● Lecture ●Problem-Solving ● Seminar	● To establish eigenvalue and eigenvectors of small oscillations ● To describe and understand the vibrations of discrete and continuous mechanical systems.	● Q & A ● Evaluation problem solving skill
Unit V (13hours)	Introduction, Singular points of trajectories, Nonlinear oscillations, Limit cycles, Chaos : Logistic map, Definitions, Fixed points, Period doubling, Universality.	●Lecture ●Problem-Solving ● Seminar	● To predict the chaotic behaviour existing in natural systems. ● To visualise the logistic map and bifurcation.	● Q & A ● Evaluation problem solving skill

Faculty In-charge
Ms. Jesmy Shaju

PHY1C02:MATHEMATICAL PHYSICS-I

Semester: 1
Course Number: 2
Contact Hours: 4 T

Number of Credits: 4
Number of Contact Hours: 72
Course Evaluation: Internal & External: 1:4

Objectives of the Course:

- The laws of Physics are often expressed through the relatively complex mathematical apparatus. This course is intended to give mathematical tools necessary for better understanding of the later courses in physics such as classical mechanics, electrodynamics, quantum mechanics,solid state Physics and statistical physics.

Prerequisites: Background of the basic mathematics at +2 and degree level

Course Outline

1. Vectors :
Rotation of coordinates, Orthogonal curvilinear coordinates, Gradient, Divergence and Curl in orthogonal curvilinear coordinates, Rectangular, cylindrical and spherical polar coordinates, Laplacian operator, Laplace's equation –application to electrostatic field and wave equations, Vector integration, Enough exercises. (11 hours)
Text : Arfken & Weber , Sections 1.2, 1.6 - 1.9, 1.10, 2.1 – 2.5

2. Matrices and Tensors :
Basic properties of matrices (Review only), Orthogonal matrices, Hermitian and Unitary matrices, Similarity and unitary transformations, Diagonalization of matrices, Definition of Tensors, Contraction, Direct products,, quotient rule, Pseudo tensors, Dual tensors, Levi Cevita symbol, irreducible tensors, Enough exercises. (11 hours)
Text : Arfken & Weber , Sections 3.2 - 3.5, 2.6 – 2.9

3. Second Order Differential Equations:
Partial differential equations of Physics, Separation of variables, Singular points, Ordinary series solution,Frobenius method, A second solution, Self adjoint differential equation, eigen functions and values, Boundary conditions,Hermitian operators and their properties, Schmidt orthogonalization, Completeness of functions, Enough exercises. (14hours)
Text : Arfken & Weber , Sections 8.1, 8.3 – 8.6, 9.1 – 9.4

4. Special functions :
Gamma function, Beta function, Delta function, Dirac delta function, Bessel functions of the first and second kinds, Generating function, Recurrence relation, Orthogonality, Neumann function, Spherical Orthogonality, Associated Legendre polynomials, Spherical harmonics, Hermite polynomials, Laguerre polynomials.
Text : Arfken & Weber , Sections 10.1, 10.4, 1.15, 11.1 – 11.3, 11.7, 12.1 – 12.4, 12.6, 13.1, 13.2

5. Fourier Series :

General properties, Advantages, Uses of Fourier series, Properties of Fourier series, Fourier integral, Fourier transform, Properties, Inverse transform, Transform of the derivative, Convolution theorem, Laplace transform, Enough exercises. (12 hours)
Text : Arfken & Weber , Sections 14.1 – 14.4, 15.2 – 15.5, 15.8
Text book :
1. G.B.Arfken and H.J.Weber : “Mathematical Methods for Physicists (5th Edition, 2001)” (Academic Press)

Reference books :
1. J.Mathews and R.Walker : “Mathematical Methods for Physics” (Benjamin)
2. L.I.Pipes and L.R.Harvill : “Applied Mathematics for Engineers and Physicists (3rd Edition)" (McGraw Hill)
3. Erwin Kreyzig : "Advanced Engineering Mathematics - 8th edition" (Wiley)
4. M. Greenberg : "Advanced Engineering Mathematics – 2nd edition " (Pearson India 2002)
5. A.W. Joshi : Matrices and tensors
6. Mathematical methods in the physical sciences, 2nd edn, Mary L Boas, John Wiley & Sons
7. Elementary Differential Equations and boundary value problems, William E. Boyce, Richard C. DiPrima, John Wiley & Sons, Inc.
8. Mathematics of Classical and Quantum Physics, F. W. Byron and R. W. Fuller, Dover Publications, Inc., New York

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**
Unit I (11hours)	Rotation of coordinates, Orthogonal curvilinear coordinates, Gradient, Divergence and Curl in orthogonal curvilinear coordinates, Rectangular, cylindrical and spherical polar coordinates, Laplacian operator, Laplace's equation – application to electrostatic field and wave equations, Vector integration, Enough exercises.	● Lecture ●Problem-Solving	● To understand the concept of coordinate system and describe orthogonal curvilinear coordinates. generalised coordinates. ● To describe Laplace's equation and its application to electrostatic fields.	Evaluation of problems ● Q and A
Unit II (11hours)	Basic properties of matrices (Review only), Orthogonal matrices, Hermitian and Unitary matrices, Similarity and unitary transformations, Diagonalization of matrices, Definition of Tensors, Contraction, Direct products,, quotient rule, Pseudo tensors, Dual tensors, Levi Cevita symbol, irreducible tensors, Enough exercises.	● Lecture ●Problem-Solving	● To learn about special types of matrices that are relevant in physics. ● To acquire a deep knowledge about tensors.	● problem solving ● Q and A
Unit III (14 hours)	Partial differential equations of Physics, Separation of variables, Singular points, Ordinary series solution,	●Lecture ●Problem-Solving	● To learn different ways of solving second order differential equations and	● Q & A ● Evaluation problem solving skill

	Frobenius method, A second solution, Self adjoint differential equation, eigen functions and values, Boundary conditions, Hermitian operators and their properties, Schmidt orthogonalization, Completeness of functions, Enough exercises.		familiarise with singular points and frobenius method ● To acquire knowledge on schmidt orthogonalization.	
Unit IV (24 hours)	functions : Gamma function, Beta function, Delta function, Dirac delta function, Bessel functions of the first and second kinds, Generating function, Recurrence relation, Orthogonality, Neumann function, Spherical Bessel function, Legendre polynomials, Generating function, Recurrence relation, Rodrigues‟ formula, Orthogonality, Associated Legendre polynomials, Spherical harmonics, Hermite polynomials, Laguerre polynomials, Enough exercises.	● Lecture ●Problem-Solving	● To get introduced to special functions like gamma ,beta and delta functions,dirac delta function,Bessel Function and their recurrence relations.	● Q & A ● Evaluation problem solving skill
Unit V (13 hours)	General properties, Advantages, Uses of Fourier series, Properties of Fourier series, Fourier integral, Fourier transform, Properties, Inverse transform, Transform of the derivative,convolution theorem, Laplace transform, Enough exercises.	●Lecture ●Problem-Solving ● Seminar	● To use the fourier series and integral. ● To understand the transformations in fourier and laplace transforms..	● Q & A ● Evaluating through internal exams

Faculty In-charge

Ms. Sharol M A

PHY1C03:ELECTRODYNAMICS AND PLASMA PHYSICS

Semester: 1
Course Number: 3
Contact Hours: 4T
Number of Credits: 4

Number of Contact Hours: 72 Hrs.
Course Evaluation: Internal & External: 1:4

Objectives of the Course:
· This subject provides an introduction to electrodynamics and a wide range of applications including communications,plasmas.

Prerequisites: Background of the electrostatics and electrodynamics at degree level

Course Outline

1. Time varying fields and Maxwell's equations :
Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and their solutions, Time harmonic fields, Multipole expansion of electric scalar potential and magnetic vector potential, Enough exercises. (14 hours)
Text : Cheng, Sections 7.3 – 7.7, Griffiths, Sections 3.4, 5.4.2

2. Plane electromagnetic waves :
Plane waves in lossless media, Plane waves in lossy media, Group velocity, Flow of electromagnetic power and the Poynting vector, Normal incidence at a plane conducting boundary, Oblique incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary, Oblique incidence at a plane dielectric boundary, Enough exercises. (13 hours)
Text : Cheng , Sections 8.2 – 8.10

3. Transmission lines, Waveguides and cavity resonators:
Transverse electromagnetic waves along a parallel plane transmission line, General transmission line equations,Wave characteristics on finite transmission lines, General wave behaviour along uniform guiding structures, Rectangular waveguides, Cavity resonators (Qualitative ideas only), Enough exercises. (14 hours)
Text : Cheng, Sections 9.2 - 9.4 , 10.2, 10.4, 10-7.1

4. Relativistic electrodynamics:
Magnetism as a relativistic phenomenon, Transformation of the field, Electric field of a point charge moving uniformly, Electromagnetic field tensor, Electrodynamics in tensor notation, Potential formulation of relativistic electrodynamics, Enough exercises. (15 hours)
Text : Griffiths, Sections 10.3.1 – 10.3.5

5. Plasma Physics :
Plasma - Definition, concepts of plasma parameter, Debye shielding, Motion of charged particles in an
electromagnetic field - Uniform electric and magnetic fields, Boltzmann and Vlasov equations, their moments - Fluid equations, Plasma oscillations, Enough exercises. (16 hours)
Text : Chen, Sections 1.1 - 1.6, 2.2 - 2.2.2, 3.1 - 3.3.2, 4.3, 4.18, 4.19, 7.2-7.3

Text books :

1. David K. Cheng : “ Field and Wave Electromagnetics (Addisson Wesley)
2. David Griffiths : “ Introductory Electrodynamics” (Prentice Hall of India, 1989)
3. F. F. Chen, Introduction to Plasma Physics and Controlled Fusion, Volume I and II, Plenum Press, recent edition

Reference books :

1. K.L. Goswami, Introduction to Plasma Physics – Central Book House, Calcutta
2. J.D.Jackson : “Classical Electrodynamics” (3rd Ed.) (Wiley,1999)

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**
Unit I (14hours)	Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and their solutions, Time harmonic fields, Multipole expansion of electric scalar potential and magnetic vector potential, Enough exercises. cises.	● Lecture ●Problem-Solving	● To explain classical electrodynamics based on Maxwell's equations including its formulation in covariant form. ● To gain a clear understanding of electromagnetics boundary conditions.	Evaluation of problems ● Q and A
Unit II (13hours)	Plane waves in lossless media, Plane waves in lossy media, Group velocity, Flow of electromagnetic power and the Poynting vector, Normal incidence at a plane conducting boundary, Oblique incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary, Oblique incidence at a plane dielectric boundary, Enough exercises.	● Lecture ●Problem-Solving	● To know that the laws of reflection,refraction are outcomes of electromagnetic boundary conditions ● Able to design dielectric coatings which act like antireflection coating and able to distinguish good metal and dielectric.	● problem solving ● Q and A

Unit III (14hours)	Transverse electromagnetic waves along a parallel plane transmission line, General transmission line equations, Wave characteristics on finite transmission lines, General wave behaviour along uniform guiding structures, Rectangular wave guides, Cavity resonators (Qualitative ideas only), Enough exercises. .	●Lecture ●Problem-Solving	● To grasp the idea of electromagnetic wave propagation through waveguides and transmission lines..	● Q & A ● Evaluation problem solving skill
Unit IV (15hours)	Magnetism as a relativistic phenomenon, Transformation of the field, Electric field of a point charge moving uniformly, Electromagnetic field tensor, Electrodynamics in tensor notation, Potential formulation of relativistic electrodynamics, Enough exercises.	● Lecture ●Problem-Solving	● To extend their understanding of special theory of relativity by including relativistic electrodynamics	● Q & A ● Evaluation problem solving skill
Unit V (16hours)	Plasma - Definition, concepts of plasma parameter, Debye shielding, Motion of charged particles in an electromagnetic field - Uniform electric and magnetic fields, Boltzmann and Vlasov equations, their moments - Fluid equations, Plasma oscillations, Enough exercises.	●Lecture ●Problem-Solving ● Seminar	● To understand rather complex physical phenomena observed in plasma.	● Q & A ● Evaluating through internal exams

Faculty In-charge
Ms. Sharol M A

PHY1C04:ELECTRONICS

Semester:1
Course Number: 4
Contact Hours per Week: 4T
Number of Credits:4
Number of Contact Hours: 72 hrs
Course Evaluation: Internal & External: 1:4

Objectives of the Course: Integrates the understanding and creation of modern electronic designs and systems.

Prerequisites:
· Knowledge of analog and digital electronics in degree level.

Course Outline:

1 .Field effect transistors : V-I characteristics of JFETs and device operation, construction of depletion and enhancement MOSFETs, V-I characteristics and device operation. Biasing of FETs, FETs as VVR and its applications, small signal model of FETs, analysis of Common Source and Common Drain amplifiers at low and high frequencies, MOSFET as a switch,CMOS and digital MOSFET gates (NOT, NAND, NOR). (10 hours)
Text: Integrated Electronics Millman and Halkias: Tata McGraw Hill
Reference:
Electronic devices and Circuit theory, Robert L Boylstead& L. Nashelsky – Pearson education
Micro Electronic Circuits: Sedra/Smith: Oxford University Press

2. Microwave and Photonic devices:
Tunnel diode, construction and characteristics, negative differential resistance and device operation, radiative transitions and optical absorption, Light emitting diodes (LED) – visible and IR, semiconductor lasers,construction and operation, population inversion, carrier and optical confinement, optical cavity and feedback,threshold current density. Photodetectors – Photoconductor (Light dependent resistor- LDR) and photodiode,p-n junction solar cells - short circuit current, fill factor and efficiency (14 hours)
Text: Semiconductor Devices- Physics and Technology - S.M.Sze, John Wiley and Sons
Semiconductor Optoelectronic devices: Pallab Bhattacharya: Prentice Hall
Reference:
Principles of semiconductor devices: B. Van Zeghbroeck
Principles of semiconductor devices: S.M. Sze: John Wiley & Sons

3. Operational Amplifier: Differential amplifiers, analysis of Emitter coupled differential amplifiers, OPAMP parameters:Open loop gain,CMRR, error currents and error voltages, input and output impedances, slew rate and UGB. Frequency response, poles and zeros; transfer functions (derivation not required), expression for phase angle. Need for compensation,

dominant pole, pole zero and lead compensation (12 hours)
Text: Integrated Electronics: Millman and Halkias: Tata McGraw Hill
Reference:
OPAMPS and Linear Integrated Circuits: Ramakant A. Gaykwad

4. OPAMP Applications: Closed loop inverting, non-inverting and difference OPAMP configurations and their characteristics; OPAMP as inverter, scale changer, summer, V to I converter, practical integrator & differentiator, active low pass , high pass and band pass Butterworth filters, band pass filter with multiple feedback, OPAMP notch filter, OPAMP Wien bridge oscillator, OPAMP astable and monostable multivibrators, Schmidt triggers. (14 hours)
Text: Integrated Electronics:Millman and Halkias : Tata McGraw Hill
OPAMPS and Linear Integrated Circuits: Ramakant A. Gaekwad
Reference:
Linear Integrated circuits:D. Roychoudhuri : New Age International Publishers

5. Digital Electronics: Minimization of Boolean functions using Karnaugh map and representation using logic gates, JK and MSJK andD flip-flops, shift registers using D and JK flip flops and their operations, shift registers as counters, ring counter, design of synchronous and asynchronous counters, state diagram,cascade counters, basic idea of static and dynamic RAM,basics of charge coupled devices. R-2R ladder D/A converter, Introduction to 8 bit microprocessor; internal architecture of Intel 8085, register organisation. (22 hours)
Text:
Digital Principles and Applications: Malvino and Leach: Tata McGraw Hill
Digital Fundamentals: Thomas. L. Floyd: Pearson Education.
Fundamentals of Microprocessors and Microcomputers: B. Ram: DhanpatRai & Sons.
Reference:
Modern Digital Electronics: R.P. Jain: Tata McGraw Hill

Course Plan

Unit/hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity Learning outcome(output)	Assessment
Unit I (10hours)	V-I characteristics of JFETs and device operation, construction of depletion and enhancement MOSFETs, V-I characteristics and device operation. Biasing of FETs, FETs as VVR and its applications, small signal model of FETs, analysis of Common Source and Common Drain amplifiers at low and high frequencies, MOSFET as a switch, CMOS and digital MOSFET gates (NOT, NAND, NOR). .	● Lecture ●Problem-Solving	● To get an idea on field effect transistors,their principles and applications. ● To know about CMOS and digital MOSFET gates.	Evaluation of problems ● Q and A
Unit II (14hours)	Tunnel diode, construction and characteristics, negative differential resistance and device operation, radiative transitions and optical absorption, Light emitting diodes (LED) – visible and IR, semiconductor lasers, construction and operation, population inversion, carrier and optical confinement, optical cavity and feedback, threshold current density. Photodetectors – Photoconductor (Light dependent resistor- LDR) and photodiode, p-n junction solar cells - short circuit current, fill factor and efficiency	● Lecture ●Problem-Solving ● Seminar	● To understand the concept of photonic devices like LED,laser diode,Photodetector,solar cell and their working in detail..	● problem solving ● Q and A

UnitIII (12hours)	Differential amplifiers, analysis of Emitter coupled differential amplifiers, OPAMP parameters: Open loop gain,CMRR, error currents and error voltages, input and output impedances, slew rate and UGB. Frequency response, poles and zeros; transfer functions (derivation not required), expression for phase angle. Need for compensation, dominant pole, pole zero and lead compensation	●Lecture ●Problem-Solving	• To grasp the idea of Operational amplifiers,opamp parameters. • To know about AC and DC characteristics of OPAMP and need for frequency compensation.	• Q & A • Evaluation problem solving skill
Unit IV (14hours)	Closed loop inverting, non-inverting and difference OPAMP configurations and their characteristics; OPAMP as inverter, scale changer, summer, V to I converter, practical integrator & differentiator, active low pass , high pass and band pass Butterworth filters, band pass filter with multiple feedback, OPAMP notch filter, OPAMP Wien bridge oscillator, OPAMP astable and monostable multivibrators, Schmidt triggers.	● Lecture ●Problem-Solving	• To extend their understanding of OPAMP applications as inverter,integrator,Differentiator, monostable and astable multivibrator etc.	• Q & A • Evaluation problem solving skill
Unit V (22hours)	Minimization of Boolean functions using Karnaugh map and representation using logic gates, JK and MSJK andD flip-flops, shift registers using D and JK flip flops and their operations, shift registers as counters, ring counter,	●Lecture ●Problem-Solving ● Seminar	• Digital electronics discussing logic gates and representation using K Maps. • To acquire knowledge about Flip	• Q & A • Evaluating through internal exams

	design of synchronous and asynchronous counters, state diagram,cascade counters, basic idea of static and dynamic RAM, basics of charge coupled devices. R-2R ladder D/A converter, Introduction to 8 bit microprocessor; internal architecture of Intel 8085, register organisation.		Flops,shift registers and counters. ● To have an understanding on intel 8085 microprocessor and its architecture.	

Faculty In-charge
Ms.Shyama I

PHY2C05:QUANTUM MECHANICS-I

Semester:2
Course Number: 1
Contact Hours per Week: 4T
Number of Credits:4
Number of Contact Hours: 72 hrs
Course Evaluation: Internal & External: 1:4

Objectives of the Course:

Prerequisites: · Background of quantum mechanics in degree level.

Course Outline:

1.Formulation of Quantum Mechanics (20 hours)
Sequential Stern-Gerlach experiments – Analogy with the polarization of light – Need for representing a quantum mechanical state as a vector in complex vector space. Dirac notation – Ket space, Bra space and Inner products – Operators– Hermitian adjoint – Hermitian operator – Multiplication – Associative axiom – Outer product. Eigenkets and eigenvalues of Hermitian operator – Eigenkets as base kets – Completeness relation – Projection operator – Matrix representation of operators, kets and bras. Measurement in a quantum mechanical system – Expectation value –Illustration with spin-½ systems – Compatible observables and simultaneous eigenkets – Maximal set of commuting observables – Incompatible observables and general uncertainty relation. Unitary operator – Change of basis and transformation matrix – Similarity transformation – Diagonalization – Unitary equivalent observables. Position eigenkets and position measurements –Infinitesimal translation operator and its properties – Linear momentum as a generator of translation – Canonical commutation relations. Position-space wave function – wave function as an expansion coefficient – Momentum operator in the position basis – Momentum-space wavefunction – Transformation function or the momentum eigenfunction in position basis –Relations between wavefunctions in position-space and momentum-space. Gaussian wave packet – Computation of dispersions of position operator and momentum operator – Minimum uncertainty product. Generalization to three
dimensions.
Text: Chapter 1, Modern Quantum Mechanics (Edn.2) by J. J. Sakurai

2.Quantum Dynamics (20 hours)
Time-evolution operator – Schrodinger equation for the time-evolution operator and its solutions according to the time-dependence of the Hamiltonian operator –Energy eigenkets – Time dependence of expectation values – Time evolution of a spin-1/2 system and Spin precession – Correlation amplitude and energy-time uncertainty relation. Schrodinger picture and Heisenberg picture – Behaviour of state kets and observables in Schrodinger picture and Heisenberg picture – Heisenberg equation of motion – Ehrenfest's theorem. Time-evolution of base kets and transition

amplitudes. Simple harmonic oscillator – energy eigenkets and energy eigenvalues – Dirac's method – Time development of the oscillator. Schrodinger's wave equation – Time-dependent wave equation – Time-independent wave equation – Continuity Equation – Interpretations
of the wavefunction – Classical limit of wave mechanics. Boundary conditions – Elementary solutions to Schrodinger's wave equation – Free particle in one dimension and three dimensions – Simple harmonic oscillator – Particle in a one-dimensional box – Particle in a finite potential well – One-dimensional potential step – Square potential barrier.
Text ::(1) Chapter 2 – upto section 2.5, Modern Quantum Mechanics (Edn.2) by J. J. Sakurai
(2) Chapter 4 – section 4.3, Quantum Mechanics (Edn.4) by V. K. Thankappan

3.Theory of Angular Momentum (15 hours)
Non-commutative nature of rotations around different axes – Rotation operator – Infinitesimal rotations in quantum mechanics – Fundamental commutation relations for angular momentum operators. Rotation operators for spin-1/2 systems– Spin precession in a magnetic field – Pauli's two component formalism – Representation of the rotation operator as 2 x 2matrix. Ladder operators and their commutation relations – Eigenvalue problem for angular momentum operators J2 and Jz–Matrix elements of angular momentum operators and rotation operator. Orbital angular momentum – Orbital angular momentum as generator of rotation – Spherical harmonics – Spherical harmonics as rotation matrices. Addition of orbital angular momentum and spin angular momentum – Addition of angular momenta of two spin-1/2 particles – Formal theory of Angular Momentum addition – Computation of Clebsch-Gordan coefficients – Clebsch-Gordan coefficients and the rotation matrices.
Text : Chapter 3 – sections 3.1, 3.2, 3.5, 3.6 and 3.8, Modern Quantum Mechanics (Edn.2) by J. J. Sakurai

4.Central Potentials (8 hours)
Schrodinger's equation for central potentials – The radial equation – Particle in an infinite spherical well – Isotropic harmonic oscillator – The Coulomb potential and the hydrogen atom problem.
Text : Chapter 3 – section 3.7, Modern Quantum Mechanics (Edn.2) by J. J. Sakurai.

5.Invariance Principles and Conservation Laws (9 hours)
Symmetry and conservation laws –Space-time symmetries – Displacement in space and conservation of linear momentum –Displacement in time and conservation of energy – Rotation in space and conservation of angular momentum – Space inversion and conservation of parity – Time reversal symmetry. The indistinguishability principle – Symmetric and antisymmetric wave functions – Eigenvalues and eigenvectors of particle-exchange operator – Spin and statistics – Pauli's exclusion principle and antisymmetric wave function – The ground state of the Helium atom.
Text: Chapter 6 and 9 – relevant sections, Quantum Mechanics (Edn.4) by V. K. Thankappan
Textbooks :
1. Modern Quantum Mechanics (Edn.2) : J. J. Sakurai, Pearson Education.
2.Quantum Mechanics (Edn.4) : V. K. Thankappan, New Age International
References:
1. Principles of Quantum Mechanics (Edn.2) : R. Shankar, Springer.
2. Introductory Quantum Mechanics: Richard L. Liboff, Pearson Education .

3. Introduction to Quantum Mechanics (Edn.2) : D.J. Griffiths, Pearson Education.
4. A Modern Approach to Quantum Mechanics: J S Townsend, Viva Books.
5. Quantum Mechanics : Non-Relativistic Theory (Course of Theoretical Physics Vol3): L. D. Landau and E. M.
Lifshitz, Pergamon Press.
6. The Feynman Lectures on Physics Vol. 3, Narosa .
7. Quantum Mechanics : Concepts and Applications (Edn.2) : Nouredine Zettili, Wiley.
8. Quantum Mechanics Demystified: David McMohan, McGrawHill 2006.
9. Quantum Mechanics (Schaum's Outline) :Yoav Pelegetal. Tata McGraw Hill Private Limited, 2/e.
10. Quantum Mechanics: 500 Problems with Solutions: G Aruldhas, Prentice Hall of India.

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**
Unit I (20hours)	Sequential Stern-Gerlach experiments – Analogy with the polarization of light – Need for representing a quantum mechanical state as a vector in complex vector space. Dirac notation – Ket space, Bra space and Inner products – Operators– Hermitian adjoint – Hermitian operator – Multiplication – Associative axiom – Outer product. Eigenkets and eigenvalues of Hermitian operator – Eigenkets as base kets – Completeness relation – Projection operator – Matrix representation of operators, kets and bras. Measurement in a quantum mechanical system – Expectation value –Illustration with spin-½ systems – Compatible	● Lecture ●Problem-Solving	● To understand linear vector space,Hilbert's space,concept of basis and operators and bra and ket notation. ● To describe Momentum and position representation.	Evaluation of problems ● Q and A

	observables and simultaneous eigenkets – Maximal set of commuting observables – Incompatible observables and general uncertainty relation. Unitary operator – Change of basis and transformation matrix – Similarity Transformation – Diagonalization – Unitary equivalent observables. Position eigenkets and position measurements –Infinitesimal translation operator and its properties – Linear momentum as a generator of translation – Canonical commutation relations. Position-space wave function – wave function as an expansion coefficient – Momentum operator in the position basis – Momentum-space wavefunction – Transformation function or the momentum eigenfunction in position basis –Relations between wavefunctions in position-space and momentum-space. Gaussian wave packet – Computation of dispersions of position operator and momentum operator – Minimum uncertainty product. Generalization to three dimensions. .			

Unit II (20hours)	Time-evolution operator – Schrodinger equation for the time-evolution operator and its solutions according to the time-dependence of the Hamiltonian operator –Energy eigenkets – Time dependence of expectation values – Time evolution of a spin-1/2 system and Spin precession – Correlation amplitude and energy-time uncertainty relation. Schrodinger picture and Heisenberg picture – Behaviour of state kets and observables in Schrodinger picture and Heisenberg picture – Heisenberg equation of motion – Ehrenfest's theorem. Time-evolution of base kets and transition amplitudes. Simple harmonic oscillator – energy eigenkets and energy eigenvalues – Dirac's method – Time development of the oscillator. Schrodinger's wave equation – Time-dependent wave equation – Time-independent wave equation – Continuity Equation – Interpretations of the wavefunction – Classical limit of wave mechanics. Boundary conditions – Elementary solutions to Schrodinger's wave equation – Free particle in one dimension and three dimensions – Simple harmonic oscillator – Particle in a one-dimensional box – Particle in a finite potential well – One-dimensional potential step – Square potential barrier.	● Lecture ●Problem-Solving ● Seminar	● To understand the concept of both schrodinger and Heisenberg formulations of time development and their applications.	● problem solving ● Q and A

Unit III(15hours)	Non-commutative nature of rotations around different axes – Rotation operator – Infinitesimal rotations in quantum mechanics – Fundamental commutation relations for angular momentum operators. Rotation operators for spin-1/2 systems– Spin precession in a magnetic field – Pauli's two component formalism – Representation of the rotation operator as 2 x 2matrix. Ladder operators and their commutation relations – Eigenvalue problem for angular momentum operators J2 and Jz–Matrix elements of angular momentum operators and rotation operator. Orbital angular momentum – Orbital angular momentum as generator of rotation – Spherical harmonics – Spherical harmonics as rotation matrices. Addition of orbital angular momentum and spin angular momentum – Addition of angular momenta of two spin-1/2 particles – Formal theory of Angular Momentum addition – Computation of Clebsch-Gordan coefficients – Clebsch-Gordan coefficients and the rotation matrices	●Lecture ●Problem-Solving	• To grasp the idea theory of angular momentum ans spin matrices. • To know about orbital angular momentum and Clebsch -Gordan coefficients.	• Q & A • Evaluation problem solving skill

Unit IV (8hours)	Schrodinger's equation for central potentials – The radial equation – Particle in an infinite spherical well – Isotropic harmonic oscillator – The Coulomb potential and the hydrogen atom problem.	● Lecture ●Problem-Solving	● To extend their understanding of central potentials with applications..	● Q & A ● Evaluation problem solving skill
Unit V (9hours)	Symmetry and conservation laws –Space-time symmetries – Displacement in space and conservation of linear momentum –Displacement in time and conservation of energy – Rotation in space and conservation of angular momentum – Space inversion and conservation of parity – Time reversal symmetry. The indistinguishability principle – Symmetric and antisymmetric wavefunctions – Eigenvalues and eigenvectors of particle-exchange operator – Spin and statistics – Pauli's exclusion principle and antisymmetric wave function – The ground state of the Helium atom.	●Lecture ●Problem-Solving	● To acquire knowledge on symmetry and conservation laws. ● To acquire knowledge about identical particles,symmetric and antisymmetric wave functions.	● Q & A ● Evaluating through internal exams

Faculty In-charge
Ms. Jesmy Shaju

PHY2C06:MATHEMATICAL PHYSICS -II

Semester:2
Course Number: 2
Contact Hours per Week: 4T
Number of Credits:4
Number of Contact Hours: 72 hrs
Course Evaluation: Internal & External: 1:4

Objectives of the Course: This course is intended to give mathematical tools necessary for better understanding of the later courses in physics such as classical mechanics, electrodynamics, quantum mechanics,solid state Physics and statistical physics.

Prerequisites: Background of the basic mathematics at +2 and degree level

Course Outline:

1. Functions of Complex Variables:
Introduction, Analyticity, Cauchy-Reimann conditions, Cauchy's integral theorem and integral formula, Laurent expansion, Singularities, Calculus of residues and applications (15 hours)-
Text:Sections 6.1 to 6.5, 7.1, 7.2

2. Group Theory:
Groups, multiplication table, conjugate elements and classes, subgroups, direct product groups, isomorphism and homomorphism, permutation groups, distinct groups of given order, reducible and irreducible representations
Text :Sections 1-1.8, Joshi.
Generators of continuous groups, rotation groups SO(2) and SO(3), rotation of functions and angular momentum, SU(2)-SO(3) homomorphism, SU(2) isospin and SU(3) eightfold way (20 hours)
Text : Sections 4.2, Arfken 5th edition.

3. Calculus of Variations:
One dependent and one independent variable, Applications of the Euler equation, Generalization to several independent variables, Several dependent and independent variables, Lagrange Multipliers, Variation subject to constraints, Rayleigh-Ritz variational technique. (14 hours)
Sections 17.1 to 17.8

4. Integral equations:
Integral equations- introduction, Integral transforms and generating functions, Neumann series, separable kernel (12 hours)-
Sections 16.1 to 16.3

5. Green's function:

Green's function, eigenfunction expansion, 1-dimensional Green's function, Green's function integral-differential equation, eigenfunction, eigenvalue equation Green's function and Dirac delta function, Enough exercises.(11 hours)
Section 9.51

Text books :

1. G.B.Arfken and H.J.Weber : “Mathematical Methods for Physicists (5th Edition, 2001)” (Academic Press)
2. A.W.Joshi, Elements of Group theory for Physicists()(New Age International (P).Ltd)

Reference books :

1. J.Mathews and R.Walker : “Mathematical Methods for Physics” (Benjamin)
2. L.I.Pipes and L.R.Harvill : “Applied Mathematics for Engineers and Physicists (3rd Edition)" (McGraw Hill)
3. Erwin Kreyzig : "Advanced Engineering Mathematics - 8th edition" (Wiley)
4. M. Greenberg : "Advanced Engineering Mathematics – 2nd edition " (Pearson India 2002)
5. Mathematical methods in the physical sciences, 2nd edn, Mary L Boas, John Wiley & Sons
6. Elementary Differential Equations and boundary value problems, William E. Boyce, Richard C. DiPrima, John Wiley & Sons, Inc.
7. Mathematics of Classical and Quantum Physics, F. W. Byron and R. W. Fuller, Dover Publications, Inc., New York

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**
Unit I (15hours)	Introduction, Analyticity, Cauchy-Reimann conditions, Cauchy's integral theorem and integral formula, Laurent expansion, Singularities, Calculus of residues and applications .	● Lecture ●Problem-Solving	● To know the method of contour integration to evaluate definite integrals of varying complexity.	Evaluation of problems ● Q and A
Unit II (20hours)	Groups, multiplication table, conjugate elements and classes, subgroups, direct product groups, isomorphism and homomorphism, permutation groups, distinct groups of given order, reducible and irreducible representations Generators of continuous groups, rotation groups SO(2) and SO(3), rotation of functions and angular momentum, SU(2)-SO(3) homomorphism, SU(2) isospin and SU(3) eightfold way	● Lecture ●Problem-Solving	● To gain the ability to apply group theory to physics problems. ● To know about different groups which are a prerequisite for deeper understanding of crystallography,particle physics,quantum mechanics and energy bands in solids.	● problem solving ● Q and A

Unit III(14 hours)	One dependent and one independent variable, Applications of the Euler equation, Generalization to several independent variables, Several dependent and independent variables, Lagrange Multipliers, Variation subject to constraints, Rayleigh-Ritz variational technique.	●Lecture ●Problem-Solving ●Seminar	• To be able to apply calculus of variation to diverse problems in physics. • The use of Lagrange Multipliers in solving physics problems.	• Q & A • Evaluation problem solving skill
Unit IV (12 hours)	Integral equations-introduction, Integral transforms and generating functions, Neumann series, separable kernel.	● Lecture ●Problem-Solving	• To find solutions to integral equations using different methods.	• Q & A • Evaluation problem solving skill
Unit V (11hours)	Green's function, eigenfunction expansion, 1-dimensional Green's function, Green's function integral-differential equation, eigenfunction, eigenvalue equation Green's function and Dirac delta function, Enough exercises.	●Lecture ●Problem-Solving ● Seminar	• To become familiar with methods of Green's Function to solve linear differential equations with inhomogeneous terms..	• Q & A • Evaluating through internal exams

Faculty in charge
Ms. Sharol M A

PHY2C07:STATISTICAL MECHANICS

Semester:2
Course Number: 3
Contact Hours per Week: 4T
Number of Credits:4
Number of Contact Hours: 72 hrs
Course Evaluation: Internal & External: 1:4

Objectives of the Course: To under**s**tand the properties of macroscopic systems using the knowledge of properties of microscopic particles.

Prerequisites: Background of thermodynamics at +2 and degree level

Course Outline:

1. The Statistical Basis of Thermodynamics:
The macroscopic and the microscopic states – Contact between statistics and Thermodynamics: Expressing T, P and μ in terms of Ω – The classical Ideal gas - The entropy of mixing and the Gibbs paradox - Phase space of a classical system - Liouville‟s theorem and its consequences. (13 Hours)
Text : Pathria, Sections 1.1 – 1.6, 2.1 – 2.2

2. Microcanonical, Canonical and Grand Canonical Ensembles:
The microcanonical ensemble – Examples : (1) Classical Ideal gas, (2) Linear harmonic oscillator - Quantum states and the phase space – Equilibrium between a system and a heat reservoir- Physical significance of the various statistical quantities in the canonical ensemble- Alternative expressions for the partition function- Examples: (1) The classical systems: Ideal gas, (2) A system of harmonic oscillators, (3) The statistics of paramagnetism - Energy fluctuations in the canonical ensemble -Equipartition theorem - Virial theorem - Equilibrium between a system and a particle-energy reservoir- Physical significance of the various statistical quantities in the grand canonical ensemble-Example : Classical Ideal gas - Density and energy fluctuations in the grand canonical ensemble. (21 Hours)
Text : Pathria, Sections 2.3 -2.5, 3.1, 3.3 - 3.9, 4.1, 4.3 – 4.5

3. Formulation of Quantum Statistics:
Quantum-mechanical ensemble theory: The density matrix- Statistics of the various ensembles-Example: An electron in a magnetic field - Systems composed of indistinguishable particles- An ideal gas in a quantum-mechanical microcanonical ensemble- An ideal gas in other quantum-mechanical ensembles-Statistics of the occupation numbers (15 Hours)
Text : Pathria, Sections 5.1 - 5.4, 6.1 – 6.3

4. Ideal Bose Systems:
Thermodynamic behaviour of an ideal Bose gas- Thermodynamics of the blackbody radiation- The field of sound waves. (10 Hours)

Text : Pathria, Sections : 7.1 - 7.3

5. Ideal Fermi Systems:
Thermodynamic behaviour of an ideal Fermi gas- Magnetic behaviour of an ideal Fermi Gas : (1) Pauli paramagnetism, (2) Landau diamagnetism – The electron gas in metals (Discussion of heat capacity only), Enoughexercises. (13 Hours)
Text : Pathria, Sections : 8.1 – 8.3

Textbook:
1. Statistical Mechanics (2nd Edition), R. K. Pathria , Butterworth-Heinemann /Elsevier (1996)
Reference books:
1. Statistical Mechanics : An Elementary Outline, Avijit Lahiri, Universities Press (2008)
2. An Introductory Course of Statistical Mechanics, Palash. B. Pal, Narosa (2008)
3. Statistical Mechanics : An Introduction, Evelyn Guha, Narosa (2008)
4. Statistical and Thermal Physics : An Introduction, S. Lokanathan and R.S.Gambhir, Prentice Hall of India (2000).
5. Introductory Statistical Mechanics (2nd Edition), Roger Bowley and Mariana Sanchez, Oxford University Press (2007)
6. Concepts in Thermal Physics, Stephen. J. Blundell and Katherine. M. Blundell, Oxford University Press (2008)
7. An Introduction to Thermal Physics, Daniel. V. Schroeder, Pearson (2006)
8. Statistical Mechanics, Donald. A. McQuarrie, Viva Books (2005)
9. Problems and Solutions on Thermodynamics and Statistical Mechanics, Ed. by Yung – Kuo Lim, Sarat Book House (2001)

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**
Unit I (13hours)	The macroscopic and the microscopic states – Contact between statistics and Thermodynamics: Expressing T, P and μ in terms of Ω – The classical Ideal gas - The entropy of mixing and the Gibbs paradox - Phase space of a classical system - Liouville‟s theorem and its consequences. .	● Lecture ●Problem-Solving	● To explain statistical physics and thermodynamics as logical consequences of postulates of statistical mechanics. ● Applications of classical statistical mechanics.	Evaluation of problems ● Q and A
Unit II (21hours)	The microcanonical ensemble – Examples : (1) Classical Ideal gas, (2) Linear harmonic oscillator - Quantum states and the phase space – Equilibrium between a system and a heat reservoir- Physical significance of the various statistical quantities in the canonical ensemble- Alternative expressions for the partition function- Examples: (1) The classical systems: Ideal gas, (2) A system of harmonic oscillators, (3) The statistics of paramagnetism - Energy fluctuations in the canonical ensemble -Equipartition theorem - Virial theorem - Equilibrium between a system and a particle-energy reservoir- Physical significance of the	● Lecture ●Problem-Solving	● To gain ideas about ensembles. ● To know about the physical significance of statistical quantities in various ensembles.	● problem solving ● Q and A

	various statistical quantities in the grand canonical ensemble- Example : Classical Ideal gas - Density and energy fluctuations in the grand canonical ensemble.			

Unit III(15hours)	Quantum-mechanical ensemble theory: The density matrix- Statistics of the various ensembles-Example: An electron in a magnetic field - Systems composed of indistinguishable particles- An ideal gas in a quantum-mechanical microcanonical ensemble- An ideal gas in other quantum-mechanical ensembles-Statistics of the occupation numbers	●Lecture ●Problem-Solving ●Seminar	• To learn the fundamental difference between classical and quantum statistics and to learn about quantum statistical distribution law. • .Applications of Quantum statistical mechanics	• Q & A • Evaluation on problem solving skill
Unit IV (10 hours)	Thermodynamic behaviour of an ideal Bose gas- Thermodynamics of the blackbody radiation- The field of sound waves.	● Lecture ●Problem-Solving	• To study the important examples of the ideal bose system.	• Q & A • Evaluation on problem solving skill

Unit V (13hours)	Thermodynamic behaviour of an ideal Fermi gas- Magnetic behaviour of an ideal Fermi Gas : (1) Pauli paramagnetism, (2) Landau diamagnetism – The electron gas in metals (Discussion of heat capacity only), Enough exercises.	●Lecture ●Problem-Solving	• To study the important examples of ideal fermi system	• Q & A • Evaluating through internal exams

Faculty in charge
Ms Shyama I

PHY2C08:COMPUTATIONAL PHYSICS

Semester:2
Course Number: 4
Contact Hours per Week: 4T
Number of Credits:4
Number of Contact Hours: 72 hrs
Course Evaluation: Internal & External: 1:4

Objectives of the Course: To study scientific problems using computational methods which combine computer science,physics and applied Mathematics to develop scientific solutions to complex problems.
Prerequisites: Background of the python programming language at degree level.

Course Outline:
1. Introduction to Python Programming: Concept of high level language, steps involved in the development of a Program- Compilers and Interpreters - Introduction to Python language: Inputs and Outputs, Variables, operators, expressions and statements - ,Strings, Lists, Tuples, and Dictionaries, Conditionals, Iteration and looping, Functions and Modules -.Mathematical functions (math module), File input and Output, Pickling. Formatted Printing. (13 hours)

2. Tools for maths and visualisation in Python (The numpy and pylab modules)*
Numpy module:- Arrays and Matrices – creation of arrays and matrices (arange, linspace, zeros, ones, random, reshape,copying), Arithmetic Operations, cross product, dot product , Saving and Restoring, Matrix inversion, solution of simultaneous equations, Data visualization- The Matplotlib, Module- Plotting graphs, Multiple plots, .Polar plots, Pie Charts, Plotting mathematical functions, Sine and other functions, Special functions – Bessel & Gamma, Fourier Series.(13 hours)

3. Numerical Methods 1*: Interpolation: linear and polynomial interpolation, equidistant points - Newton's forward/backward difference, spline interpolation. Curve fitting- Least square fit- linear and exponential. Derivatives: Lagrange polynomials, Newton difference polynomials, finite difference approximations. Numerical integration: simple quadratures (trapezoid, Simpson). Solution of nonlinear equations: closed domain methods (bisection and regula falsi.Monte Carlo Method – Simple Integration. (15 hours)

4. Numerical Methods-2* : Ordinary differential equations: Initial value problems: the first-order Euler method, the second-order single point methods (predictor), Runge-Kutta methods. Boundary value problems: the shooting method, the equilibrium method, the Numerov's method, the eigenvalue problems - the equilibrium method . Fourier transforms: discrete Fourier transforms, fast Fourier transforms. (15 hours)

5. Computational methods in Physics and Computer simulations 12 hrs (24 marks)*:
Classical Mechanics: One Dimensional Motion: Falling Objects: Introduction – Formulation: from Analytical methods to Numerical Methods - Euler Method, Freely falling body, Fall of a body in viscous medium, Two dimensional motion:Projectile motion (by Euler method) and Planetary motion (R-K Method), Accuracy considerations, -, Oscillatory motion –Ideal Simple Harmonic Oscillator (Euler method), Motion of a damped oscillator (Feynmann-Newton method)., Logistic maps. Monte-Carlo simulations: value of π, simulation of radioactivity. Quantum Mechanics: 1D Schrodinger equation –wave function and eigen values. (16 hours)
(Visualisation can be done with matplotlib/pylab)
*(Programs are to be discussed in Python)
Textbooks for Numerical Methods:
1. Introductory methods of numerical analysis, S.S. Sastry , (Prentice Hall of India,1983)
2. Numerical Methods in Engineering and Science, Dr. B S Grewal, Khanna Publishers, New Delhi (or any other book)
3. Numerical Mathematical Analysis, J.B. Scarborough

References:
(For Python any book can be used as reference. Moreover a number of open articles are available freely in internet. Python is included in default in all GNU/Linux platforms and It is freely downloadable for Windows platform as well. However use of GNU/Linux may be encouraged).
1. www.python.org
2. Python Essential Reference, David M. Beazley, Pearson Education
3. Core Python Programming, Wesley J Chun, Pearson Education
4. Python Tutorial Release 2.6.1 by Guido van Rossum, Fred L. Drake, Jr., editor. This Tutorial can be obtained from website http://www.altaway.com/resources/python/tutorial.pdf
5. How to Think Like a Computer Scientist: Learning with Python, Allen Downey , Jeffrey Elkner , Chris Meyers, http://www.greenteapress.com/thinkpython/thinkpython.pdf
6. Numerical Recipes in C, second Edition(1992), Cambridge University Press
7. Numerical Recipes in Fortran 77, second Edition(1992), Cambridge University Press

8. Numpy reference guide, http://docs.scipy.org/doc/numpy/numpy-ref.pdf (and other free resources available on net)
9. Matplotlib , http://matplotlib.sf.net/Matplotlib.pdf (and other free resources available on net)
10. Numerical Methods, E Balagurusamy, Tata McGraw-Hill
11. Numerical Methods , T Veerarajan, T Ramachandran, Tata MCGraw-Hill
12. Numerical Methods with Programs I BASIC, Fortran & Pascal, S Balachandra Rao, C K Shantha. Universities Press
13. Numerical methods for scientists and engineers, K. Sankara Rao, PHI
14. Computational Physics, V.K.Mittal, R.C.Verma & S.C.Gupta-Published by Ane Books,4821,Pawana Bhawan,first floor,24 Ansari Road,Darya Ganj,New Delhi-110 002 (For theory part and algorithms. Programs must be discussed in Python)
15. Numerical Methods in Engineering with Python by Jaan Kiusalaas

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**
Unit I (13hours)	Concept of high level language, steps involved in the development of a Program - Compilers and Interpreters - Introduction to Python language: Inputs and Outputs, Variables, operators, expressions and statements - ,Strings, Lists, Tuples, and Dictionaries, Conditionals, Iteration and looping, Functions and Modules -. Mathematical functions (math module), File input and Output, Pickling. Formatted Printing. .	● Lecture ●Problem-Solving	Have a strong base in the python programming language regarding different data types such as list,dictionaries etc.. ● Understand python libraries and modules.	Evaluation of problems ● Q and A
Unit II (13hours)	Numpy module:- Arrays and Matrices – creation of arrays and matrices (arange, linspace, zeros, ones, random, reshape, copying), Arithmetic Operations, cross product, dot product , Saving and Restoring, Matrix inversion, solution of simultaneous equations, Data visualization- The Matplotlib, Module- Plotting graphs, Multiple plots, .Polar plots, Pie Charts, Plotting mathematical functions, Sine and other functions, Special functions–Bessel & Gamma, Fourier Series.	● Lecture ●Problem-Solving	● To get an idea about different modules such as numpy,matplotlib etc. ● Understand arrays and matrices and enable data visualisation.	● problem solving ● Q and A

Unit III (15hours)	Interpolation: linear and polynomial interpolation, equidistant points - Newton's forward/backward difference, spline interpolation. Curve fitting- Least square fit- linear and exponential. Derivatives: Lagrange polynomials, Newton difference polynomials, finite difference approximations. Numerical integration: simple quadratures (trapezoid, Simpson). Solution of non-linear equations: closed domain methods (bisection and regula falsi. Monte Carlo Method – Simple Integration.	●Lecture ●Problem-Solving ●Seminar	• To get a wide knowledge of numerical methods in computational physics that can be used to solve many problems which does not have an analytic solution.	• Q & A • Evaluation problem solving skill
Unit IV (15hours)	Ordinary differential equations: Initial value problems: the first-order Euler method, the second-order single point methods (predictor), Runge-Kutta methods. Boundary value problems: the shooting method, the equilibrium method, the Numerov's method, the eigenvalue problems - the equilibrium method . Fourier transforms: discrete Fourier transforms, fast Fourier transforms.	● Lecture ●Problem-Solving	• To find solutions to ordinary differential equations using Euler,R K methods etc in python language.	• Q & A • Evaluation problem solving skill

Unit V (16hours)	Classical Mechanics: One Dimensional Motion: Falling Objects: Introduction – Formulation: from Analytical methods to Numerical Methods - Euler Method, Freely falling body, Fall of a body in viscous medium, Two dimensional motion: Projectile motion (by Euler method) and Planetary motion (R-K Method), Accuracy considerations, -, Oscillatory motion – Ideal Simple Harmonic Oscillator (Euler method), Motion of a damped oscillator (Feynmann-Newton method)., Logistic maps. Monte-Carlo simulations: value of π, simulation of radioactivity. Quantum Mechanics: 1D Schrodinger equation – wave function and eigen values.	●Lecture ●Problem-Solving ● Seminar	● To solve physics problems using python language.	● Q & A ● Evaluating through internal exams

Faculty in charge
Ms Shyama I

Practical for Semester I & II
a) PHY1L01 & PHY2L03 (GENERAL PHYSICS)

Contact Hours per Week: 8L
Number of Credits:3
Course Evaluation: Internal & External: 1:4

Objectives of the Course:

- Learn various experimental and computational tools thereby developing analytical abilities to address real world problems.
- Adopt the skills related to research, education, and industry- academia

Prerequisites: Background of the practical knowledge at degree level.

Course Outline:

1. All the experiments should involve error analysis. Internal evaluation to be done in the respective semesters and grades to be intimated to the controller at the end of each semester itself. Practical observation book to be submitted to the examiners at the time of examination.
2. Eight experiments are to be done by a student in a semester. One mark is to be deducted from internal marks for each experiment not done by the student if the required total of experiments are not done in the semesters.
3. The PHOENIX/EXPEYES Experimental Kit developed at the Inter University Accelerator Centre, New Delhi, may be used for the experiments wherever possible.

(At least 16 experiments should be done, 8 each for I & II semesters)

1. Y and σ - Interference method (a) elliptical (b) hyperbolic fringes. To determine Y and σ of the material of the given specimen by observing the elliptical and hyperbolic fringes formed in an interference set up
2. Y & σ by Koenig's method
3. Variation of surface tension with temperature-Jaeger's method. To determine the surface tension of water at different temperatures by Jaeger's method of observing the air bubble diameter at the instant of bursting inside water
4. Stefan's constant-To determine Stefan's constant
5. Thermal conductivity of liquid and air by Lee's disc method.
6. Dielectric constant by Lecher wire- To determine the wavelength of the waves from the given RF oscillator and the dielectric constant of the given oil by measurement of a suitable capacitance by Lecher wire setup.
7. Viscosity of a liquid - Oscillating disc method. To determine the viscosity of the given liquid by

measurements on the time period of oscillation of the disc in air and in the liquid
8. Mode constants of a vibrating strip. To determine the first and second mode constants of a steel vibrating strip; Y to be measured by the Cantilever method and frequency of vibration by the Melde's string method
9. Constants of a thermocouple and temperature of inversion.
10. Study of magnetic hysteresis - B-H Curve using standard toroid / specimen in any form.
11. Maxwell's L/C bridge -To determine the resistance and inductance of the given unknown inductor by Maxwell's L/C bridge OR Anderson's Bridge – L/C and self inductance. .(The kit developed by Indian Academy of Science can also be used)
12. Susceptibility measurement by Quincke's and Guoy's methods - Paramagnetic susceptibility of salt and specimen
13. Michelson's interferometer - (a) λ and (b) d λ and thickness of mica sheet.
14. Photoelectric effect. Determination of Plank's constant
15. Frank Hertz experiment .To measure the ionization potential of Mercury by drawing current versus applied voltage.
16. Fabry Perot etalon -Determination of thickness of air film.
17. Elementary experiments using Laser: (a) Study of Gaussian nature of laser beam (b) Evaluation of beam spot size (c) Measurement of divergence (d) Diameter of a thin wire
18. Diffraction Experiments using lasers (a)Diffraction by single slit/double slit/circular aperture (b)Diffraction by reflection grating
19. Measurement of the thermal and electrical conductivity of Cu to determine the Lorents number.(The kit developed by Indian Academy of Science can also be used)
20. Passive filters .(The kit developed by Indian Academy of Science can also be used)
21. Microwave experiments - Determination of wavelength, VSWR, attenuation, dielectric constant.
22. Experiments with Lock-in Amplifier(a) Calibration of Lock In Amplifier (b) Phase sensitive detection (c) Mutual inductance determination (d) Low resistance determination.(The kit developed by Indian Academy of Science can also be used)
23. Cauchy's constants using liquid prism
24. Forbes method of determining thermal conductivity
25. Zeeman effect using Fabry-Perot etalon.

Reference Books:

1. B.L. Worsnop and H.T. Flint - Advanced Practical Physics for students - Methuen & Co (1950)
2. E.V. Smith - Manual of experiments in applied Physics - Butterworth (1970)
3. R.A. Dunlap - Experimental Physics - Modern methods - Oxford University Press (1988)
4. D. Malacara (ed) - Methods of experimental Physics - series of volumes - Academic Press Inc (1988)
5. S.P. Singh –Advanced Practical Physics – Vol I & II – Pragati Prakasan, Meerut (2003) – 13th Edition
6. A.C. Melissinos and J.Napolitano, Experiments in Modern Physics, Academic Press, 2003
7. K.Muraleedhara Varier, A Practical Approach to Nuclear Physics, Narosa Publishing House (2018)

Course Plan

Sl No.	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity Learning outcome(output)	Assessment
1 2 3 4 5	Y and σ - Interference method (a) elliptical (b) hyperbolic fringes. To determine Y and σ of the material of the given specimen by observing the elliptical and hyperbolic fringes formed in an interference set up Susceptibility measurement by Quincke's and Guoy's methods - Paramagnetic susceptibility of salt and specimen. Dielectric constant by Lecher wire- To determine the wavelength of the waves from the given RF oscillator and the dielectric constant of the given oil by measurement of a suitable capacitance by Lecher wire setup. Frank Hertz experiment .To measure the ionization potential of Mercury by drawing current versus applied voltage. Photoelectric effect. Determination of Plank's constant Maxwell's L/C bridge -To determine the resistance and	• Seminar • Practicals • pear learning.	• These practical papers make the student familiar with General physics experiments like Cornu's method, Quincke's method, Photoelectric effect etc	• Model Exam • Record Verification • Daily Test

6	inductance of the given unknown inductor by Maxwell's L/C bridge OR Anderson's Bridge – L/C and self inductance. .(The kit developed by Indian Academy of Science can also be used)			
7	Cauchy's constants using liquid prism			
8	Diffraction Experiments using lasers (a)Diffraction by single slit/double slit/circular aperture (b)Diffraction by reflection grating			
9	Y & σ by Koenig's method			
10	Thermal conductivity of liquid and air by Lee's disc method.			
11	Mode constants of a vibrating strip. To determine the first and second mode constants of a steel vibrating strip; Y to be measured by the Cantilever method and frequency of vibration by the Melde's string.			
12	Fabry Perot etalon -Determination of thickness of air film			
13	Passive filters .(The kit developed by Indian Academy of Science can also be used)			

14	Viscosity of a liquid - Oscillating disc method. To determine the viscosity of the given liquid by measurements on the time period of oscillation of the disc in air and in the liquid.			
15	Variation of surface tension with temperature-Jaeger's method. To determine the surface tension of water at different temperatures by Jaeger's method of observing the air bubble diameter at the instant of bursting inside water			
16	Study of magnetic hysteresis - B-H Curve using standard toroid / specimen in any form.			

Faculty in charge
Ms. Sharol M A

b) PHY1L02 & PHY2L04 (ELECTRONICS)

(At least 16 experiments should be done, 8 each for I & II semesters.)
External Practical Exam for PHY1L02&PHY2L04 together will be conducted at the end of 2nd semester.

1. Study the V-I characteristics of a Silicon Controlled Rectifier – Construct half-wave and full-wave circuits using SCR.

2. a). Study the V-I characteristics of UJT. Determine intrinsic stand-off ratio. Design and construct a relaxation oscillator and sharp pulse generator for different frequencies.
b). Design and construct a time delay circuit to switch ON a suitable load driven by a SCR. Trigger the SCR using UJT.
3. a).Study the V-I characteristics of a JFET. Determine pinch-off voltage, saturation drain current and cut-off voltage of the device.
b). Design and construct a low frequency common source amplifier using JFET. Study the frequency response and measure the i/p and o/p impedances.
4. Design and construct a d.c voltage regulator using transistors and Zener diodes. Study the line and load regulation characteristics for suitable o/p voltage and maximum load current.
5. Design a single stage bipolar transistor amplifier. Compare the characteristics and performance of the circuit without feedback and with suitable negative feedback. Compare theoretical and observed magnitudes of voltage gain, i/p and o/p impedances in both cases.
6. Design and construct a differential amplifier using transistors. Study frequency response and measure i/p, o/p impedances. Also measure CMRR of the circuit.
7. a).Design and construct an amplitude modulator circuit. Study the response for suitable modulation depths.
b).Design and construct a diode A.M detector circuit to recover the modulating signal from the A.M wave.
8. Design and construct a two stage I.F amplifier circuit. Study the response of single and coupled stages.
9. Design and construct a Darlington pair amplifier using medium power transistors for a suitable output current. Study the frequency response of the circuit and measure the i/p and o/p impedances.
10.Design and construct a piezo-electric crystal oscillator to generate square waves of suitable frequencies. Compare designed and observed frequencies.
11.Design and construct an R.F oscillator using a tunnel diode. Measure frequency of the output signal.
12.Design and construct an OPAMP based summing and averaging amplifier for three suitable inputs. Compare the designed and observed outputs.
13.Design and construct a Wien bridge oscillator using OP AMP for different frequencies. Compare designed and observed frequencies.
14.Design and construct an astable multivibrator using OPAMP for suitable frequencies.
15.Design and construct a monostable multivibrator using OPAMP for suitable pulse widths.
16.Design and construct a triangular wave generator using OPAMPs for different frequencies.
17. Design and construct OPAMP based precision half and full wave rectifiers. Observe the o/p on CRO and study the circuit operation.
18.Design and construct an astable multivibrator using timer IC 555. Measure frequency and duty cycle of the o/p signal.
Modify the circuit to obtain almost perfect square waves.
19.Design and construct an monostable multivibrator using timer IC 555, for different pulse widths. Compare designed and observed pulse widths.
20.Design and construct a voltage controlled oscillator using timer IC 555. Study the performance.
21.Design and construct Schmidt triggers using OP AMPS – for symmetrical and non-symmetrical LTP/UTP. Trace hysteresis curve.

22.Design and construct OPAMP based analogue integrator and differentiator. Study the response in each case.
23. a). Design and construct OP AMP based circuit for solving a second order differential equation. Study the performance.
b). Design and construct OP AMP based circuit for solving a simultaneous equation. Study the performance.
24. Design and construct Second order Butterworth Low pass, High Pass and Band Pass filters using OPAMPs. Study the performance in each case.
25. Design and construct a narrow band-pass filter for a given centre frequency using a single OP AMP with multiple feedback. Study the frequency response.
26. 4 bit D/A converter using R-2R ladder network. Realization of 4 bit A/D converter using D/A converter.
27. Study of 4 bit binary counter (IC 7493) and 4 bit decade counter(IC 7490) in various modes. Use the counters as frequency dividers.
28. Design and construct a 3 bit binary to decimal decoder using suitable logic gates. Verify the operation.
29. Set up a four bit shift register IC 7495 and verify right shift and left shift operations for different data inputs.
References: Design and construction ideas may be obtained from standard electronics text books.
For further reference:
Basic Electronics and Lab Video Prof. T.S. Natarajan IIT Madras
http://nptel.iitm.ac.in/video.php?subjectId=122106025

Course Plan

Sl No.	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity Learning outcome(output)	Assessment
1	Study of 4 bit binary counter (IC 7493) and 4 bit decade counter(IC 7490) in various	• Seminar • Practicals • pear learning.	• Design, development and testing of electronic	• Model Exam • Record Verificatio

	modes. Use the counters as frequency dividers. Design and construct a Darlington pair amplifier using medium power transistors for a suitable output current. Study the frequency response of the circuit and measure the i/p and o/p impedances. Design and construct an OPAMP based summing and averaging amplifier for three suitable inputs. Compare the designed and observed outputs. Design and construct a Wien bridge oscillator using OP AMP for different frequencies. Compare designed and observed frequencies. Design and construct an astable multivibrator using timer IC 555. Measure frequency and duty cycle of the o/p signal. Design and construct an astable multivibrator using OPAMP for suitable frequencies. Design and construct a triangular wave generator using OPAMPs for different frequencies. Design and construct OPAMP based precision half and full wave rectifiers. Observe the o/p on CRO and study the circuit operation. Design and construct an monostable multivibrator using		circuits with OP amps, discrete electronic components and integrated circuit chips. ● Designing amplifier, oscillator, and wave shaping circuits for defined specifications. ● Designing electronic filters and understanding phase sensitive lock in detection technique	n ● Daily Test

9	timer IC 555, for different pulse widths. Compare designed and observed pulse widths.			
10	.Design and construct a voltage controlled oscillator using timer IC 555. Study the performance.			
11	Design and construct Schmidt triggers using OP AMPS – for symmetrical and non-symmetrical LTP/UTP. Trace hysteresis curve.			
12	Design and construct OPAMP based analogue integrator and differentiator. Study the response in each case.			
13	Design and construct Second order Butterworth Low pass, High Pass and Band Pass filters using OPAMPs. Study the performance in each case.			
14	Design and construct a narrow band-pass filter for a given centre frequency using a single OP AMP with multiple feedback. Study the frequency response			
15	Design a single stage bipolar transistor amplifier. Compare the characteristics and performance of the circuit without feedback and with suitable negative feedback. Compare theoretical and observed magnitudes of voltage gain, i/p and o/p impedances in both cases			

16	Design and construct an astable multivibrator using OPAMP for suitable frequencies.			

Faculty in charge
Ms. Shyama I

PHY3C09:QUANTUM MECHANICS II

Semester: 3
Course Number: 1
Contact Hours: 4T
Number of Credits: 4
Number of Contact Hours: 72
Course Evaluation: Internal & External: 1:4

Objectives of the Course: To equip them with the techniques of angular momentum, perturbation theory and scattering theory so that they can use these in various branches of physics as per their requirement.

Prerequisites: Background of Quantum mechanics I.

Course Outline

1.Time-Independent Perturbation Theory (20 Hrs.)

Non-degenerate perturbation theory – First-order theory and Second-order theory – Examples : (1) Linear harmonic oscillator (2) Anharmonic oscillator – Degenerate perturbation theory – Two-fold degeneracy – Higher-order degeneracy –The fine-structure of hydrogen – Relativistic correction – Spin-orbit coupling - Zeeman effect – Weak-field Zeeman effect– Strong-field Zeeman effect – Intermediate-field Zeeman effect – Hyperfine splitting – Linear Stark effect in the hydrogen atom.

Text : (1) Chapter 6, Introduction to Quantum Mechanics (Edn.2) by David. J. Griffiths,
(2) Chapter 8, section 8.3, Quantum Mechanics (Edn.4) by V. K. Thankappan

2.Variational Method and WKB Method (12 Hrs.)

Bound states (Ritz method) – Linear harmonic oscillator – Helium atom – WKB wavefunction in classical region – Example : Potential well with two vertical walls – WKB wavefunction in nonclassical region – Example : Tunneling – Connection formulae – Examples : (1) Potential well with one vertical wall (2) Potential well with no vertical walls.

Text : (1) Chapter 8, section 8.2A, Quantum Mechanics (Edn.4) by V. K. Thankappan
(2) Chapter 6, Introduction to Quantum Mechanics (Edn.2) by David. J. Griffiths

3.Time-dependent perturbation theory (12 Hrs.)

First order time-dependent perturbation theory – Constant perturbation – Transition to a continuum – Fermi's Golden rule – Scattering cross section in the Born approximation – Harmonic perturbation – Radiative transitions in atoms.

Text : Chapter 8, sections 8.4, 8.4A, 8.4B, Quantum Mechanics (Edn.4) by V. K. Thankappan

4. Scattering (12 Hrs.)

Scattering amplitude – Method of partial waves – Scattering by a central potential – Optical theorem – Scattering by a square-well potential

Text: Chapter 7, relevant sections, Quantum Mechanics (Edn.4) by V. K. Thankappan

5.Relativistic Quantum Mechanics (16 Hrs.)

Klein-Gordon equation – First order wave equations – Weyl equation – Dirac equation – Properties of Dirac matrices – Dirac particle is spin-1/2 particle – Spinor – Equation of continuity – Dirac particle in an external magnetic field : Non- relativistic limit – Hole theory

Text: Chapter 10, relevant sections; Quantum Mechanics (Edn.4) by V. K. Thankappan

Textbooks:

1. Quantum Mechanics (Edn.4) : V. K. Thankappan, New Age International.
2. Introduction to Quantum Mechanics (Edn.2) : D.J. Griffiths, Pearson Education.

References :

1. Principles of Quantum Mechanics (Edn.2) : R. Shankar, Springer.
2. Introductory Quantum Mechanics: Richard L. Liboff, Pearson Education .
3. A Modern Approach to Quantum Mechanics: J S Townsend, Viva Books.

4. Quantum Mechanics : Non-Relativistic Theory (Course of Theoretical Physics Vol3): L. D. Landau and E. M.
Lifshitz, Pergamon Press.
5. The Feynman Lectures on Physics Vol 3, Narosa.
6. Quantum Mechanics : Concepts and Applications (Edn.2) : NouredineZettili, Wiley.
7. Quantum Mechanics Demystified: David McMahon, McGrawHill 2006.
8. Quantum Mechanics (Schaum's Outline) :YoavPelegetal. Tata McGraw Hill Private Limited, 2/e.
9. Quantum Mechanics: 500 Problems with Solutions: G Aruldhas, Prentice Hall of India.
10. www.nptel/videos.in/2012/11/quantum-physics.html
11. https://nptel.ac.in/courses/115106066/

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**

Unit I (20 hours)	Non-degenerate perturbation theory – First-order theory and Second-order theory – Examples : (1) Linear harmonic oscillator (2) Anharmonic oscillator – Degenerate perturbation theory – Two-fold degeneracy – Higher-order degeneracy – The fine-structure of hydrogen – Relativistic correction – Spin-orbit coupling - Zeeman effect – Weak-field Zeeman effect – Strong-field Zeeman effect – Intermediate-field Zeeman effect – Hyperfine splitting – Linear Stark effect in the hydrogen atom.	● Lecture ●Problem-Solving	● To understand the idea of time independent perturbation theory . ● To be familiar with Hydrogen atom by its properties	Evaluation of problems ● Q and A
Unit II (12hours)	Bound states (Ritz method) – Linear harmonic oscillator – Helium atom – WKB wavefunction in classical region – Example : Potential well with two vertical walls – WKB wavefunction in nonclassical region – Example : Tunneling – Connection formulae – Examples : (1) Potential well with one vertical wall (2) Potential well with no vertical walls.	● Lecture ●Problem-Solving	● To understand Approximation methods for time-independen t problems like the WKB approximation ● To acquire a deep knowledge of the connection formula and its applications.	● problem solving ● Q and A

Unit III(12 hours)	First order time-dependent perturbation theory – Constant perturbation – Transition to a continuum – Fermi's Golden rule – Scattering cross section in the Born approximation – Harmonic perturbation – Radiative transitions in atoms.	●Lecture ●Problem-Solving ● Seminar ● Powerpoint presentation	● To get an idea time dependent Perturbation theory and Interaction of an atom with the electromagnetic field	● Q & A ● Evaluation problem solving skill
Unit IV (12hours)	Scattering amplitude – Method of partial waves – Scattering by a central potential – Optical theorem – Scattering by a square-well potential	● Lecture ●Problem-Solving ● Seminar	● To describe and understand Scattering, its parameters and its application	● Q & A ● Evaluation problem solving skill
Unit V (16hours)	Klein-Gordon equation – First order wave equations – Weyl equation – Dirac equation – Properties of Dirac matrices – Dirac particle is spin-1/2 particle – Spinor – Equation of continuity – Dirac particle in an external magnetic field : Non-relativistic limit – Hole theory	●Lecture ●Problem-Solving ● Seminar	● TO get an idea of Relativistic Quantum Mechanics using Dirac equation, Dirac matrices,. The Klein Gordon equation etc	● Q & A ● Evaluation problem solving skill

Faculty In-charge
Ms. Jesmy Shaju

PHY3C10 :NUCLEAR AND PARTICLE PHYSICS

Semester:3
Course Number: 2
Contact Hours per Week: 4T
Number of Credits:4

Number of Contact Hours: 72 hrs
Course Evaluation: Internal & External: 1:4

Objectives of the Course: The course deals with the various dimensions related to nuclear physics and structuring of atoms. It also discusses the different nuclear models.
Prerequisites: Background of Nuclear physics at degree level.

Course Outline:
1.Nuclear Forces: Properties of the nucleus, size, binding energy, angular momentum , The deuteron and two- nucleon scattering experimental data, Simple theory of the deuteron structure, Low energy n-p scattering, characteristics of nuclear forces, Spin dependence,Tensor force, Scattering cross sections, Partial waves, Phase shift, Singlet and triplet potentials, Effective range theory, p-p scattering. (12 hours)
Text: K.S.Krane : "Introductory Nuclear Physics" (Wiley), (Ch. 3 and 4)

2. Nuclear Decay: Basics of alpha decay and theory of alpha emission, Beta decay, Energetics of beta decay,Fermi theory of beta decay, Comparative half-life, Allowed and forbidden transitions, Selection rules, Parity violation in beta decay. Neutrino. Energetics of Gamma Decay, Multipole moments, Decay rate, Angular
momentum and parity selection rules, Internal conversion, Lifetimes. (12 hours)
Text: K.S.Krane : "Introductory Nuclear Physics" (Wiley), (Ch. 8, 9 and 10)

3. Nuclear Models, Fission and Fusion: Shell model potential, Spin-orbit potential, Magnetic dipole moments, Electric quadrupole moments, Valence Nucleons, Collective structure, Nuclear vibrations, Nuclear rotations,Liquid drop Model, Semi Empirical Mass formula, Energetics of Fission process, Controlled Fission reactions.Fusion process, Characteristics of fusion, solar fusion, Controlled fusion reactors. (19 hours)
Text: K.S.Krane : "Introductory Nuclear Physics" (Wiley), (Ch. 5,13.1-13.5,14)

4. Nuclear Radiation Detectors and Nuclear Electronics: Gas detectors – Ionization chamber, Proportional counter and G M counter, Scintillation detector, Photomultiplier Tube (PMT), Semiconductor detectors – Ge(Li), Si(Li) and surface barrier detectors, Preamplifiers, Amplifiers, Single channel analyzers, Multi- channel analyzers, counting statistics, energy measurements. (12 hours)
Text: S S Kapoor and V S Ramamurthy: "Nuclear Radiation Detectors" (Wiley)

5. Particle Physics: Four basic forces - Gravitational, Electromagnetic, Weak and Strong - Relative strengths, classification of particles, Yukawa's theory, Conservation of energy and masses, Electric charges, Conservation of angular momentum, Baryon and lepton numbers, Conservation of strangeness, Conservation of isospin and its components, Conservation of parity, Charge conjugation, CP violation, time reversal and CPT theorem. Extremely short lived particles, Resonances - detecting methods and experiments, Internal symmetry, The Sakata model, SU (3), The eightfold way, Gell Mann and Okubo mass formula, Quarks and quark model, Confined quarks, Experimental evidence, Coloured quarks. (17 hours)

Text : Y.Neeman and Y.Kirsh: "The particle hunters' (Cambridge University Press), Ch 6.1- 3, 3.4, 7.1-10,
8.1, 9. 1-7)

Reference Books :

1. H.S.Hans : “Nuclear Physics – Experimental and theoretical” (New Age International, 2001).
2. G.F.Knoll : “Radiation Detection and Measurement, (Fourth Edition, Wiley, 2011)
3. G.D.Coughlan, J.E.Dodd and B.M.Gripalos “The ideas of particle physics – an introduction for scientists”, (Cambridge Press)
4. David Griffiths – “Introduction to elementary particles” – Wiley (1989)
5. S.B.Patel : “An Introduction to Nuclear Physics” (New Age International Publishers)
6. Samuel S.M.Wong: “Introductory Nuclear Physics” (Prentice Hall,India)
7.B.L.Cohen : “Concepts of Nuclear Physics” (Tata McGraw Hill)
8.E.Segre : “Nuclei and Particles” (Benjamin, 1967)
9.K Muraleedhara Varier: “Nuclear Radiation Detection: Measurement and Analysis” (Narosa).

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**
Unit I (12hours)	Properties of the nucleus, size, binding energy, angular momentum , The deuteron and two-nucleon scattering experimental data, Simple theory of the deuteron structure, Low energy n-p scattering, characteristics of nuclear forces, Spin dependence,Tensor force, Scattering cross sections, Partial waves, Phase shift, Singlet and triplet potentials, Effective range theory, p-p scattering.	● Lecture ●Problem-Solving	● have a basic knowledge of nuclear size ,shape , binding energy.etc and also the characteristics of nuclear force in detail. ● Understand different types of scattering.	Evaluation of problems ● Q and A

Unit II (12hours)	Basics of alpha decay and theory of alpha emission, Beta decay, Energetics of beta decay, Fermi theory of beta decay, Comparative half-life, Allowed and forbidden transitions, Selection rules, Parity violation in beta decay. Neutrino. Energetics of Gamma Decay, Multipole moments, Decay rate, Angular momentum and parity selection rules, Internal conversion, Lifetimes.	● Lecture ●Problem-Solving	● To acquire knowledge about nuclear decay processes and their outcomes. ● Have a wide understanding regarding beta and gamma decay.	● problem solving ● Q and A

Unit III (19hours)	Shell model potential, Spin-orbit potential, Magnetic dipole moments, Electric quadrupole moments, Valence Nucleons, Collective structure, Nuclear vibrations, Nuclear rotations, Liquid drop Model, Semi Empirical Mass formula, Energetics of Fission process, Controlled Fission reactions. Fusion process, Characteristics of fusion, solar fusion, Controlled fusion reactors.	●Lecture ●Problem-Solving ● Seminar ● Powerpoint presentation	● To be able to gain knowledge about various nuclear models and potentials associated.	● Q & A ● Evaluation problem solving skill

Unit IV (12hours)	Gas detectors – Ionization chamber, Proportional counter and G M counter, Scintillation detector, Photomultiplier Tube (PMT), Semiconductor detectors – Ge(Li), Si(Li) and surface barrier detectors, Preamplifiers, Amplifiers, Single channel analyzers, Multi- channel analyzers, counting statistics, energy measurements.	● Lecture ●Problem-Solving ● Seminar	● To Grasp knowledge about Nuclear reactions, Fission and Fusion and their characteristics	● Q & A ● Evaluation problem solving skill
Unit V (17hours)	Physics: Four basic forces - Gravitational, Electromagnetic, Weak and Strong - Relative strengths, classification of particles, Yukawa's theory, Conservation of energy and masses, Electric charges, Conservation of angular momentum, Baryon and lepton numbers, Conservation of strangeness, Conservation of isospin and its components, Conservation of parity, Charge conjugation, CP violation, time reversal and CPT theorem. Extremely short lived particles, Resonances - detecting methods and experiments, Internal symmetry, The Sakata model, SU (3), The eightfold way, Gellmann and Okubo mass formula, Quarks and quark model, Confined quarks, Experimental evidence, Coloured quarks.	●Lecture ●Problem-Solving ● Seminar	● To understand the basic forces in nature and classification of particles ● To study in detail conservation laws and quark models in detail.	● Q & A ● Evaluation problem solving skill

Faculty In-charge
Ms. Shyama I

PHY3C11: SOLID STATE PHYSICS

Semester:3
Course Number: 3
Contact Hours per Week: 4T
Number of Credits:4
Number of Contact Hours: 72 hrs
Course Evaluation: Internal & External: 1:4

Objectives of the Course: To understand Energy band theory, Formation of energy bands. Gaps at Brillouin zone boundaries, distinction between metal, insulator, semiconductor, weak and tight binding approximations
Prerequisites: Background of Solid state physics at degree level.

Course Outline

1. Crystal Structure and binding:Symmetry elements of a crystal, Types of space lattices, Miller indices, Diamond Structure, NaCI Structure,BCC, FCC,HCP structures with examples, Description of X-ray diffraction using reciprocal lattice, Brillouin zones,Vander Waals interaction, Cohesive energy of inert gas crystals, Madelung interaction, Cohesive energy of ionic crystals,Covalent bonding, Metallic bonding, Hydrogen-bonded crystals (12 hours)

2. Lattice Vibrations:
Vibrations of monatomic and diatomic lattices, Quantization of lattice vibrations, Inelastic scattering of neutrons, Einstein and Debye models of specific heat, Thermal conductivity, Effect of imperfection (9 hours)

3. Electron States and Semiconductors:
Free electron gas in three dimensions, Specific heat of metals, Sommerfeld theory of electrical conductivity, Wiedemann-Franz law, Hall effect, Nearly free electron model and formation of energy bands, Bloch functions, Kronig Penny model, Formation of energy gap at Brillouin zone boundaries, Number of orbitals in a band, Equation of motion of electrons in energy bands, Properties of holes, Effective mass of carriers, Intrinsic carrier concentration, Hydrogenic model of donor and acceptor states. Direct band gap and indirect band gap semiconductors (17 hours)

4. Dielectric, Ferroelectric and magnetic properties:
Theory of Dielectrics: polarization, Dielectric constant, Local Electric field, Dielectric polarisability, Polarisation from Dipole orientation, Ferroelectric crystals, Order-disorder type of ferroelectrics, Properties of Ba Ti O3, Polarisation catastrophe, Displasive type ferroelectrics, Landau theory of ferroelectric phase transitions, Ferroelectric domain, Antiferroelectricity, Piezoelectricity,

Applications of Piezoelectric Crystals,Diamagnetism and Paramagnetism: Langevin's theory of diamagnetism, Langevin's theory of paramagnetism, theory of Atomic magnetic moment, Hund‟s rule, Quantum theory of magnetic Susceptibility Ferro, Anti and Ferri magnetism: Weiss theory of ferromagnetism, Ferromagnetic domains, Neel Model of Antiferromagnetism and Ferrimagnetism, Spin waves, Magnons in Ferromagnets (qualitative) (22 hours)

5. Superconductivity:
Meissner effect, Type I and Type II superconductors, energy gap Isotope effect, London equation and penetration of magnetic field, Cooper pairs and the B C S ground state (qualitative, Flux quantization, Single particle tunneling, DC and AC Josephson effects, High Tc Superconductors(qualitative) description of cuprates, Enough exercises. (12 hours)
Text books:
1. C.Kittel,: Introduction to Solid State Physics 5th edition (Wiley Eastern)
2. A.J.Dekker: Solid State Physics (Macmillian 1958)

Reference Books:
1. M.Ali Omar, Elementary Solid State Physics, Addison-Wesley Publishing Company
2. N.W. Ashcroft and Mermin : Solid State Physics (Brooks Cole (1976)
3. Elements of Solid State Physics, Srivastava J.P. Prentice Hall of India (2nd edn)
4. Ziman J.H. Principles of Theory of Solids - (Cambridge 1964)
5. Harald Ibach and Hans Luth, Solid State Physics : An Introduction to Principles of Solid State Physics,
Springer (2009)

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**

Unit I (12hours)	Symmetry elements of a crystal, Types of space lattices, Miller indices, Diamond Structure, NaCI Structure, BCC, FCC,HCP structures with examples, Description of X-ray diffraction using reciprocal lattice, Brillouin zones, Vander Waals interaction, Cohesive energy of inert gas crystals, Madelung interaction, Cohesive energy of ionic crystals, Covalent bonding, Metallic bonding, Hydrogen-bonded crystals	● Lecture ●Problem-Solving	● have a basic knowledge of crystal systems and spatial symmetries ● To be able to account for how crystalline materials are studied using diffraction, including concepts like reciprocal lattice and Brillouin zones	Evaluation of problems ● Q and A
Unit II (9hours)	Vibrations of monatomic and diatomic lattices, Quantization of lattice vibrations, Inelastic scattering of neutrons, Einstein and Debye models of specific heat, Thermal conductivity, Effect of imperfection	● Lecture ●Problem-Solving	● To know what phonons are, and be able to perform estimates of their dispersive and thermal properties , be able to calculate thermal and electrical properties in the free-electron model	● problem solving ● Q and A

Unit III(17 hours)	Free electron gas in three dimensions, Specific heat of metals, Sommerfeld theory of electrical conductivity, Wiedemann-Franz law, Hall effect, Nearly free electron model and formation of energy bands, Bloch functions, Kronig Penny model, Formation of energy gap at Brillouin zone boundaries, Number of orbitals in a band, Equation of motion of electrons in energy bands, Properties of holes, Effective mass of carriers, Intrinsic carrier concentration, Hydrogenic model of donor and acceptor states. Direct band gap and indirect band gap semiconductors	●Lecture ●Problem-Solving ● Seminar ● Powerpoint presentation	● To know Bloch's theorem and what energy bands ● know the fundamental principles of semiconductors	● Q & A ● Evaluation problem solving skill
Unit IV (22hours)	Theory of Dielectrics: polarization, Dielectric constant, Local Electric field, Dielectric polarisability, Polarisation from Dipole orientation, Ferroelectric crystals, Order-disorder type of ferroelectrics, Properties of Ba Ti O3, Polarisation catastrophe, Displacive type ferroelectrics, Landau theory of ferroelectric phase transitions, Ferroelectric domain, Antiferroelectricity, Piezoelectricity, Applications of Piezoelectric Crystals, Diamagnetism and Paramagnetism: Langevin's theory of diamagnetism, Langevin's theory of paramagnetism, theory of	● Lecture ●Problem-Solving	● To know the fundamentals of dielectric and ferroelectric properties of materials ● To know basic models of dia, para and ferro magnetism	● Q & A ● Evaluation problem solving skill

	Atomic magnetic moment, Hund‟s rule, Quantum theory of magnetic Susceptibility Ferro, Anti and Ferri magnetism: Weiss theory of ferromagnetism, Ferromagnetic domains, Neel Model of Antiferromagnetism and Ferrimagnetism, Spin waves, Magnons in Ferromagnets			
Unit V (12hours)	Meissner effect, Type I and Type II superconductors, energy gap Isotope effect, London equation and penetration of magnetic field, Cooper pairs and the B C S ground state (qualitative, Flux quantization, Single particle tunneling, DCand AC Josephson effects, High Tc Superconductors(qualitative) description of cuprates, Enough exercises. and AC Josephson effects, High Tc Superconductors(qualitative) description of cuprates, Enough exercises.	●Lecture ●Problem-Solving ● Seminar	● To be able to explain superconductivity using BCS theory	● Q & A ● Evaluation problem solving skill

Faculty in charge
Ms. Sharol M A

PHY3E05: EXPERIMENTAL TECHNIQUES

Semester:3

Course Number: 4
Contact Hours per Week: 4T
Number of Credits:4
Number of Contact Hours: 72 hrs
Course Evaluation: Internal & External: 1:4

Objectives of the Course: To offer excellent preparation for a career in a research laboratory in the high-tech industry, or as a MSc student to get an idea about research techniques.

Prerequisites: Background of Nuclear physics at degree level.

Course Outline

1. Vacuum Techniques : Units and basic definitions, Roughing pumps - Oil sealed rotary vacuum pump and Sorption pump, High vacuum pumps – Turbo molecular pump, Diffusion pump, Oil vapour booster pump, Ion pumps - Sputter ion pump and Getter ion pump, Cryo pump, Vacuum gauges - Pirani gauge, Thermocouple gauge, penning gauge (Cold cathode
Ionization gauge) and Hot filament ionization gauge, Vacuum accessories – Diaphragm, Gate valve, Butterfly valve, Baffle and isolation valves, magnetic valves, adjustable valves, air inlet valves, Traps - Liquid nitrogen trap, Sorption traps, and, gaskets and O rings (19 hours)
Text : Muraleedhara Varier et al. "Advanced Experimental Techniques in Modern Physics", Sections 1.4, 1.6 – 1.8, 1.9.2.3 –1.9.2.5, 1.10.1, 1.10.6, 1.10.3

2. Thin film techniques : Introduction, Fabrication of thin films, Thermal evaporation in vacuum – Resistive heating, Electron beam evaporation and laser evaporation techniques, Sputter deposition, Glow discharge, Thickness measurement by quartz crystal monitor, optical interference method, electrical conductivity measurement, Thermo electric power, Interference filters - Multilayer optical filters, Technological Applications of thin films. (14 hours)
Text : Muraleedhara Varier, et al. "Advanced Experimental Techniques in Modern Physics" Sections 2.1, 2.2.1.1, 2.2.1.4, 2.2.1.5, 2.2.2, 2.3.2, 2.3.3, 2.3.1, 2.7, 2.6.1

3.Accelerator techniques : High voltage DC accelerators, Cascade generator, Van de Graaff accelerator, Tandem Van de Graaff accelerator, Linear accelerator, Cyclotron, Synchrotron (Electron and proton), Ion sources – Ionization processes,
simple ion source, ion plasma source and RF ion source, Ion implantation – techniques and profiles, Ion beam sputtering–Principles and applications. (14 hours)
Text : Muraleedhara Varier, et al. "Advanced Experimental Techniques in Modern Physics", Sections 4.3, 4.4, 4.5.1, 4.5.4,
4.5.5, 4.6, 4.8.1 – 4.8.3, 4.9

4. Materials Analysis by nuclear techniques: Introduction, Basic principles and requirements, General experimental setup, mathematical basis and nuclear reaction kinematics, Rutherford backscattering – introduction, Theoretical background – classical and quantum mechanical, experimental setup, energy loss and straggling and applications. Neutron activation analysis – principles and experimental arrangement, applications, Proton induced X-ray Emission – principle

and experimental set up, applications to water samples, human hair samples and forensic samples, limitations of PIXE.
(15 hours)
Text: Advanced Experimental Techniques in Modern Physics – K. Muraleedhara Varier, Antony Joseph and P.P.Pradyumnan, Pragati Prakashan, Meerut (2006)

5. X- Ray Diffraction Technique :Introduction, Lattice planes and Bragg's Law, Diffractometer - Instrumentation, Single crystal and Powder diffraction, Scherrer equation, Structure factor, Applications of XRD - Crystallinity, Unit Cell Parameters, Phase transition studies, thin film studies, Awareness on Powder Diffraction File (PDF) of the International Centre for Diffraction Data. (10 hours)
Text: Elements of Modern X-ray Physics, Jens Als Nielsen and Des McMorrow, (John Wiley and Sons 2000)
Reference books:
1. Scientific foundations of vacuum techniques – S. Dushman and J.M. Laffer, John Wiley New York (1962)
2. Thin film phenomena – K.L. Chopra, McGraw Hill (1983)
3. R. Sreenivasan – Approach to absolute zero - Resonance magazine Vol 1 no 12, (1996) , vol 2 nos 2, 6 and 10 (1997)
4. R. Berry, P.M. Hall and M.T. Harris – Thin film technology – Van Nostrand (1968)
5. Dennis and Heppel – Vacuum system design
6. Nuclear Micro analysis – V. Valkovic
7. B.D. Cullity, Elements of X-ray diffraction, Addison Wesley Inc (1978)
8. Useful link for XRD-http://pd.chem.ucl.ac.uk/pdnn/powintro/whatdiff.htm

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**
Unit I (19hours)	Units and basic definitions, Roughing pumps - Oil sealed rotary vacuum pump and Sorption pump, High vacuum pumps – Turbo molecular pump, Diffusion pump, Oil vapour booster pump, Ion pumps - Sputter ion pump and Getter ion pump, Cryo pump, Vacuum guages - Pirani gauge, Thermocouple gauge, penning guage (Cold cathode Ionization guage) and Hot filament ionization gauge, Vacuum accessories – Diaphragm, Gate valve, Butterfly valve, Baffle and isolation valves, magnetic valves, adjustable valves, air inlet valves, Traps - Liquid nitrogen trap, Sorption traps, and gaskets and O rings	● Lecture ●Problem-Solving	• Have gained a clear understanding of different vacuum pumps • the production and maintenance of vacuum systems and its uses and needs in Physics	Evaluation of problems ● Q and A

Unit II (14hours)	Introduction, Fabrication of thin films, Thermal evaporation in vacuum – Resistive heating, Electron beam evaporation and laser evaporation techniques, Sputter deposition, Glow discharge, Thickness measurement by quartz crystal monitor, optical interference method, electrical conductivity measurement, Thermo electric power, Interference filters - Multi layer optical filters, Technological Applications of thin films.	● Lecture ●Problem-Solving	● Understands in depth about thin film preparation and production controlling techniques ● the application of thin films in the field of science & Technology.	● problem solving ● Q and A

Unit III(14hours)	High voltage DC accelerators, Cascade generator, Van de Graaff accelerator, Tandem Van de Graaff accelerator, Linear accelerator, Cyclotron, Synchrotron (Electron and proton), Ion sources – Ionization processes, simple ion source, ion plasma source and RF ion source, Ion implantation – techniques and profiles, Ion beam sputtering– principles and applications.	●Lecture ●Problem-Solving ● Seminar ● Powerpoint presentation	● Extend their understanding of various particle accelerators and its industrial uses.	● Q & A ● Evaluation problem solving skill
Unit IV (15hours)	Introduction, Basic principles and requirements, General experimental setup, mathematical basis and nuclear reaction kinematics, Rutherford backscattering – introduction, Theoretical background –	● Lecture ●Problem-Solving	● To understand about mathematical basis of nuclear reactors ● To discuss PIXE and its applications.	● Q & A ● Evaluation problem solving skill

	classical and quantum mechanical, experimental setup, energy loss and straggling and applications. Neutron activation analysis – principles and experimental arrangement, applications, Proton induced X-ray Emission – principle and experimental setup, applications to water samples, human hair samples and forensic samples, limitations of PIXE.			
Unit V (10hours)	:Introduction, Lattice planes and Bragg's Law, Diffractometer - Instrumentation, Single crystal and Powder diffraction, Scherrer equation, Structure factor, Applications of XRD - Crystallinity, Unit Cell Parameters, Phase transition studies, thin film studies, Awareness on Powder Diffraction File (PDF) of the International Centre for Diffraction Data.	●Lecture ●Problem-Solving ● Seminar	• To understand about different material analysis techniques and applications.	• Q & A • Evaluation problem solving skill

Faculty in charge
Ms. Jesmy shaju

PHY4C12: ATOMIC AND MOLECULAR SPECTROSCOPY

Semester:4
Course Number: 1
Contact Hours per Week: 4T
Number of Credits:4
Number of Contact Hours: 72 hrs
Course Evaluation: Internal & External: 1:4

Objectives of the Course: To understand about Electron-Atom, Ion-Atom, Atom-Atom Scattering, Atoms in strong EM fields, Ionisation by charged particles and photons Diatomic Molecules, Molecular Orbitals, Angular Momentum Born-Oppenheimer Approximation, Potential Energy Curves, Electronic, Vibrational and Rotational degrees of freedom Optical, Infrared, Microwave and Raman Spectroscopy

Prerequisites: Background of Spectroscopy at degree level.

Course Outline

1. Atomic Spectroscopy: (12 hours)

Vector Atom model – L S coupling & J J coupling, effect of electric & magnetic field on atoms and molecules; Zeeman effect, Paschen Back effect and stark effect

Text: Sections 10.1 to 10.11, 12.1to12.10, 13.1 to13.9, 20.1to 20.8 –Introduction to atomic spectra by H E White

2. Microwave and Infrared spectroscopy: (17 hours)

The spectrum of non rigid rotator, e.g. of HF, spectrum of symmetric top molecule e.g. of CH3Cl, Instrumentation for Microwave Spectroscopy Stark Modulator, Information derived from Rotational Spectrum: I R Spectroscopy: Born – Oppenheimer approximation, Effect of Breakdown of Born Oppenheimer approximation, Normal modes and vibration of H2O and CO2. Instrumentation for I R Spectroscopy – Fourier transformation I R Spectroscopy

Text: Sections 6.6 ,6.7,6.8,6.9 6.11,6.13,6.14 7.1 to 7.71,7.12,7.15,7.16,7.17,7.18 Molecular structure and Spectroscopy
by G. Aruldhas

3. Raman Spectroscopy: (14 hours)

Rotational Raman Spectrum of Symmetric top molecules, e.g. of CHCl3 Combined use of Raman & IR Spectroscopy in structure determination e.g. of CO2 and NO3. Instrumentation for Raman Spectroscopy, Non-linear Raman effects, Hyper Raman effect, stimulated Raman effect and Inverse Raman Effect

Text: Sections 8.32, 8.4, 8.5, 8.6, 8.7, 8.10, 15.1, 15.215.3, 15.4 Molecular structure and Spectroscopy by G.Aruldhas

4. Electronic Spectroscopy of molecules: (12 hours)

Vibrational Analysis of band systems, Deslander's table, Progressions & sequences, Information Derived from vibrational analysis, Franck Condon Principle. Rotational fine structure and P R and R Branches, fortrat Diagram, Dissociation Energy, Example of Iodine molecule

Text: Sections 9.1 to9.9 Molecular structure and Spectroscopy by G .Aruldhas

5. Spin Resonance Spectroscopy: (17 hours)

Interaction of nuclear spin and magnetic field, level population Larmour precession, Resonance Conditions, Bloch equations, Relaxation times, Spin-spin and spin lattice relaxation. The chemical shift, Instrumentation for NMR spectroscopy, Electron Spin Spectroscopy of the unpaired e, Total Hamiltonian, Fine structure, Electron Nucleus coupling, and hyperfine spectrum ESR spectrometer. Mossbauer Spectroscopy, Resonance fluorescence of γ-rays, Recoilless emission of γ-rays and Mossbauer effect, Chemical shift, effect of magnetic field. Eg. of Fe57 Experimental techniques, Enough

exercises.

Text: Sections 10.1 to 10.9, 11.1 to11.5.4, 13.1 to13.5 Molecular structure and Spectroscopy by G.Aruldhas

Textbooks:

1. Molecular Structure & Spectroscopy G Aruldhas
2. C N Banwell & E.M. Mccash – Fundamentals of Molecular Spectroscopy
3. Atomic Spectroscopy – White

Reference books:

1. Straughan and Walker Spectroscopy Volume I, II and III
2. G.M.Barrow – Introduction to Molecular Spectroscopy
3. H.H. Willard, Instrumental Methods of Analysis,7th Edition , CBS-Publishers, New Delhi.
4. Atomic Spectroscopy –K P Rajappan Nair, MJP Publishers, Chennai
5. Elements of spectroscopy Gupta Kumar –Pragati Prakasan ,Meerut

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**

Unit I (12hours)	Vector Atom model – L S coupling & J J coupling, effect of electric & magnetic field on atoms and molecules; Zeeman effect, Paschen Back effect and stark effect	● Lecture ●Problem-Solving	● know about different atom model and will be able to differentiate different atomic systems, ● different coupling schemes and their interactions with magnetic and electric fields.	Evaluation of problems ● Q and A
Unit II (17hours)	The spectrum of non rigid rotator, e.g. of HF, spectrum of symmetric top molecule e.g. of CH3Cl, Instrumentation for Microwave Spectroscopy Stark Modulator, Information derived from Rotational Spectrum: I R Spectroscopy: Born – Oppenheimer approximation, Effect of Breakdown of Born Oppenheimer approximation, Normal modes and vibration of H2O and CO2. Instrumentation for I R Spectroscopy – Fourier transformation I R Spectroscopy	● Lecture ●Problem-Solving	● Have gained ability to apply the techniques of microwave and infrared spectroscopy ● To elucidate the structure of molecules	● problem solving ● Q and A

Unit III(14hours)	Rotational Raman Spectrum of Symmetric top molecules, e.g. of CHCl3 Combined use of Raman & IR Spectroscopy in structure determination e.g. of CO2 and NO3. Instrumentation for Raman Spectroscopy, Non-linear Raman effects, Hyper Raman effect, stimulated Raman effect and Inverse Raman Effect .	●Lecture ●Problem-Solving ● Seminar ● Powerpoint presentation	● Be able to apply the principle of Raman spectroscopy and its applications in the different field of science & Technology.	● Q & A ● Evaluation problem solving skill
Unit IV (12hours)	Vibrational Analysis of band systems, Deslander's table, Progressions & sequences, Information Derived from vibrational analysis, Franck Condon Principle. Rotational fine structure and P R and R Branches, fortrat Diagram, Dissociation Energy, Example of Iodine molecule	● Lecture ●Problem-Solving	● To become familiar with different resonance spectroscopic techniques and its applications	● Q & A ● Evaluation problem solving skill
Unit V (17hours)	Interaction of nuclear spin and magnetic field, level population Larmour precession, Resonance Conditions, Bloch equations, Relaxation times, Spin-spin and spin lattice relaxation. The chemical shift, Instrumentation for NMR spectroscopy, Electron Spin Spectroscopy of the unpaired e, Total Hamiltonian, Fine structure, Electron Nucleus coupling, and hyperfine spectrum ESR spectrometer. Mossbauer Spectroscopy, Resonance fluorescence of γ-rays, Recoilless emission of γ-rays and Mossbauer effect, Chemical shift, effect of magnetic field. Eg. of Fe57 Experimental techniques, Enough	●Lecture ●Problem-Solving ● Seminar	● to find solutions to problems related to different spectroscopic systems.	● Q & A ● Evaluation problem solving skill

	exercises.			

Faculty in charge
Ms. Jesmy Shaju

PHY4E14: LASER SYSTEMS,OPTICAL FIBERS AND APPLICATIONS

Semester:4
Course Number: 2
Contact Hours per Week: 4T
Number of Credits:4
Number of Contact Hours: 72 hrs
Course Evaluation: Internal & External: 1:4

Objectives of the Course:

Prerequisites: Background of Nuclear physics at degree level.

Course Outline

1.Basic Laser theory:
Einstein coefficients, Light amplification, The threshold condition, Line broadening mechanisms, Laser rate equations, Theory of Q-switched and Modelocked lasers, Cavity modes, stable and unstable resonators, Analysis of optical resonators. (18 hours)

2. Various laser systems:
Ruby, Nd:YAG, Argon ion, He-Ne, CO2 laser, Fiber Laser, Semionductor Lasers, Optical parametric Oscillator – Working principle and energy level diagrams. (12 hours)

3. Nonlinear optics:
Nonlinear polarization, Second and third Harmonic generation, Symmetry requirement for second Harmonic generation, Nonlinear refractive index, Multi photon absorption, Nonlinear materials, Four wave mixing and Z-scan Technique (14 hours)

4. Laser Applications:
Spatial frequency filtering, Holograpy, Industrial application of lasers, Lasers in medicine, Isotope separation, laser induced chemical reactions, Laser induced fusion (13 hours)

5. Optical Fibers:
Introduction, What are optical fibers, Importance, propagation of light in optical fibers,

Basic structure, Acceptance angle, Numerical aperture, Stepped index monomode fibers, disadvantages, Graded index monomode fibers, Optical fibers as cylindrical waveguides, Scalar wave equation and the modes of a fiber, Modal analysis for a step index fiber, Single mode fibers. (15 hours)

Textbooks:

1. K.Thyagarajan and Ajoy Ghatak : "LASERS :Fundamentals and Applications" (2nd Edition,Springer, 2010)
2. William T Silfvast :" Laser fundamentals" (2nd Edition, Cambridge University Press, 2004))
3. B.B Laud : "Lasers and Nonlinear Optics" (3rd Edition, New age international Publishers, 2011)
4. Ajoy Ghatak and K. Thyagarajan "Optical Electronics" (Cambridge University Press, 1989)
5. John. M.Senior : "Optical Fiber Communications: Principles and Practice" (3rd Edition, Pearson Education India, 2009)

Reference books

1. Subirkumar Sarkar :"Optical Fiber and Fiber Optic Communication Systems" (S. Chand & Co.)
2. Ajoy Ghatak and K.Thayagarajan : Introduction to Fiber Optics" (Cambridge University Press, 1998)

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**
Unit I (18 hours)	Einstein coefficients, Light amplification, The threshold condition, Line broadening mechanisms, Laser rate equations, Theory of Q-switched and Modelocked lasers, Cavity modes, stable and unstable resonators, Analysis of optical resonators.	● Lecture ●Problem-Solving	● Understand basic laser theory and to study Einstein coefficients.	Evaluation of problems ● Q and A

Unit II (12 hours)	Ruby, Nd:YAG, Argon ion, He-Ne, CO2 laser, Fiber Laser, Semionductor Lasers, Optical parametric Oscillator – Working principle and energy level diagrams.	● Lecture ●Seminar	● To understand important laser systems and their working mechanism.	● problem solving ● Q and A

Unit III (14 hours)	Nonlinear polarization, Second and third Harmonic generation, Symmetry requirement for second Harmonic generation, Nonlinear refractive index, Multi photon absorption, Nonlinear materials, Four wave mixing and Z-scan Technique	●Lecture ●Problem-Solving ●Powerpoint presentation	● To understand non linear optics and various phenomena.	● Q & A ● Evaluation problem solving skill
Unit IV (13 hours)	Spatial frequency filtering, Holograpy, Industrial application of lasers, Lasers in medicine, Isotope separation, laser induced chemical reactions, Laser induced fusion	● Lecture ●Seminar	● To understand various applications of lasers . ● Laser induced reactions,Laser induced Fusion.	● Q & A ● Evaluation problem solving skill

Unit V (15 hours)	Introduction, What are optical fibers, Importance, propagation of light in optical fibers, Basic structure, Acceptance angle, Numerical aperture, Stepped index monomode fibers, disadvantages, Graded index monomode fibers, Optical fibers as cylindrical waveguides, Scalar wave equation and the modes of a fiber, Modal analysis for a step index fiber, Single mode fibers.	●Lecture ●Problem-Solving	• Understand the basics of optical fibers and its applications.	• Q & A • Evaluation problem solving skill

Faculty in charge
Ms. Sharol M A

PHY4E20: MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS

Semester:4
Course Number:3
Contact Hours per Week: 4T
Number of Credits:4
Number of Contact Hours: 72 hrs
Course Evaluation: Internal & External: 1:4

Objectives of the Course: This course is designed to provide students with the necessary foundation for entry-level industrial applications in process monitoring and controlling, with an emphasis on analysis, problem solving, exposure to open-ended problems and design methods. At the end of the course, students will be able to design an application based on microcontrollers or microprocessors.

Prerequisites: Background of microprocessor in electronics at pg level

1.Microprocessor and Assembly language programming :

Microprocessor as CPU, Internal architecture of Intel 8085, Instruction set, Addressing modes, Examples of Assembly language programming, Addition and subtraction of 2 byte numbers, multiplication and division of 1 byte numbers, Sorting of 1 byte numbers (12 hrs)
Text: 1. Introduction to Microprocessors–A.P. Mathur (Tata-McGraw Hill).
2. Fundamentals of Microprocessors and Micro Computers"– B. Ram- Dhanapati Rai

2 Microprocessor timings; Interfacing memory and I/O devices :
Instruction cycles, machine cycles and timing diagram, address space partitioning, generation of control signals for memory and I/O device interfacing, memory interfacing, I/O device interfacing, Address decoding using 74LS138 (10 hrs)
Text: 1. "Introduction to Microprocessors" –A.P. Mathur (Tata-McGraw Hill).
2 Fundamentals of Microprocessors and Micro Computers"– B. Ram- Dhanapati Rai

3 Peripheral devices and interfacing :
Programmable Peripheral Interface- Intel 8255, Programmable Interval Timer- Intel 8253, Programmable DMA controller- Intel 8257, Programmable Interrupt controller- Intel 8259. ADC interfacing - General idea with block diagram, 7 segment LED display interfacing – General idea of display and driver (16 hrs)
Text 1. Fundamentals of Microprocessors and Microcomputers– B. Ram – Dhanapati Rai
2. Introduction to Microprocessors –A.P. Mathur (Tata-McGraw Hill).
3.Microprocessors – Architecture, Programming and Applications with 8085 - R.S.Gaonkar (Wiley Eastern)

4 Microcontrollers and Programming :
Microcontroller vs microprocessor, microcontrollers in embedded systems. Overview of AVR family of microcontrollers, simplified block diagram of AVR microcontroller, General idea of ROM, RAM, EEPROM, I/O pins and peripherals in microcontrollers. AVR architecture and Assembly level programming – General purpose registers, Data memory and instructions, status register and instructions, branch instructions, call and time delay loops; Assembler
directives, sample programs.
Text : (Relevant sections from chapters 1,2 and 3: Textbook 4)
Arithmetic and logical instructions – sample programs. (16 hrs)
Text : (Relevant sections from chapters 5: The Book 4)

5. AVR Programming :
I/O programming, I/O port pins and functions, features of ports A, B, C and D, dual role of Ports, sample programs. I/O ports and bit addressability.
Text : (Relevant sections from chapter 4: Book 4)
AVR programming in C: C language data types for AVR, C programs for arithmetic, logic time delay and I/O operations. (18 hrs)

Text : (Relevant sections from chapter 7: Book 4)

Textbooks:

1. Introduction to Microprocessors–A.P. Ma 6. thur (Tata-McGraw Hill).
2. Fundamentals of Microprocessors and Micro Computers"– B. Ram- Dhanapati Rai
3.Microprocessors – Architecture, Programming and Applications with 8085 - R.S.Gaonkar (Wiley Eastern)
4.The AVR microcontroller and embedded systems – using Assembly and C.
Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Prentice Hall - Pearson
Ref: 1. Programming and customizing the AVR microcontroller: Dhananjay V Gadre.
2. Embedded C programming and the Atmel AVR: Barnett, Cox, O'Cull.

Practical for Semesters III & IV

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity Learning outcome(output)**	**Assessment**
Unit I (12hours)	Microprocessor as CPU, Internal architecture of Intel 8085, Instruction set, Addressing modes, Examples of Assembly language programming, Addition and subtraction of 2 byte numbers, multiplication and division of 1 byte numbers, Sorting of 1 byte numbers	● Lecture ●Problem-Solving	● Study the Organization and internal architecture of the Intel 8085 ● learn assembly language programming and arithmetic	Evaluation of problems ● Q and A

Unit II (10hours)	Instruction cycles, machine cycles and timing diagram, address space partitioning, generation of control signals for memory and I/O device interfacing, memory interfacing, I/O device interfacing, Address decoding using 74LS138.	● Lecture ●Problem-Solving	● Aware of Memory interfacing, and different Data transfer schemes, CO4 ● Learn interfacing with peripheral I/O devices	● problem solving ● Q and A

Unit III(16hours)	Programmable Peripheral Interface- Intel 8255, Programmable Interval Timer- Intel 8253, Programmable DMA controller- Intel 8257, Programmable Interrupt controller- Intel 8259. ADC interfacing - General idea with block diagram, 7 segment LED display interfacing – General idea of display and drivers.	●Lecture ●Problem-Solving ● Powerpoint presentation	● Learn common applications of microprocessors like E Analog to Digital convert,7 segment LED displays,; Temperature measurement and control using a microprocessor	● Q & A ● Evaluation problem solving skill
Unit IV (16 hours)	Microcontroller vs microprocessor, microcontrollers in embedded systems. Overview of AVR family of microcontrollers, simplified block diagram of AVR microcontroller, General idea of ROM, RAM, EEPROM, I/O pins and peripherals in microcontrollers. AVR architecture and Assembly level programming – General purpose registers, Data memory and instructions, status register and instructions, branch instructions, call and time delay loops; Assembler directives, sample programs.	● Lecture ●Problem-Solving	● To learn differences between microcontrollers and microprocessors ● To extent the idea of AVR microcontroller	● Q & A ● Evaluation problem solving skill

Unit V (18hours)	I/O programming, I/O port pins and functions, features of ports A, B, C and D, dual role of Ports, sample programs. I/O ports and bit addressability. AVR programming in C: C language data types for AVR, C programs for arithmetic, logic time delay and I/O operations. .	●Lecture ●Problem-Solving	• To understand the I/O port in an AVR microcontroller • To learn about AVR programming in C:	• Q & A • Evaluation problem solving skill

Faculty in charge
Ms. Shyama I

PRACTICALS SEMESTER III & IV

a) PHY3L05 & PHY4L06 (MODERN PHYSICS)

Contact Hours per Week: 8L
Number of Credits:3
Course Evaluation: Internal & External: 1:4

Objectives of the Course:

- Learn various experimental and computational tools thereby developing analytical abilities to address real world problems.
- Adopt the skills related to research, education, and industry- academia

Prerequisites: Background of the practical knowledge at degree level.

Course Outline:

External Practical Exam for PHY3L05 & PHY4L06 together will be conducted at the end of 4th semester.

At least 10 experiments are to be done from Part A and 2 each from the elective paper as listed in Part B. If no practicals have been given for a particular elective papers, two more experiments from Part A should be done. It may be noted that some experiments are given both in Part A and B – of course such experiments can be done only once: either as included in part A or in part B. Internal evaluation to be done in each semester and final grades to be intimated to the controller at the end of 2nd and 4th semesters. One mark is to be deducted from internal marks for each experiment not done by the student if the required total number experiments are not done in the semesters. The PHOENIX/EXPEYES Experimental Kit developed at the Inter University Accelerator Centre, New Delhi, may be used for experiments wherever possible.

PART A

1. G.M. Counter plateau and statistics of counting - To obtain the plateau, operating voltage and to verify the distribution law satisfied by the radioactive decay
2. Absorption coefficient for beta & gamma rays -To determine the absorption coefficient of the given materials using a G. M. Counter
3. Feather analysis – End point energy - To determine the end point energy of the beta particles from a given source using Feather analysis
4. Scintillation counter - To calibrate the given gamma ray (scintillation) spectrometer using standard gamma sources and to determine the energy of an unknown gamma ray source
5. Compton scattering - To verify the theoretical expression for the energy of the Compton scattered gamma rays at a given angle using a Scintillation gamma spectrometer / determine the rest mass energy of the electron
6. Half life of Indium – thermal neutron absorption - To determine the half life of In-116 by irradiation of In foil and beta counting using a GM counter
7. Photoelectric effect in lead - To get the spectrum of X rays emitted form lead target by photo electric effect using Cs-137 gammas
8. Conductivity, Reflectivity, sheet resistance and refractive index of thin films
9. Hall effect in semiconductors-To determine the carrier concentration in the given specimen of semiconducting material
10. ESR spectrometer – Determination of g factor
11. Rydberg constant determination
12. Absorption spectrum of KMnO4 and Iodine. To determine the wavelength of the absorption bands of KMnO4 and to determine the dissociation energy of iodine molecules from its absorption spectrum.
13. Ionic conductivity of KCl/NaCl crystals
14. Curie Weiss law -To determine the Curie temperature
15. To study the Thermoluminescence of F-centres of Alkali halides
16. Variation of dielectric constant with temperature of a ferroelectric material (Barium Titanate)
17. Polarization of light and verification of Malu‟s law.
18. Refractive index measurement of a transparent material by measuring Brewster‟s angle
19. Measurement of the thermal relaxation time constant of a serial light bulb.
20. Dielectric constant of a non polar liquid
21. Vacuum pump – pumping speed
22. Pirani gauge – characteristics
23. Ultrasonic interferometer. To determine the velocity and compressibility of sound in liquids.
24. Study of LED characteristics - Determination of wavelength of emission, I-V characteristics and variation with temperature, variation of output power vs. applied voltage

25. Optical fibre characteristics - To determine the numerical aperture, attenuation and bandwidth of the given optical fibre specimen
26. Band gap energy of Ge by four probe method.-To study bulk resistance and to determine band gap energy.
27. Thomson‟s e/m measurement.-To determine charge to mass ratio of the electron by Thomson‟s method.
28. Determination of Band gap energy of Ge and Si using diodes.
29. Millikan‟s oil drop experiment .To measure the charge on the electron.
30. Zener voltage characteristic at low and ambient temperatures – To study the variation of the Zener voltage of the given Zener diode with temperature
31. Thermionic work function – To determine the thermionic work function of the material of the cathode of the given vacuum diode/triode from the characteristic at different filament currents

PART B

I . ADVANCED ELECTRONICS

1. Simple temperature control circuit
2. Binary rate multiplier
3. Optical feedback amplifier
4. Frequency modulation and pulse modulation
5. Binary multiplier
6. Write ALP and execute using 8085 kit for generating a square wave of desired frequency using PPI 8255 interfacing. observe the output on CRO and measure frequency.
7. Write ALP to alternately switch on/off a green and a red LED within a given small time interval. Execute using 8085 kit.
8. Write ALP to convert a given d.c voltage (between 0 and 5 V) using ADC 0800/0808 interfaced to 8085 microprocessor. Execute using the given kit and check the result.

II MATERIAL SCIENCE / CONDENSED MATTER PHYSICS

1. Curie-Weiss law – (To determine the Curie temperature)
2. Solid-liquid phase transitions – measurement of resistivity of metals
3. Growth of a single crystal from solution and determination of structural, electrical and optical properties
4. Study of colour centres – Thermoluminescence glow curves
5. Ionic conductivity in KCl/NaCl crystals
6. Thermoluminescence spectra of alkali halides
7. Thermo emf of bulk samples (Al/Cu)
8. Electron spin resonance
9. Strain gauge – Y of a metal beam
10. Variation of dielectric constant with temperature of a ferroelectric material (Barium titanate)
11. Ferrite specimen – variation of magnetic properties with composition

III COMMUNICATION ELECTRONICS
1. Amplitude modulation and demodulation
2. Frequency modulation and demodulation
3. Pulse amplitude modulation and demodulation
4. Pulse code modulation and demodulation
5. Pulse position modulation and demodulation
6. Study of crystal detector

7. L-C transmission line characteristic
8. Tuned RF amplifier
9. Seely discriminators
10. AM transmitter
11. Radiation from dipole antenna
12. Optical fibre characteristics (Numerical aperture, attenuation and bandwidth)
13. Optical feedback circuit (Feedback factor, gain and frequency response)

IV. ADVANCED NUCLEAR PHYSICS and RADIATION PHYSICS

1. Half-life of Indium – thermal neutron absorption - To determine the half-life of In-116 by irradiation of In foil and beta counting using a GM counter
2. Alpha spectrometer - To calibrate the given alpha spectrometer and determine the resolution
3. Photoelectric effect in lead - To get the spectrum of X rays emitted from lead target by photo electric effect using Cs-137 gammas
4. Inner bremsstrahlung - To study the intensity spectrum of inner bremsstrahlung from given gamma source
5. Coincidence circuits - To construct and study the performance of series and parallel coincidence circuits using transistors and to determine the resolving time
6. Single channel analyzer - Study of characteristics of a SCA using precision pulser
7. Ionization chamber - Study of variation of pulse height with applied voltage and to obtaing the pulse height spectrum of X-rays
8. Proportional counter - Study of variation of pulse height with applied voltage and to obtaining the pulse height spectrum of X-rays
9. Track detector – track diameter distribution - To measure the diameters of the alpha tracks in CR-39 track detector
10. Beta ray spectrometer - To plot the momentum distribution of beta particles from given beta sources
11. Range of alpha particles in air and mylar - To determine the range of alpha particles from Am-241 source in air and in mylar using either a surface barrier detector or a GM counter

V EXPERIMENTAL TECHNIQUES

1. Rydberg constant – hydrogen spectrum
2. ESR – Lande g factor
3. IR spectrum of few samples
4. Vacuum pump – pumping speed
5. Vacuum pump – Effect of connecting pipes
6. Absorption bands of Iodine
7. Vibrational bands of AlO
8. Pirani gauge – characteristics
9. Thin films – electrical properties (sheet resistance)
10. Thin films – optical properties (Reflectivity, transmission, attenuation, refractive index)

VI. ELECTRONIC INSTRUMENTATION

1. Strain gauge
2. Simple servomechanism
3. Temperature control
4. Coincidence circuits

5. Multiplexer
6. IEEE 488 Electrical interface
7. Single channel analyzer
8. Differential voltmeter
9. Frequency synthesizer – Signal generator
10. Silicon controlled rectifier – characteristics
11. Silicon controlled rectifier – power control

VII. DIGITAL SIGNAL PROCESSING

1 (a) Compute and plot the cross and auto correlation coefficients of one dimensional signal
(b)Estimate the pitch period of a periodic signal using correlation method. (3 hours).
2 (a) Compute and plot the convolution coefficients of one dimensional signal .
(b)Estimate the pitch period of a periodic signal using the convolution method. (3 hours).
3 Write a program for determining the Linear and circular Convolution of a finite sequence x(n) and h(n).Accept the sequences x(n) and h(n) from the user. Display the output sequence y(n).Plot all three sequences. (3 hours).
4 Compute the N-point DFT of the following. Vary the value of N and visualize the effect with N=8, 16, 24, 64,128,256. (3 hours).
5 Design an N point FIR low pass filter with cutoff frequency 0.2* pi using i) Rectangular ii) Hamming iii) Kaiser windows. Plot for N=16,32,64,128,256.Compare with N=1024 and record your observations. (3 hours).
(The programs are to be executed in Python/MATLAB)

VIII. LASER SYSTEMS, OPTICAL FIBRES AND APPLICATIONS

1. Optical fibre characteristics (Numerical aperture, attenuation and bandwidth)
2. Optical feedback circuit (Feedback factor, gain and frequency response
3. Determination of size of lycopodium particles by Laser diffraction

Reference Books for PHY 305 & PHY 405 :

1. B.L. Worsnop and H.T. Flint – Advanced Practical Physics for students – Methuen & Co (1950)
2. E.V. Smith – Manual of experiments in applied Physics – Butterworth (1970)
3. R.A. Dunlap – Experimental Physics – Modern methods – Oxford University Press (1988)
4. D. Malacara (ed) – Methods of experimental Physics – series of volumes – Academic Press Inc (1988)
5. A.C.Melissinos, J.Napolitano - Experiments in Modern Physics -Academic Press 2003.

Course Plan

Sl. No	Topics to be taught (input)	Procedure	Activity Learning	Assessment

		(process) Student centric Method of teaching	outcome(output)	
1 2 3 4 5 6 7 8	G.M. Counter plateau and statistics of counting - To obtain the plateau, operating voltage and to verify the distribution law satisfied by the radioactive decay Absorption coefficient for beta & gamma rays -To determine the absorption coefficient of the given materials using a G. M. Counter Hall effect in semiconductors-To determine the carrier concentration in the given specimen of semiconducting material ESR spectrometer – Determination of g factor Rydberg constant determination Absorption spectrum of KMnO4 and Iodine. To determine the wavelength of the absorption bands of KMnO4 and to determine the dissociation energy of iodine molecules from its absorption spectrum. Band gap energy of Ge by four probe method.-To study bulk resistance and to determine band gap energy. Thomson‟s e/m measurement.-To determine charge to mass ratio of the	• Seminar • Peer Learning • Practicals	• This laboratory course focuses on the advanced physics experiments chosen from Atomic and Molecular Physics, Experimental techniques, Nuclear Physics andCommunication Electronics. • It provides an insight to students about experimental techniques, data analysis, error analysis while investigating physical phenomena. • This course provides practical knowledge to students as they perform experiments and correlate it to theory.	• Model Exam • Record Verification • Daily Test

	electron by Thomson‟s method.			
9	Determination of Band gap energy of Ge and Si using diodes.			
10	Write ALP and execute using 8085 kit for generating a square wave of desired frequency using PPI 8255 interfacing. observe the output on CRO and measure frequency.			
11	Write ALP to convert a given d.c voltage (between 0 and 5 V) using ADC 0800/0808 interfaced to 8085 microprocessor. Execute using the given kit and check the result.			
12	Amplitude modulation and demodulation			
13	Pulse amplitude modulation and demodulation			
14	Ultrasonic interferometer. To determine the velocity and compressibility of sound in liquids.			

Faculty in charge
Ms. Jesmy Shaju

b) PHY4L07: COMPUTATIONAL PHYSICS PRACTICAL

The programs are to be executed in Python. For visualization Pylab/matplotlib may be used.
At least 10 experiments are to be done, opting any 5 from Part A and another 5 from
Part B. The Practical examination is of 6 hours duration.

Part A

1. Interpolation : To interpolate the value of a function using Lagrange’s interpolating polynomial
2. Least square fitting :To obtain the slope and intercept by linear and Non-linear fitting.

3. Evaluation of polynomials. Bessel and Legendre functions: Using the series expansion and recurrence relations.
4. Numerical integration : By using Trapezoidal method and Simpson's method
5. Solution of algebraic and transcendental equations .Newton Raphson method, minimum of a function
6. Solution of algebraic equation by Bisection method
7. Matrix addition, multiplication, trace, transpose and inverse
8. Solution of second order differential equation- Runge Kutta method
9. Monte Carlo method : Determination of the value of π by using random numbers
10. Numerical double integration
11. Solution of parabolic/elliptical partial differential equations
(e.g.: differential equations for heat and mass transfer in fluids and solids, unsteady behaviour of fluid flow past bodies, Laplace equation etc.,)

Part B

1. To plot the trajectory of a particle moving in a Coulomb field (Rutherford scattering) and to determine the deflection angle as a function of the impact parameter
2. Generate phase space plots - To plot the momentum v/s position plots for the following systems : (i) a conservative case (simple pendulum) (ii) a dissipative case (damped pendulum)
3. Simulation of the wave function for a particle in a box - To plot the wave function and probability density of a particle in a box; Schrödinger equation to be solved and eigen value must be calculated numerically.
4. Simulation of a two slit photon interference experiment : To plot the light intensity as a function of distance along the screen kept at a distance from the two slit arrangement.
5. Trajectory of motion of (a) projectile without air resistance (b) projectile with air resistance
6. Logistic map function – Solution and bifurcation diagram
7. Experiment with Phoenix/expEYES kit - Time constant of RC circuits by curve fitting. *
8. Experiment with Phoenix/expEYES kit - Fourier analysis of different waveforms captured using the instrument. *
(*If Phoenix is not available, data may be given in tabulated form)
9. Simulation of Kepler's orbit and verification of Kepler's laws.
10. Simulations of small oscillations in simple molecules:: Diatomic molecule/Triatomic molecule for various lengths(any one case)
11. Simulation of random walk in 1D/2D and determination of mean square distance.
12. Simulation of magnetic field - To plot the axial magnetic field v/s distance due to a current loop carrying current.
13. Simulation of the trajectory of a charged particle in a uniform magnetic field.
14. Simulation of polarisation of electromagnetic waves.
15. Simulation of coupled oscillators - Phase space portraits.

Textbooks :
1. Computational Physics -An introduction., R.C.Varma, P.K.Ahluwalia and K.C.Sharma, New Age International
Publishers
2. Numpy Reference guide, http://docs.scipy.org/doc/numpy/numpy-ref.pdf (also, free resources available on net)
3. Matplotlib , http://matplotlib.sf.net/Matplotlib.pdf (and other free resources available on net)
4. Numerical Methods in Engineering and Science, Dr. B S Grewal, Khanna Publishers, New Delhi (or any other

book)
5. Numerical Methods, E Balagurusamy, Tata McGraw-Hill
6. Numerical Methods , T Veerarajan, T Ramachandran, Tat MCGraw-Hill
7. Numerical Methods with Programs I BASIC, Fortran & Pascal, S Balachandra Rao, C K Shantha. Universities
Press
8. Numerical methods for scientists and engineers, K. Sankara Rao, PHI
9. Introductory methods of numerical analysis, S.S.Sastry , (Prentice Hall of India,1983)
10. Numerical Methods in Engineering with Python by Jaan Kiusalaas
Note: Experiments from Part A can be done with data from physical situations wherever possible. For example
consider the following cases.
a) The load W placed on a spring reduces its length L. A set of observations are given below. Calculate force constant and length of the spring before loading
W
(kg) 0.28 0.51 0.67 0.93 1.15 1.38 1.60 1.98
L (m) 6.62 5.93 4.46 4.25 3.3 3.15 2.43 1.46
b) The displacements of a particle at different instants are given below. What is the time instant at which the displacement is 70.2 m
t(s) 1.0 2.2 301 4.5 5.8 6.7 7.6 8.3 9.4
s(m) 3.0 10.56 19.07 37.12 59.16 77.38 98.04 115.78 146.6

Course Plan

Sl. No	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity Learning outcome(output)	Assessment
1 2 3 4	Interpolation : To interpolate the value of a function using Lagrange's interpolating polynomial Least square fitting :To obtain the slope and intercept by linear and Non-linear fitting. Numerical integration : By using Trapezoidal method and Simpson's method Solution of algebraic and transcendental equations .Newton Raphson method, minimum of a function	• Seminar • Peer Learning • Practicals	• For modern day technology students need to learn programming and Python is a very useful one for Physics students. • In this laboratory course students get the lessons in computer programming using Python.	• Model Exam • Record Verification • Daily Test

5	Solution of algebraic equation by Bisection method			
6	Matrix addition, multiplication, trace, transpose and inverse			
7	Solution of second order differential equation- Runge Kutta method			
8	Monte Carlo method : Determination of the value of π by using random numbers			
9	To plot the trajectory of a particle moving in a Coulomb field (Rutherford scattering) and to determine the deflection angle as a function of the impact parameter			
10	Simulation of the wave function for a particle in a box - To plot the wave function and probability density of a particle in a box; Schrödinger equation to be solved and eigen value must be calculated numerically.			
11	Simulation of a two slit photon interference experiment : To plot the light intensity as a function of distance along the screen kept at a distance from the two slit arrangement.			
12	Trajectory of motion of (a) projectile without air resistance (b) projectile with air resistance			
13	Logistic map function – Solution and bifurcation diagram			

Faculty in charge
Ms. Jesmy Shaju

64,128,256. (3 hours).
5 Design an N point FIR low pass filter with cutoff frequency 0.2* pi using i) Rectangular ii) Hamming iii) Kaiser windows. Plot for N=16,32,64,128,256.Compare with N=1024 and record your observations. (3 hours).
(The programs are to be executed in Python/MATLAB)

VIII. LASER SYSTEMS, OPTICAL FIBRES AND APPLICATIONS

1. Optical fibre characteristics (Numerical aperture, attenuation and bandwidth)
2. Optical feedback circuit (Feedback factor, gain and frequency response
3. Determination of size of lycopodium particles by Laser diffraction

Reference Books for PHY 305 & PHY 405 :
1. B.L. Worsnop and H.T. Flint – Advanced Practical Physics for students – Methuen & Co (1950)
2. E.V. Smith – Manual of experiments in applied Physics – Butterworth (1970)
3. R.A. Dunlap – Experimental Physics – Modern methods – Oxford University Press (1988)
4. D. Malacara (ed) – Methods of experimental Physics – series of volumes – Academic Press Inc (1988)
5. A.C.Melissinos, J.Napolitano - Experiments in Modern Physics -Academic Press 2003.

Course Plan

Sl. No	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity Learning outcome(output)	Assessment
1 2	G.M. Counter plateau and statistics of counting - To obtain the plateau, operating voltage and to verify the distribution law satisfied by the radioactive decay Absorption coefficient for beta & gamma rays -To determine the absorption coefficient of	• Seminar • Peer Learning • Practicals	• This laboratory course focuses on the advanced physics experiments chosen from Atomic and Molecular Physics, Experimental techniques, Nuclear Physics	• Model Exam • Record Verification • Daily Test

	the given materials using a G. M. Counter		andCommunication Electronics. • It provides an insight to students about experimental techniques, data analysis, error analysis while investigating physical phenomena. • This course provides practical knowledge to students as they perform experiments and correlate it to theory.	
3	Hall effect in semiconductors-To determine the carrier concentration in the given specimen of semiconducting material			
4	ESR spectrometer – Determination of g factor			
5	Rydberg constant determination			
6	Absorption spectrum of KMnO4 and Iodine. To determine the wavelength of the absorption bands of KMnO4 and to determine the dissociation energy of iodine molecules from its absorption spectrum.			
7	Band gap energy of Ge by four probe method.-To study bulk resistance and to determine band gap energy.			
8	Thomson‟s e/m measurement.-To determine charge to mass ratio of the electron by Thomson‟s method.			
9	Determination of Band gap energy of Ge and Si using diodes.			
10	Write ALP and execute using 8085 kit for generating a square wave of desired frequency using PPI 8255 interfacing. observe the output on CRO and measure frequency.			

11	Write ALP to convert a given d.c voltage (between 0 and 5 V) using ADC 0800/0808 interfaced to 8085 microprocessor. Execute using the given kit and check the result.			
12	Amplitude modulation and demodulation			
13	Pulse amplitude modulation and demodulation			
14	Ultrasonic interferometer. To determine the velocity and compressibility of sound in liquids.			

Faculty in charge
Ancy Maria Varghese

b) PHY4L07: COMPUTATIONAL PHYSICS PRACTICAL

The programs are to be executed in Python. For visualization Pylab/matplotlib may be used.
At least 10 experiments are to be done, opting any 5 from Part A and another 5 from
Part B. The Practical examination is of 6 hours duration.

Part A

1. Interpolation : To interpolate the value of a function using Lagrange's interpolating polynomial
2. Least square fitting :To obtain the slope and intercept by linear and Non-linear fitting.
3. Evaluation of polynomials. Bessel and Legendre functions: Using the series expansion and recurrence relations.
4. Numerical integration : By using Trapezoidal method and Simpson's method
5. Solution of algebraic and transcendental equations .Newton Raphson method, minimum of a function
6. Solution of algebraic equation by Bisection method
7. Matrix addition, multiplication, trace, transpose and inverse
8. Solution of second order differential equation- Runge Kutta method
9. Monte Carlo method : Determination of the value of π by using random numbers
10. Numerical double integration
11. Solution of parabolic/elliptical partial differential equations
(e.g.: differential equations for heat and mass transfer in fluids and solids, unsteady behaviour of fluid flow past bodies, Laplace equation etc.,)

Part B

1. To plot the trajectory of a particle moving in a Coulomb field (Rutherford scattering) and to determine the deflection angle as a function of the impact parameter
2. Generate phase space plots - To plot the momentum v/s position plots for the following systems : (i) a conservative case (simple pendulum) (ii) a dissipative case (damped pendulum)
3. Simulation of the wave function for a particle in a box - To plot the wave function and probability density of a particle in a box; Schrödinger equation to be solved and eigen value must be calculated numerically.
4. Simulation of a two slit photon interference experiment : To plot the light intensity as a function of distance along the screen kept at a distance from the two slit arrangement.
5. Trajectory of motion of (a) projectile without air resistance (b) projectile with air resistance
6. Logistic map function – Solution and bifurcation diagram
7. Experiment with Phoenix/expEYES kit - Time constant of RC circuits by curve fitting. *
8. Experiment with Phoenix/expEYES kit - Fourier analysis of different waveforms captured using the instrument. *
(*If Phoenix is not available, data may be given in tabulated form)
9. Simulation of Kepler's orbit and verification of Kepler's laws.
10. Simulations of small oscillations in simple molecules:: Diatomic molecule/Triatomic molecule for various lengths(any one case)
11. Simulation of random walk in 1D/2D and determination of mean square distance.
12. Simulation of magnetic field - To plot the axial magnetic field v/s distance due to a current loop carrying current.
13. Simulation of the trajectory of a charged particle in a uniform magnetic field.
14. Simulation of polarisation of electromagnetic waves.
15. Simulation of coupled oscillators - Phase space portraits.

Textbooks :

1. Computational Physics -An introduction., R.C.Varma, P.K.Ahluwalia and K.C.Sharma, New Age International
Publishers
2. Numpy Reference guide, http://docs.scipy.org/doc/numpy/numpy-ref.pdf (also, free resources available on net)
3. Matplotlib , http://matplotlib.sf.net/Matplotlib.pdf (and other free resources available on net)
4. Numerical Methods in Engineering and Science, Dr. B S Grewal, Khanna Publishers, New Delhi (or any other
book)
5. Numerical Methods, E Balagurusamy, Tata McGraw-Hill
6. Numerical Methods , T Veerarajan, T Ramachandran, Tat MCGraw-Hill
7. Numerical Methods with Programs I BASIC, Fortran & Pascal, S Balachandra Rao, C K Shantha. Universities
Press
8. Numerical methods for scientists and engineers, K. Sankara Rao, PHI
9. Introductory methods of numerical analysis, S.S.Sastry , (Prentice Hall of India,1983)
10. Numerical Methods in Engineering with Python by Jaan Kiusalaas

Note: Experiments from Part A can be done with data from physical situations wherever possible. For example
consider the following cases.

a) The load W placed on a spring reduces its length L. A set of observations are given below. Calculate force constant and length of the spring before loading

W
(kg) 0.28 0.51 0.67 0.93 1.15 1.38 1.60 1.98
L (m) 6.62 5.93 4.46 4.25 3.3 3.15 2.43 1.46

b) The displacements of a particle at different instants are given below. What is the time instant at which the displacement is 70.2 m

t(s) 1.0 2.2 301 4.5 5.8 6.7 7.6 8.3 9.4
s(m) 3.0 10.56 19.07 37.12 59.16 77.38 98.04 115.78 146.6

Course Plan

Sl. No	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity Learning outcome(output)	Assessment
1	Interpolation : To interpolate the value of a function using Lagrange's interpolating polynomial	• Seminar • Peer Learning • Practicals	• For modern day technology students need to learn programming and Python is a very useful one for Physics students. • In this laboratory course students get the lessons in computer programming using Python.	• Model Exam • Record Verification • Daily Test
2	Least square fitting :To obtain the slope and intercept by linear and Non-linear fitting.			
3	Numerical integration : By using Trapezoidal method and Simpson's method			
4	Solution of algebraic and transcendental equations .Newton Raphson method, minimum of a function			
5	Solution of algebraic equation by Bisection method			
6	Matrix addition, multiplication, trace, transpose and inverse			

7	Solution of second order differential equation- Runge Kutta method			
8	Monte Carlo method : Determination of the value of π by using random numbers			
9	To plot the trajectory of a particle moving in a Coulomb field (Rutherford scattering) and to determine the deflection angle as a function of the impact parameter			
10	Simulation of the wave function for a particle in a box - To plot the wave function and probability density of a particle in a box; Schrödinger equation to be solved and eigen value must be calculated numerically.			
11	Simulation of a two slit photon interference experiment : To plot the light intensity as a function of distance along the screen kept at a distance from the two slit arrangement.			
12	Trajectory of motion of (a) projectile without air resistance (b) projectile with air resistance			
13	Logistic map function – Solution and bifurcation diagram			

Faculty in charge
Ancy Maria Varghese

		June 2016	
I Sem BSc. (M)	Theoritical & Inorganic Chemistry	Module I	Ms. Maria Jose
III Sem BSc. (M)	CHE3B03	Module I	Dr. Santhosh Paul
V Sem BSc (M	CHE5B06	Module I, II	Dr. Laina A.L
	CHE5B07	Module I, II	Dr. Laina. A.L
	CHE5B08	Module I, II	Ms. Maria Jose
	CHE5D01	Module I	Dr. Santhosh Paul
I Sem BSc. (Sub)	CHE1C01	Module I	Dr. Santhosh Paul
III Sem BSc (Sub)	CHE3C03	Module I, II	Dr. Laina A.L
BSc (M)	Practicals		Ms. Maria Jose
BSc (Sub)	Practicals		Dr. Santhosh Paul
I Sem MSc.	CH1C01	Module I, II	Dr. Rosabella K
	CH1C02	Module I, II	Ms. Lim V.G
	CH1C03	Module I, II	Ms. Heena P
	CH1C04	Module I, II	Ms. Limi
III Sem MSc.	CH3C09	Module I, II	Dr. Rosabella K
	CH3C10	Module I, II	Ms. Heena P
	CH3C11	Module I, II	Ms. Limi V.G
	CH3E03	Module I, II	Ms Heena P
I Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi V.G
	Physical Practicals		Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals		Ms. Heena P
	Organic Practicals		Ms. Lim. V.G.
	Physical Practicals		Dr. Rosabella K.

July 2016

Department of Chemistry
Sacred Heart College
Chalakudy

Scanned by TapScanner

July 2016

I Sem BSc. (M)	CHE1B01	Module II	Dr. Santhosh Paul
III Sem BSc. (M)	CHE3B03	Module II	Ms. Maria Jose
V Sem BSc. (M)	CHE5B06	Module III	Dr. Laina A.L
	CHE5B07	Module III, IV	Dr. Santhosh Paul
	CHE5B08	Module III, IV	Dr. Laina A.L
	CHE5D01	Module II	Ms. Maria Jose.
I Sem BSc (Sub)	CHE1C01	Module II	Dr. Santhosh Paul
III Sem BSc. (Sub)	CHE3C03	Module III, IV	Dr. Laina A.L.
BSc. (M)	Practicals		Ms. Maria Jose
BSc. (Sub)	Practicals		Dr. Santho
I Sem MSc.	CH1C01	Module III	Dr. Rosabella K
	CH1C02	Module III	Ms. Heena P
	CH1C03	Module III	Ms. Limi V.G.
	CH1C04	Module III	Dr. Rosabella K
III Sem MSc.	CH3C09	Module III	Dr. Rosabella. K
	CH3C10	Module III	Ms. Limi
	CH3C11	Module III	Ms. Heena P.
	CH3E03	Module III	Ms. Limi V.G
I Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi. V.G.
	Physical Practicals		Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi. V.G.
	Physical Practicals		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Scanned by TapScanner

August 2016

I Sem BSc (M)	CHE1B01	Module III	Ms. Maria Jose
III Sem BSc (M)	CHE3B03	Module III	Dr. Laina A.L
V Sem BSc (M)	CHE5B06	Module IV	Dr. Santhosh Paul
	CHE5B07	Module V, VI	Dr Santhosh Paul
	CHE5B08	Module V	Ms. Maria Jose,
	CHE5D01	Module III	Dr. Laina A.L,
I Sem BSc. (Sub)	CHE1C01	Module III	Dr. Santosh Paul
III Sem BSc. (Sub)	CHE3C03	Module V	Dr. Laina A.L
BSc (M)	Practicals		Ms. Maria Jose
BSc. (Sub)	Practicals		Dr. Santhosh Paul
I Sem MSc.	CH1C01	Module IV	Dr. Rosabella K.
	CH1C02	Module IV	Ms. Limi. V. G.
	CH1C03	Module IV	Ms. Heena P.
	CH1C04	Module IV	Ms. Limi. V. G
III Sem MSc.	CH3C09	Module IV	Dr. Rosabella K.
	CH3C10	Module IV	Ms. Heena P
	CH3C11	Module IV	Ms. Limi V. G.
	CH3E03	Module IV	Ms. Heena P.
I Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi. V. G.
	Physical Practicals		Dr. Rosabella K.
II Sem MSc	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi. V. G.
	Physical Practicals		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Scanned by TapScanner

		September 2016	
I Sem BSc (M)	CHE1B01	Module IV	Ms. Maria Jose -
III Sem BSc. (M)	CHE3B03	Module IV	Dr. Santosh Paul.
V Sem BSc (M)	CHE5B06	Module V	Dr. Santhosh Paul.
	CHE5B07	Module VII	Dr. Laina A.L.
	CHE5B08	Module VI	Ms. Maria Jose
	CHE5D01	Module IV	Ms. Maria Jose
I Sem BSc. (Sub)	CHE1C01	Module IV	Dr. Santhosh Paul
III Sem BSc (Sub)	CHE3C03	Module VI	Dr. Laina A.L
BSc. (M)	Practicals		Ms. Maria Jose
BSc. (Sub)	Practicals.		Dr. Santhosh A.L
I Sem MSc.	CH1C01	Module V	Dr. Rosabella K
	CH1C02	Module V	MS. Heena P
	CH1C03	Module V	Ms. Limi. V.G
	CH1C03	Module V	Dr. Rosabella K.
III Sem MSc.	CH3C09	Module V	Dr. Rosabella K.
	CH3C10	Module V	Ms. Heena P.
	CH3C11	Module V	Ms. Limi. V.G
	CH3E03	Module V	Dr. Rosabella K.
I Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi. V.G.
	Physical Practicals		Dr. Rosabella K.
II Sem MSc	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi. V.G
	Physical Practicals		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Scanned by TapScanner

October 2016

I Sem BSc (M)	CHE1B01	Module V	Dr. Laina A.L
III Sem BSc (M)	CHE3B03	Module V	Dr. Santhosh Paul
V Sem BSc (M)	CHE5B06	Module VI	Ms Maria Jose
	CHE5B07	Module VIII	Ms. Maria Jose
	CHE5B08	Module VII	Dr. Laina A.L
	CHE5D01	Module V	Dr. Santhosh Paul.
I Sem BSc. (Sub)	CHE1C01	Module V	Dr. Santhosh Paul
III Sem BSc (Sub)	CHE3C03	Module VII	Dr. Laina A.L
BSc. (M)	Practicals		Ms. Maria Jose
BSc. (Sub)	Practicals		Dr. Santhosh Paul
I Sem MSc.	CH1C01	Module VI	Dr. Rosabella K.
	CH1C02	Module VI	Ms. Limi. V.G
	CH1C03	Module VI	Ms. Limi V.G
	CH1C04	Module VI	Ms. Heena P.
III Sem MSc.	CH3C09	Module VI	Dr. Rosabella K
	CH3C10	Module VI	Ms. Heena P
	CH3C11	Module VI	Ms. Limi V.G
	CH3E03	Module VI	Ms. Limi. V.G
I Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi. V.G.
	Physical Practicals		Dr. Rosabella K.
II Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi. V.G
	Physical Practicals		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Scanned by TapScanner

		November 2016	
II Sem BSc (M)	CHE2B02	Module I	Ms. Maria Jose
IV Sem BSc. (M)	CHE4B04	Module I, II	Dr. Santhosh Paul
VI Sem BSc. (M)	CHE6B09	Module I	Dr. Laina A.L
	CHE6B10	Module I, II	Dr. Laina A.L
	CHE6B11	Module I, II	Dr. Santhosh Paul
	CHE6B12	Module I, II	Ms. Maria Jose
	CHE6B13(E2)	Module I, II	Ms. Maria Jose.
II Sem BSc (Sub)	CHE2C02	Module I (half)	Dr. Santhosh Paul
IV Sem BSc (Sub)	CHE4C04	Module I	Dr. Laina A.L
BSc. (M)	Practicals		Ms. Maria Jose
BSc (Sub)	Practicals.		Dr. Santhosh Paul
II Sem MSc.	CH2C05	Module I, II	Dr. Rosabella K.
	CH2C06	Module I, II	Ms. Limi V.G
	CH2C07	Module I, II	Ms. Heena P
	CH2C08	Module I, II	Dr. Rosabella K
IV Sem MSc.	CH4C12	Module I, II	Dr. Rosabella K
	CH4C13	Module I, II	Ms. Heena. P.
	CH4E05	Module I, II	Ms Limi.
II Sem MSc.	Inorganic Practicals		Ms. Heena. P
	Organic Practicals		Ms. Limi. V.G
	Physical Practicals		Dr. Rosabella K.
IV Sem MSc.	Inorganic Practicals		Ms. Heena. P
	Organic Practicals		Ms. Limi. V.G
	Physical Practicals.		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Scanned by TapScanner

	December 2016		
II Sem BSc. (M)	CHE2B02	Module II	Dr. Santosh Paul
IV Sem BSc (M)	CHE4B04	Module III	Ms. Maria Jose
VI Sem BSc. (M)	CHE6B09	Module II	Dr. Laina A.L
	CHE6B10	Module III	Dr. Laina A.L
	CHE6B11	Module III	Ms. Maria Jose
	CHE6B12	Module III, IV	Dr. Santosh Paul
	CHE6B13(E2)	Module III	Dr. Laina A.L
II Sem BSc. (Sub)	CHE2CO2	Module I (Contd.)	Ms. Maria Jose
IV Sem BSc (Sub)	CHE4CO4	Module II, III	Dr. Laina A.L
BSc. (M)	Practicals		Ms. Maria Jose
BSc. (Sub)	Practicals		Dr. Santhosh
II Sem MSc.	CH2C05	Module III	Dr. Rosabella
	CH2C06	Module III	Ms. Heena
	CH2C07	Module IV	Ms. Limi
	CH2C08	Module III	Ms. Heena
IV Sem MSc.	CH4C12	Module III, IV	Dr. Rosabella
	CH4C13	Module III, IV	Ms. Heena
	CH4E05	Module III, IV	Ms. Limi
II Sem MSc.	Inorganic Practicals		Ms. Heena. P
	Organic Practicals		Ms. Limi. V.G
	Physical Practicals		Dr. Rosabella
IV Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi. V.G.
	Physical Practicals.		Dr. Rosabella.

Department of Chemistry
Sacred Heart College
Chalakudy

Scanned by TapScanner

	January 2017		
II Sem BSc (M)	CHE2B02	Module III (half)	Ms. Malsa Jose
IV Sem BSc (M)	CHE4B04	Module IV	Ms. Malsa Jose
VI Sem BSc (M)	CHE6B09	Module III	Dr. Laina A.L
	CHE6B10	Module IV	Dr. Santhosh Paul
	CHE6B11	Module IV	Ms. Malsa Jose
	CHE6B12	Module V	Dr. Laina A.L
	CHE6B13(E2)	Module IV	Dr. Santosh Paul
II Sem BSc. (Sub)	CHE2C02	Module II	Ms. Malsa Jose
IV Sem BSc. (Sub)	CHE4C04	Module IV	Dr. Laina A.L
BSc. (M)	Practicals		Ms. Malsa Jose
BSc. (Sub)	Practicals.		Dr. Santhosh Paul
II Sem MSc.	CH2C05	Module IV	Dr. Rosabella
	CH2C06	Module IV	Ms. Limi V.S
	CH2C07	Module IV	Ms. Heena P
	CH2C08	Module IV	Ms. Heena P
IV Sem MSc.	CH4C12	Module V	Dr. Rosabella K
	CH4C13	Module V	Ms. Heena P
	CH4E05	Module V	Ms. Limi V.S
II Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi. V.S
	Physical Practicals		Dr. Rosabella. K.
IV Sem MSc	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi. V.S
	Physical Practicals		Dr. Rosabella. K.

Department of Chemistry
Sacred Heart College
Chalakudy

Scanned by TapScanner

		February 2017	
II Sem B.Sc. (M)	CHE2B02	Module (III) contd.	Ms. Maria Jose
IV Sem B.Sc (M)	CHE4B04	Module V	Dr. Laina. A.L
VI Sem B.Sc-(M)	CHE6B09	Module IV	Dr. Santhosh Paul
	CHE6B10	Module V	Ms. Maria Jose
	CHE6B11	Module VI	Dr. Laina A.L
	CHE6B12	Module VI	Dr. Santhosh Paul
	CHE6B13(E2)	Module V	Ms. Maria Jose
II Sem B.Sc (Sub)	CHE2C02	Module III	Dr. Santhosh Paul
IV Sem B.Sc (Sub)	CHE4C04	Module V, VI	Dr. Laina A.L
B.Sc. (M)	Practicals		Ms. Maria Jose
B.Sc. (Sub)	Practicals		Dr. Santhosh Paul
II Sem M.Sc.	CH2C05	Module V	Dr. Rosabella
	CH2C06	Module V	Heena P
	CH2C07	Module V	Limi V.G
	CH2C08	Module V	Dr. Rosabella
IV Sem M.Sc.	CH4C12	Module VI, VII	Limi V.G
	CH4C13	Module VI, VII	Heena P
	CH4E05	Module VI, VII	Dr. Rosabella.
II Sem M.Sc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi V.G.
	Physical Practicals.		Dr. Rosabella K.
II Sem M.Sc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi V.G.
	Physical Practicals.		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Scanned by TapScanner

March 2017

II Sem BSc (M)	CHE2B02	Module IV	Dr. Laiva A.L.
IV Sem BSc (M)	CHE4B04	Module VII	Ms. Maria Jose
VI Sem BSc (M)	CHE6B09	Module V	Dr. Santhosh Paul
	CHE6B10	Module VI	Ms. Maria Jose
	CHE6B11	Module VI	Ms. Maria Jose,
	CHE6B12	Module VII	Dr. Laina. A.L
	CHE6B13 (E2)	Module VI	Dr. Santhosh Paul
II Sem BSc (Sub)	CHE2C02	Module IV	Dr. Laina A.L
IV Sem BSc (Sub)	CHE4C04	Module VII	Dr. Santhosh Paul
BSc (M)	Practicals		Ms Maria Jose
BSc (Sub)	Practicals		Dr. Santhosh Paul
II Sem MSc	CH2C05	Module VI	Dr. Rosabella.
	CH2C06	Module VI	Limi V.G
	CH2C07	Module VI	Heena P.
	CH2C08	Module VI	Heena. P
IV Sem MSc	CH4C12	Module VIII	Dr. Rosabella
	CH4C13	Module VIII	Limi V.G
	CH4E05	Module VIII	Limi V.G.
II Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi V.G.
	Physical Practicals.		Dr. Rosabella K.
IV Sem MSc.	Inorganic Practicals		Ms. Heena. P.
	Organic Practicals		Ms. Limi. V.G.
	Physical Practicals		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Scanned by TapScanner

June 2017

I Sem BSc. (M)	CHE1B01	Module I — Ms. Maria Jose
III Sem BSc. (M)	CHE3B03	Module I — Dr. Laina A.L
V Sem BSc. (M)	CHE5B06	Module I, II — Ms. Maria Jose
	CHE5B07	Module I, II — Dr. Santhosh Paul
	CHE5B08	Module I, II — Dr. Laina A.L
	CHE5D01	Module I — Ms. Maria Jose
I Sem BSc. (Sub)	CHE1C01	Module I — Dr. Santhosh Paul
III Sem BSc. (Sub)	CHE3C03	Module I, II — Dr. Laina A.L
BSc. (M)	Practicals	Dr. Laina A.L
BSc. (Sub)	Practicals	Ms. Maria Jose.
I Sem MSc.	CH1C01	Module I, II — Dr. Rosabella K.
	CH1C02	Module I, II — Anu Rose
	CH1C03	Module I, II — Ms. Aswathy M.A
	CH1C04	Module I, II — Ms. Anu Rose.
III Sem MSc.	CH3C09	Module I, II — Dr. Rosabella K.
	CH3C10	Module I, II — Ms. Aswathy M.A
	CH3C11	Module I, II — Anu Rose.
	CH3E03	Module I, II — Dr. Rosabella K.
I Sem MSc.	Inorganic Practicals	Ms. Anu Rose
	Organic Practicals	Ms. Aswathy M.A
	Physical Practicals	Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals	Ms. Anu Rose.
	Organic Practicals	Ms. Aswathy M.A
	Physical Practicals	Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

July 2017

I Sem BSc. (M)	CHE1B01	Module II	Dr. Santhosh Paul
III Sem BSc. (M)	CHE3B03	Module II	Ms. Maria Jose
V Sem BSc. (M)	CHE5B06	Module III	Dr Santhosh Paul
	CHE5B07	Module III, IV	Dr. Laina A.L
	CHE5B08	Module III, IV	Ms. Maria Jose
	CHE5D01	Module II	Dr Santhosh Paul
I Sem BSc (Sub.)	CHE1C01	Module II	Dr. Laina A.L
III Sem BSc (Sub)	CHE3C03	Module III, IV	Ms Maria Jose
BSc. (M)	Practicals		Dr. Laina A.L
BSc. (Sub)	Practicals.		Ms. Maria Jose
I Sem MSc.	CH1C01	Module III	Dr. Rosabella K
	CH1C02	Module III	Ms. Aswathy M.A
	CH1C03	Module III	Ms. Anu Rose.
	CH1C04	Module III	Ms. Aswathy M.
III Sem MSc.	CH3C09	Module III	Dr. Rosabella K.
	CH3C10	Module III	Ms. Anu Rose
	CH3C11	Module III	Ms. Aswathy M.
	CH3E03	Module III	Ms. Aswathy M.
I Sem MSc.	Inorganic Practicals		Ms. Anu Rose
	Organic Practicals		Ms - Aswathy M.
	Physical Practicals		Dr. Rosabella K.
III Sem MSc	Inorganic Practicals		Ms. Anu Rose
	Organic Practicals		Ms. Aswathy M.
	Physical Practicals.		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

August 2017

I Sem BSc (M)	CHE1B01	Module III	Dr. Laina A.L
III Sem BSc (M)	CHE3B03	Module III	Ms. Maria Jose
V Sem BSc. (M)	CHE5B06	Module IV	Dr. Santhosh Paul
	CHE5B07	Module V, VI	Dr. Laina A.L
	CHE5B08	Module V	Dr. Santhosh Paul
	CHE5D01	Module III	Ms. Maria Jose.
I Sem BSc. (Sub)	CHE1C01	Module III	Dr. Laina A.L
III Sem BSc. (Sub)	CHE3C03	Module V	Dr. Santhosh Paul
BSc. (M)	Practicals		Dr. Laina A.L
BSc. (Sub)	Practicals.		Ms. Maria Jose.
I Sem MSc.	CH1C01	Module IV	Dr. Rosabella.
	CH1C02	Module IV	Ms. Anu Rose
	CH1C03	Module IV	Ms. Aswathy M.A
	CH1C04	Module IV	Ms. Anu Rose
III Sem MSc.	CH3C09	Module IV	Dr Rosabella.
	CH3C10	Module IV	Ms. Anu Rose
	CH3C11	Module IV	MS Aswathy M.
	CH3E03	Module. IV	Dr. Rosabella.
I Sem MSc.	Inorganic Practicals		Ms. Anu Rose.
	Organic Practicals		Ms. Aswathy M,
	Physical Practicals		Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals		Ms. Anu Rose
	Organic Practicals		Ms. Aswathy M.
	Physical Practicals.		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Mah
Maria Jose

Scanned by TapScanner

September 2017

I Sem BSc. (MT)	CHE1B01	Module IV	Ms. Maria Jose
III Sem BSc. (MT)	CHE3B03	Module IV	Dr. Laina A.L
V Sem BSc. (MT)	CHE5B06	Module V	Dr. Santhosh Paul
	CHE5B07	Module VII	Ms. Maria Jose
	CHE5B08	Module VI	Dr. Laina A.L
	CHE5D01	Module IV	Ms. Maria Jose.
I Sem BSc (Sub)	CHE1C01	Module IV	Dr Santhosh Paul
III Sem BSc (Sub)	CHE3C03	Module VI	Ms. Maria Jose
BSc. (MT)	Practicals		Dr. Laina A.L
BSc. (Sub)	Practicals		Ms. Maria Jose
I Sem MSc.	CH1C01	Module V	Dr Rosabella K.
	CH1C02	Module V	Ms. Anu Rose.
	CH1C03	Module V	Ms. Aswathy M.
	CH1C04	Module V	Ms Anu Rose
III Sem MSc.	CH3C09	Module V	Dr. Rosabella K.
	CH3C10	Module V	Ms. Aswathy
	CH3C11	Module V	Ms Anu Rose
	CH3E03	Module V	Ms. Aswathy.
I Sem MSc.	Inorganic Practicals		Ms. Anu Rose.
	Organic Practicals		Ms. Aswathy M.
	Physical Practicals.		Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals		Ms. Anu. Rose
	Organic Practicals		Ms. Aswathy M.
	Physical Practicals.		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Mah
Maria Jose

Scanned by TapScanner

October 2017

I Sem BSc (M)	CHG1B01	Module IV	Dr. Santhosh Paul
III Sem BSc (M)	CHE3B03	Module V	Ms. Maria Jose.
V Sem BSc (M)	CHE5B06	Module VI	Dr. Laina A.L
	CHE5B07	Module VIII	Dr. Santhosh Paul
	CHE5B08	Module VII	Ms Maria Jose
	CHE5D01	Module V	Dr. Laina A.L
I Sem BSc (Sub.)	CHE1C01	Module V	Ms. Maria Jose
III Sem BSc (Sub.)	CHE3C03	Module VII	Dr. Laina A.L
BSc (M)	Practicals		Dr. Laina A.L
BSc (Sub)	Practicals		Ms. Maria Jose.
I Sem MSc.	CH1C01	Module VI	Dr. Rosabella K.
	CH1C02	Module VI	Ms. Anu Rose
	CH1C03	Module VI	Ms. Anu Rose
	CH1C04	Module VI	Ms. Aswathy M.
III Sem MSc.	CH3C09	Module VI	Dr. Rosabella K.
	CH3C10	Module VI	Ms. Aswathy M.
	CH3C11	Module VI	Ms. Anu Rose.
	CH3E03	Module VI	Ms. Anu Rose.
I Sem MSc.	Inorganic Practicals		Ms. Anu Rose
	Organic Practicals		Ms. Aswathy M.
	Physical Practicals		Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals		Ms. Anu Rose
	Organic Practicals		Ms. Aswathy M.
	Physical Practicals		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

	November 2017		
II Sem BSc. (M)	CHE2B02	Module I	Dr. Santhosh L
IV Sem BSc. (M)	CHE4B04	Module I, II	Dr. Laina A.L
VI Sem BSc. (M)	CHE6B09	Module I	Ms. Maria Jose
	CHE6B10	Module I, II	Ms. Maria Jose
	CHE6B11	Module I, II	Dr. Laina A.L
	CHE6B12	Module I, II	Dr. Santhosh
	CHE6B13(E2)	Module I, II	Dr. Laina A.L
II BSc. (Sub)	CHE2C02	Module I (half)	Ms. Maria Jose
IV Sem BSc. (Sub)	CHE4C04	Module I	Dr. Laina A.L.
BSc. (M)	Practicals		Dr. Laina A.L
BSc. (Sub)	Practicals.		Ms. Maria Jose
II Sem MSc.	CH2C05	Module I, II	Dr. Rosabella K.
	CH2C06	Module I, II	Ms. Anu Rose
	CH2C07	Module I, II	Ms. Aswathy M.
	CH2C08	Module I, II	Ms. Anu Rose
IV Sem MSc.	CH4C12	Module I, II	Dr Rosabella K
	CH4C13	Module I, II	Ms. Aswathy M.
	CH4E05	Module I, II	Ms. Anu. Rose.
II Sem MSc	Inorganic Practical		Ms. Anu. Rose
	Organic Practical		Ms. Aswathy M.
	Physical Practical		Dr. Rosabella K.
IV Sem MSc.	Inorganic Practical		Ms. Anu. Rose.
	Organic Practical		Ms. Aswathy M.
	Physical Practical		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Mah
Maria Jose

Scanned by TapScanner

December 2017

IISemBSc.(M)	CHE2B02	Module II	Dr. Laina. A.L
IVSemBSc.(M)	CHE4B04	Module III	Dr. Santhosh Paul
VISemBSc (M)	CHE6B09	Module II	Dr. Laina A.L
	CHE6B10	Module III	Ms. Maria Jose
	CHE6B11	Module III	Dr. Santhosh Paul
	CHE6B12	Module III, IV	Dr. Laina A.L
	CHE6B13(E2)	Module III	Ms. Maria Jose
IISemBSc (Sub)	CHE2C02	Module I (contd.)	Dr. Santhosh Paul
IVSem BSc. (Sub)	CHE4C04	Module II, III	Dr. Laina A.L
BSc (M)	Practicals		Dr. Laina A.L
BSc (Sub)	Practicals		Ms. Maria Jose
IISem MSc.	CH2C05	Module III	Dr. Rosabella K.
	CH2C06	Module III	Ms Anu Rose
	CH2C07	Module III	Ms. Aswathy M.
	CH2C08	Module III	Dr. Rosabella K.
IVSem MSc.	CH4C12	Module III, IV	Dr. Rosabella K.
	CH4C13	Module III, IV	Ms. Anu Rose
	CH4E05	Module III, IV	Ms. Aswathy M.
IISem MSc.	Inorganic Practicals		Ms. Anu Rose.
	Organic Practicals		Ms. Aswathy M.
	Physical Practicals		Dr. Rosabella K.
IVSem MSc.	Inorganic Practicals		Ms. Anu Rose
	Organic Practicals		Ms. Aswathy M
	Physical Practicals.		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

January 2018

IISemBSc.CA(T)	CHE2B02	Module III (half)	Ms. Maria Jose.
IV SemBSc (A)	CHE4B04	Module IV	Ms. Maria Jose.
VI SemBSc CA()	CHE6B09	Module III	Dr. Laina A.L
	CHE6B10	Module IV	Dr. Santhosh Paul
	CHE6B11	Module IV	Dr. Santhosh Paul
	CHE6B12	Module V	Dr. Laina A.L
	CHE6B13(E2)	Module IV	Ms. Maria Jose
IISemBSc(Sub)	CHE2C02	Module II	Dr. Santhosh Paul
IVSemBSc(Sub)	CHE4C04	Module IV	Ms. Maria Jose.
BSc.(M)	Practicals		Dr. Laina A.L
BSc.(Sub.)	Practicals.		Ms. Maria Jose
IISem MSc.	CH2C03	Module IV	Dr. Rosabella K
	CH2C06	Module IV	Ms. Aswathy M.
	CH2C07	Module IV	Ms. Anu Rose
	CH2C08	Module IV	Ms. Aswathy M.
IV Sem MSc	CH4C12	Module V	Dr. Rosabella K.
	CH4C13	Module V	Ms. Anu Rose
	CH4E05	Module V	Ms. Aswathy M.
IISem MSc.	Inorganic Practicals		MS Anu Rose.
	Organic Practicals		Ms. Aswathy M
	Physical Practicals		Dr. Rosabella K.
IV Sem MSc	Inorganic Practicals		Ms. Anu Rose
	Organic Practicals		Ms. Aswathy M.
	Physical Practicals		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

February 2018

II Sem BSc. (M)	CH2B02	Module III (contd.)	Dr. Santhosh Paul
IV Sem BSc. (M)	CHE4B04	Module V	Ms. Maria Jose
VI Sem BSc (M)	CHE6B09	Module IV	Dr. Santhosh Paul
	CHE6B10	Module V	Ms. Maria Jose
	CHE6B11	Module V	Dr. Laina A.L
	CHE6B12	Module VI	Dr. Laina A.L
	CHE6B13(CE2)	Module. V	Dr. Santhosh Paul
II Sem BSc. (Sub)	CHE2C02	Module III	Ms. Maria Jose
IV Sem BSc (Sub)	CHE4C04	Module V, VI	Ms. Maria Jose
		Modula	
BSc. (M)	Practicals	M.	Dr. Laina A.L
BSc (Sub)	Practicals.		Ms. Maria Jose
II Sem MSc	CH2C05	Module V	Dr. Rosabella K.
	CH2C06	Module V	Ms. Anu Rose
	CH2C07	Module V	Ms. Aswathy M.
	CH2C08	Module V	Ms. Anu Rose
IV Sem MSc	CH4C12	Module VII, VIII	Dr. Rosabella K.
	CH4C13	Module VI. VII	Ms Aswathy M.
	CH4E05	Module VI, VII	Ms. Anu Rose.
II Sem MSc.	Inorganic Practicals		Ms. Anu Rose.
	Organic Practicals		Ms. Aswathy M.
	Physical Practicals		Dr. Rosabella K.
IV Sem MSc.	Inorganic Practicals		Ms. Anu Rose.
	Organic Practicals		Ms. Aswathy M.
	Physical Practicals.		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

March 2018

IISemBSc.(M)	CHE2B02	Module IV	Dr. Laina A.L.
IVSemBSc.(M)	CHE4B04	Module VI	Dr. Santhosh Paul
VISemBSc.CM	CHE6B09	Module V	Dr. Laina A.L
	CHE6B10	Module VI	Ms. Malia Jose.
	CHE6B11	Module VI	Ms. Malia Jose.
	CHE6B12	Module VII	Dr. Santhosh Paul
	CHE6B13(CE2)	Module VI	Dr. Laina. A.L
IISemBSc(Sub)	CHE2C02	Module IV	Dr. Santhosh Paul
IVSemBSc(Sub)	CHE4C04	Module VII	Dr. Santhosh Paul
BSc.(M)	Practicals		Dr. Laina A.L
BSc.(Sub)	Practicals		Ms. Malia Jose.
IISemMSc.	CH2C05	Module VI	Dr. Rosabella K.
	CH2C06	Module VI	Ms. Aswathy M.
	CH2C07	Module VI	Ms. Anu Rose
	CH2C08	Module VI	Ms. Anu Rose
IVSemMSc.	CH4C12	Module VIII	Dr. Rosabella K.
	CH4C13	Module VIII	Ms. Anu Rose.
	CH4E05	Module VIII	Ms. Aswathy M.
IISemMSc.	Inorganic Practicals		Ms. Anu Rose.
	Organic Practicals		Ms. Aswathy M.
	Physical Practicals		Dr. Rosabella K.
IVSemMSc.	Inorganic Practicals		Ms. Anu Rose.
	Organic Practicals		Ms. Aswathy M.
	Physical Practicals		Dr. Rosabella. K.

Department of Chemistry
Sacred Heart College
Chalakudy

Mah
Maria Jose

Scanned by TapScanner

June 2018

I Sem BSc (M)	CHE1B01	Module I	Dr. Santhosh Paul
III Sem BSc (M)	CHE3B03	Module I	Ms. Maria Jose
V Sem BSc (M)	CHE5B06	Module I, II	Dr. Laina A.L
	CHE5B07	Module I, II	Dr. Santhosh Paul
	CHE5B08	Module I, II	Dr. Anuja E.V
	CHE5D01	Module I	Ms. Maria Jose
I Sem BSc. (Sub)	CHE1C01	Module I	Dr. Laina A.L
III Sem BSc (Sub)	CHE3C03	Module I, II	Dr. Santhosh Paul.
BSc (M)	Practicals		Dr. Anuja E.V
BSc (Sub)	Practicals.		Dr. Laina A.L
I Sem MSc.	CH1C01	Module I, II	Dr. Rosabella K.
	CH1C02	Module I, II	Ms. Linda Tresa.
	CH1C03	Module I, II	Ms. Athira T.
	CH1C04	Module I, II	Ms. Linda Tresa.
III Sem MSc	CH3C09	Module I, II	Dr. Rosabella K.
	CH3C10	Module I, II	Ms. Linda Tresa.
	CH3E03	Module I, II	Ms. Athira T.
I Sem MSc.	Inorganic Practicals		Ms. Athira T.
	Organic Practicals		Ms. Linda Tresa
	Physical Practicals		Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals		Ms. Athira T.
	Organic Practicals		Ms. Linda Tresa
	Physical Practicals		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

July 2018

I Sem BSc (M)	CHE1B01	Module II — Ms. Maria Jose.
III Sem BSc (M)	CHE3B03	Module II — Dr. Santhosh Paul
V Sem BSc (M)	CHE5B06	Module III — Dr. Anuja E.V
	CHE5B07	Module III, IV — Dr. Santhosh Paul.
	CHE5B08	Module III, IV — Dr. Laina A.L
	CHE5D01	Module II — Dr. Anuja E.V
I Sem BSc (Sub)	CHE1C01	Module II — Ms. Maria Jose
III Sem BSc (Sub)	CHE3C03	Module III, IV — Dr. Laina A.L
BSc. (M)	Practicals	Dr. Anuja E.V
BSc. (Sub)	Practicals	Dr. Laina A.L
I Sem MSc.	CH1C01	Module II — Dr. Rosabella K.
	CH1C02	Module III — Ms. Linda Tresa.
	CH1C03	Module III — Ms. Linda Tresa.
	CH1C04	Module III — Ms. Athira T.
III Sem MSc	CH3C09	Module III — Dr. Rosabella K.
	CH3C10	Module III — Ms. Athira T.
	CH3E03	Module. III — Ms. Athira T.
I Sem MSc.	Inorganic Practicals	Ms. Athira T.
	Organic Practicals	Ms. Linda Tresa.
	Physical Practicals.	Dr. Rosabella K.
III Sem MSc	Inorganic Practicals	Ms. Athira T.
	Organic Practicals	Ms. Linda Tresa.
	Physical Practicals	Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

August 2018

I & III BSc. (M)	CHE1B01	Module. III	Dr. Laina A. L
III Sem BSc. (M)	CHE3B03	Module III	Dr Santhosh Paul
V Sem BSc (M)	CHE5B06	Module IV	Dr Anuja E.V
	CHE5B07	Module V, VI	Ms. Maria Jose
	CHE5B08	Module V	Dr. Santhosh Paul
	CHE5D01	Module III	Dr. Laina. A. L
I Sem BSc. (Sub)	CHE1C01	Module III	Ms. Maria Jose.
III Sem BSc (Sub)	CHE3C03	Module V	Dr. Anuja E.V
BSc (M)	Practicals		Dr. Anuja E.V
BSc (Sub)	Practicals.		Dr. Laina A.L
I Sem MSc.	CH1C01	Module IV	Dr. Rosabella K.
	CH1C02	Module IV	Ms. Linda Tresa.
	CH1C03	Module IV	Ms. Athira T.
	CH1C04	Module IV	Dr. Rosabella K.
III Sem MSc.	CH3C09	Module IV	Ms. Linda Tresa
	CH3C10	Module IV	Ms. Athira T.
	CH3E03	Module IV	Ms. Linda Tresa.
I Sem MSc.	Inorganic Practicals		Ms. Athira T
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals		Ms. Athira T.
	Organic Practicals		Ms. Linda Tresa
	Physical Practicals		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

September 2018

I Sem BSc. (M)	CHE1B01	Module IV — Ms. Maria Jose
III Sem BSc. (M)	CHE3B03	Module IV — Dr. Santhosh Paul
V Sem BSc. (M)	CHE5B06	Module V — Dr. Laina A.L
	CHE5B07	Module VII — Dr. Anuja E.V
	CHE5B08	Module VI — Ms. Maria Jose
	CHE5D01	Module IV — Dr. Santhosh Paul
I Sem BSc. (Sub)	CHE1C01	Module IV — Dr. Laina A.L
III Sem BSc. (Sub)	CHE3C03	Module VI — Ms. Maria Jose
BSc. (M)	Practicals	Dr. Anuja E.V
BSc. (Sub)	Practicals.	Dr. Laina A.L
I Sem MSc.	CH1C01	Module V — Dr. Rosabella K.
	CH1C02	Module V — Ms. Linda Tresa.
	CH1C03	Module V — Ms. Athira T.
	CH1C04	Module V — Ms. Athira. T
III Sem MSc.	CH3C09	Module V — Dr. Rosabella K.
	CH3C10	Module V — Ms. Linda Tresa
	CH3E03	Module V — Ms. Athira. T.
I Sem MSc.	Inorganic Practicals	Ms. Athira T.
	Organic Practicals	Ms. Linda Tresa.
	Physical Practicals	Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals	Ms. Athira T.
	Organic Practicals	Ms. Linda Tresa.
	Physical Practicals.	Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

October 2018

I Sem BSc (M)	CHE1B01	Module V	Dr. Laina A.L
III Sem BSc (M)	CHE3B03	Module V	Dr. Anuja E.V
I Sem BSc (M)	CHE5B06	Module VI	Dr. Santhosh Paul
	CHE5B07	Module VIII	Ms. Maria Jose
	CHE5B08	Module VII	Dr. Anuja E.V
	CHE5D01	Module V	Dr. Santhosh Paul
I Sem BSc (Sub)	CHE1C01	Module V	Ms. Maria Jose
III Sem BSc (Sub)	CHE3C03	Module VII	Dr. Anuja E.V
BSc (M)	Practicals		Dr. Anuja E.V
BSc (Sub)	Practicals		Dr. Laina A.L
I Sem MSc.	CH1C01	Module VI	Dr. Rosabella K.
	CH1C02	Module VI	Ms. Linda Tresa
	CH1C03	Module VI	Ms. Athira.
	CH1C04	Module VI	Ms. Linda Tresa.
III Sem MSc.	CH3C09	Module VI	Ms. Athira.
	CH3C10	Module VI	Dr. Rosebella K.
	CH3C11	Module VI	Ms. Linda Tresa
	CH3E03	Module VI	Ms. Athira.
I Sem MSc.	Inorganic Practicals		Ms. Athira
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosebella K.
II Sem MSc.	Inorganic Practicals		Ms. Athira.
	Organic Practicals		Ms. Linda Tresa
	Physical Practicals		Dr. Rosebella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

November 2018

II Sem BSc. (M)	CHE2B02	Module I	Ms. Maria Jose.
IV Sem BSc. (M)	CHE4B04	Module I, II	Dr. Santhosh Paul.
VI Sem BSc. (M)	CHE6B09	Module I	Dr Laina. A.L
	CHE6B10	Module I, II	Dr. Anuja E.V
	CHE6B11	Module I, II	Ms. Maria Jose
	CHE6B12	Module I, II	Dr. Anuja E.V
	CHE6B13(E2)	Module I, II	Dr. Santhosh Paul
II Sem BSc. (Sub)	CHE2C02	Module I (half)	Dr. Laina A.L
IV Sem BSc (Sub)	CHE4C04	Module I	Ms. Maria Jose.
BSc. (M)	Practicals		Dr. Anuja E.V
BSc. (Sub)	Practicals.		Dr. Laina A.L
II Sem MSc.	CH2C05	Module I, II	Dr. Rosabella K.
	CH2C06	Module I, II	Ms. Athira.
	CH2C07	Module I, II	Ms. Linda Tresa.
	CH2C08	Module I, II	Ms. Athira.
IV Sem MSc.	CH4C12	Module I, II	Dr. Rosabella K.
	CH4C13	Module I, II	Ms. Athira
	CH4E05	Module I, II	Ms. Linda Tresa.
II Sem MSc.	Inorganic Practicals		Ms. Athira
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosabella K.
IV Sem MSc.	Inorganic Practicals		Ms. Athira.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

December 2018

II Sem BSc. (M)	CHE2B02	Module II	Ms. Maria Jose
IV Sem BSc. (M)	CHE4B04	Module III	Dr. Anuja E.V
VI Sem BSc. (M)	CHE6B09	Module II	Dr. Santhosh Paul
	CHE6B10	Module III	Dr. Laina A.L
	CHE6B11	Module IV	Dr. Anuja E.V
	CHE6B12	Module III, IV	Ms. Maria Jose.
	CHE6B13(E2)	Module. III	Dr. Santhosh Paul
II Sem BSc (Sub)	CHE2C02	Module I (contd.)	Dr. Laina A.L.
IV Sem BSc (Sub)	CHE4C04	Module II, III	Dr. Santhosh Paul.
BSc. (M)	Practicals		Dr. Anuja E.V
BSc. (Sub)	Practicals		Dr. Laina A.L
II Sem MSc.	CH2C05	Module III	Dr. Rosebella K.
	CH2C06	Module III	Ms. Athira
	CH2C07	Module III	Ms. Linda
	CH2C08	Module III	Dr. Rosebella. K,
IV Sem MSc.	CH4C12	Module III, IV	Ms. Linda
	CH4C13	Module III, IV	Ms. Athira T.
	CH4E05	Module III, IV	Dr. Rosebella. K
II Sem MSc.	Inorganic Practicals		Ms. Athira. T.
	Organic Practicals		Ms. Linda.
	Physical Practicals		Dr. Rosebella K.
IV Sem MSc.	Inorganic Practicals		Ms. Athira. T.
	Organic Practicals		Ms. Linda.
	Physical Practicals		Dr. Rosabella. K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

January 2019

II Sem BSc. (M)	CHE2B02	Module III (half)	Dr. Anuja E.V
IV Sem BSc. (M)	CHE4B04	Module IV	Dr. Laina A.L
VI Sem BSc. (M)	CHE6B09	Module III	Dr. Santhosh Paul
	CHE6B10	Module IV	Dr. Anuja E.V
	CHE6B11	Module IV	Dr. Laina A.L
	CHE6B12	Module V	Ms. Maria Jose.
	CHE6B13(E2)	Module IV	Dr. Santhosh Paul
II Sem BSc. (Sub)	CHE2C02	Module II	Dr. Laina A.L
IV Sem BSc. (Sub)	CHE4C04	Module IV	Ms. Maria Jose.
BSc. (M)	Practicals		Dr. Anuja E.V
BSc. (Sub)	Practicals.		Dr. Laina A.L
II Sem MSc.	CH2C05	Module IV	Dr. Rosebella K.
	CH2C06	Module IV	Ms. Linda Tresa.
	CH2C07	Module IV	Ms. Athira
	CH2C08	Module IV	Dr. Rosebella K.
IV Sem MSc.	CH4C12	Module V	Ms. Athira
	CH4C13	Module V	Ms. Linda Tresa.
	CH4E05	Module V	Ms. Athira.
II Sem MSc.	Inorganic Practicals		Ms. Athira T.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosebella T.
IV Sem MSc.	Inorganic Practicals		Ms. Athira T.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practical.		Dr. Rosabella T.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

February 2019

II Sem BSc. (M)	CHE2B02	Module III (contd.)	Dr. Santhosh Paul
IV Sem BSc. (M)	CHE4B04	Module V	Dr. Anuja E.V
VI Sem BSc. (M)	CHE6B09	Module IV	Dr. Laina A.L
	CHE6B10	Module V	Ms. Maria Jose
	CHE6B11	Module V	Ms. Maria Jose.
	CHE6B12	Module VI	Dr. Laina A.L
	CHE6B13 (E2)	Module V	Dr. Anuja E.V
II Sem BSc. (Sub)	CHE2C02	Module III	Ms. Maria Jose.
IV Sem BSc. (Sub)	CHE4C04	Module V, VI	Dr. Santhosh Paul
BSc. (M)	Practicals		Dr. Anuja E.V
BSc. (Sub)	Practicals.		Dr. Laina A.L
II Sem MSc.	CH2C05	Module V	Dr. Rosebella K.
	CH2C06	Module V	Ms. Linda Tresa
	CH2C07	Module V	Ms. Athira. T.
	CH2C08	Module V	Dr. Rosebella K.
IV Sem MSc.	CH4C12	Module VI, VII	Ms. Linda Tresa
	CH4C13	Module VI, VII	Ms. Athira T
	CH4E05	Module VI, VII	Ms Athira T.
IV Sem MSc.	Inorganic Practicals		Ms. Athira T.
	Organic Practicals		Ms. Linda Tresa
	Physical Practicals		Dr. Rosebella K.
IV Sem MSc.	Inorganic Practicals		Ms. Athira T.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals.		Dr. Rosebella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

Scanned by TapScanner

March 2019.

II Sem BSc. (M)	CHE2B02	Module IV	Dr. Laina A.L
IV Sem BSc. (M)	CHE4B04	Module VI	Dr. Santhosh Paul
VI Sem BSc. (M)	CHE6B09	Module V	Dr. Anuja E.V
	CHE6B10	Module VI	Dr. Santhosh Paul
	CHE6B11	Module VI	Dr. Laina A.L
	CHE6B12	Module VII	Ms. Maria Jose
	CHE6B12 (Es)	Module VI	Ms. Maria Jose
II Sem BSc. (Sub)	CHE2C02	Module IV	Dr. Santhosh Paul
IV Sem BSc. (Sub)	CHE4C04	Module VII	Dr. Anuja E.V
BSc. (M)	Practicals		Dr. Anuja E.V
BSc. (Sub)	Practicals.		Dr. Laina A.L
II Sem MSc.	CH2C05	Module VI	Dr. Rosebella K.
	CH2C06	Module VI	Ms. Linda Teresa.
	CH2C07	Module VI	Ms. Athira T.
	CH2C08	Module VI	Ms. Athira T.
IV Sem MSc.	CH4C12	Module VIII	Dr. Rosebella K
	CHHC13	Module VIII	Ms. Linda
	CH4E05	Module VIII	Ms. Athira.
II Sem MSc.	Inorganic Practicals		Ms. Athira.
	Organic Practicals		Ms. Linda.
	Physical Practicals.		Dr. Rosebella K.
IV Sem MSc.	Inorganic Practicals		Ms. Athira
	Organic Practicals		Ms. Linda.
	Physical Practicals		Dr. Rosebella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Mark
Maria Jose

Scanned by TapScanner

June 2019

I Sem BSc. (M)	CHE1B01	Module I, II	Ms. Maria Jose
III Sem BSc. (M)	CHE3B03	Module I	Dr. Santhosh Paul
V Sem BSc. (M)	CHE5B06	Module I, II	Dr. Santhosh Paul.
	CHE5B07	Module I, II	Dr. Laina A.L
	CHE5B08	Module I, II	Ms. Anila Paul.
I Sem BSc. (Sub)	CHE1C01	Module I (half)	Ms. Anila Paul
III Sem BSc. (Sub)	CHE3C03	Module I, II	Ms. Maria Jose.
BSc. (M)	Practicals,		Dr. Laina A.L
BSc. (Sub)	Practicals,		Ms. Anila Paul
I Sem MSc.	CHE1C01	Module I, II	Dr. Rosabella K.
	CHE1C02	Module I, II	Ms. Heena. P
	CHE1C03	Module I	Ms. Linda Tresa
	CHE1C04	Module I	Ms. Heena. P.
III Sem MSc.	CHE3C09	Module I, II	Dr. Rosabella K.
	CHE3C10	Module I, II	Ms. Linda Teesa.
	CHE3C11	Module I, II	Ms. Heena. P
	CHE3E03	Module I	Ms. Anila Paul.
I Sem MSc	Inorganic Practicals		Ms. Heena P.
	Organic Practical		Ms. Linda Tresa
	Physical Practicals		Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals		Ms. Heena P
	Organic Practicals		Ms. Linda Tresa
	Physical Practicals.		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Mah

Maria Jose

July 2019

I Sem BSc. (M)	CHE1B01	Module III	Dr. Santhosh Paul
III Sem BSc. (M)	CHE3B03	Module II	Dr. Laina. A. L
V Sem BSc. (M)	CHE5B06	Module III, IV (Half)	Ms. Maria Jose.
	CHE5B07	Module III, IV	Ms. Maria Jose
	CHE5B08	Module III	Dr. Santhosh Paul
I Sem BSc. (Sub)	CHE1C01	Module I (contd.)	Ms. Linda Tresa
III Sem BSc. (Sub)	CHE3C03	Module II, IV	Ms. Anila Paul
BSc. (M)	Practicals.		Dr. Laina A. L
BSc. (Sub)	Practicals.		Ms. Anila Paul.
I Sem MSc.	CHE1C01	Module III, IV	Dr. Rosabella. K.
	CHE1C02	Module III	Ms. Linda Tresa
	CHE1C03	Module II, III	Ms. Anila Paul.
	CHE1C04	Module II, III	Ms. Heena P.
III Sem MSc.	CHE3C09	Module III	Ms. Rosabella. K
	CHE3C10	Module III	Ms Linda Tresa
	CHE3C11	Module III	Ms. Anila Paul,
	CHE3E03	Module II, III	Ms. Heena P.
I Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Linda Tresa
	Physical Practicals		Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals		Ms. Heena P
	Organic Practicals		Ms. Linda Tresa
	Physical Practicals.		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

August 2019

I Sem BSc. (M)	CHE1B01	Module IV	Ms. Maria Jose
III Sem BSc (M)	CHE3B03	Module III	Dr. Laina. A. L
V Sem BSc. (M)	CHE5B06	Module IV (contd.)	Ms. Anila Paul
	CHE5B07	Module V	Ms. Maria Jose
	CHE5B08	Module IV	Dr. Santhosh Paul
I Sem BSc. (Sub)	CHE1C01	Module II	Dr. Santhosh Paul
III Sem BSc. (Sub)	CHE3C03	Module V	Ms. Maria Jose.
BSc. (M)	Practicals		Dr. Laina A.L.
BSc. (Sub)	Practicals.		Ms. Anila Paul
I Sem MSc.	CHE1C01	Module V, VI	Dr. Rosabella K.
	CHE1C02	Module IV	Ms. Heena P.
	CHE1C03	Module IV	Ms. Linda Tresa
	CHE1C04	Module IV	Ms. Heena P.
III Sem MSc.	CHE3C09	Module IV, V	Dr. Rosabella K.
	CHE3C10	Module IV	Ms. Linda Tresa.
	CHE3C11	Module IV	Ms. Heena P.
	CHE3E03	Module IV	Ms. Anila Paul.
I Sem MSc.	Inorganic Practicals		Ms. Linda Tresa
	Organic Practicals		Ms. Heena. P.
	Physical Practicals		Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals.		Dr. Rosabella. K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

September 2019

I Sem BSc. (M)	CHE1B01	Module V	Ms. Anila Paul
III Sem BSc. (M)	CHE3B03	Module IV	Dr. Laina A.L
V Sem BSc. (M)	CHE5B06	Module I, VI	Ms. Maria Jose.
	CHE5B07	Module VI	Dr. Santhosh Paul
	CHE5B08	Module V	Dr. Laina A.L
I Sem BSc. (Sub)	CHE1C01	Module III	Dr. Santhosh Paul
III Sem BSc. (Sub)	CHE3C03	Module VI	Ms. Maria Jose.
BSc. (M)	Practicals.		Dr. Laina A.L.
BSc. (Sub).	Practicals.		Ms. Anila Paul.
I Sem MSc.	CHE1C01	Module VII	Dr. Rosabella K.
	CHE1C02	Module V	Ms. Heena. P
	CHE1C03	Module V	Ms. Linda Tresa.
	CHE1C04	Module V	Ms. Anila Paul.
III Sem MSc.	CHE3C09	Module VI, VII	Dr. Rosabella. K.
	CHE3C10	Module V	Ms. Linda Tresa.
	CHE3C11	Module V	Ms. Heena. P.
	CHE3E03	Module V	Ms. Anila Paul.
I Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosabella. K.
III Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practical		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosabella. K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

October 2019

I Sem BSc. (M)	CHE1B01	Module VI	Ms. Anila Paul
III Sem BSc. (M)	CHE3B03	Module V	Dr. Laina A. L.
V Sem BSc. (M)	CHE5B06	Module VIII	Dr. Santhosh Paul
	CHE5B07	Module VII	Ms. Maria Jose
	CHE5B08	Module VI	Ms. Maria Jose.
I Sem BSc. (Sub)	CHE1C01	Module IV	Dr. Santhosh Paul
III Sem BSc (Sub)	CHE3C03	Module VII	Ms. Anila Paul.
BSc. (M)	Practicals.		Dr. Laina A. L
BSc. (Sub)	Practicals,		Ms. Anila Paul.
I Sem MSc.	CHE1C01	Module VIII	Dr. Rosabella K.
	CHE1C02	Module VI	Ms. Linda Tresa.
	CHE1C03	Module VI	Ms. Anila Paul
	CHE1C04	Module VI	Ms. Heena. P.
III Sem MSc.	CHE3C09	Module VIII	Dr. Rosabella. K.
	CHE3C10	Module VI	Ms. Heena P
	CHE3C11	Module VI	Ms. Linda Tresa.
	CHE3E03	Module VI	Ms. Heena P.
I Sem MSc.	Inorganic Practicals		Ms. Heena. P.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosabella. K.
III Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic "		Ms. Linda Tresa.
	Physical "		Dr. Rosabella. K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

	November 2019		
II Sem BSc (M)	CHE2B02	Module I	Ms. Maria Jose.
IV Sem BSc (M).	CHE4B04	Module I	Dr. Santhosh Paul.
VI Sem BSc (M).	CHE6B09	Module I	Dr. Laina. A.L
	CHE6B10	Module I, II	Dr. Laina A.L
	CHE6B11	Module I, II	Ms. Anila Paul.
	CHE6B12	Module I, II	Dr. Santhosh Paul.
	CHE6B13(E)	Module I	Ms. Maria Jose.
II Sem BSc (Sub)	CHE2C02	Module I half	Ms. Anila Paul.
IV Sem BSc (Sub)	CHE4C04	Module I, II	Dr. Laina A.L
BSc. (M)	Practicals		Dr. Laina A.L.
BSc (Sub).	Practicals		Ms. Anila Paul.
II Sem MSc.	CHE2C05	Module I	Dr. Rosebella K.
	CHE2C06	Module I	Ms. Heena. P.
	CHE2C07	Module I, II	Ms. Linda Tresa.
	CHE2C08	Module I	Ms. Linda Tresa.
IV Sem MSc.	CHE4C12	Module I, II	Dr. Rosebella K.
	CHE4E05	Module I	Ms. Linda Tresa.
	CHE4E08	Module I, II	Ms. Heena. P.
II Sem MSc	Inorganic Practicals		Ms. Heena. P.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosebella. K.
IV Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosebella. K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

December 2019.

II Sem BSc (M)	CHE2B02	Module II' half	Dr. Santhosh Paul.
IV Sem BSc (M)	CHE4B04	Module II	Dr. Laina A.L
VI Sem BSc (M)	CHE6B09	Module II	Ms. Malia Jose.
	CHE6B10	Module III	Ms. Maria Jose.
	CHE6B11	Module III	Dr. Laina. A.L.
	CHE6B12	Module III, IV	Dr. Santhosh Paul.
	CHE6B13(E2)	Module II, III	Dr. Laina A.L.
II Sem BSc (Sub)	CHE2102	Module I contd.	Ms. Anila Paul.
IV Sem BSc (Sub)	CHE4102.	Module III, IV	Ms. Maria Jose.
BSc (M)	Practicals.		Dr. Laina A.L
BSc (Sub)	Practicals.		Ms. Anila Paul.
II Sem MSc.	CHE2C05	Module II	Dr. Rosabella. K.
	CHE2C06	Module II	Ms. Linda Tresa.
	CHE2C07	Module III	Ms. Heena. P.
	CHE2C08	Module II'.	Ms. Anila Paul.
IV Sem MSc.	CHE4C12	Module III, IV	Dr. Rosabella. K.
	CHE4E05	Module II, III	Ms. Heena. P
	CHE4E08	Module III IV	Ms. Linda Tresa.
II Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosabella K.
IV Sem MSc	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Linda Tresa
	Physical Practicals		Dr. Rosabella K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

	January 2020		
II Sem BSc. (M)	CHE2B02	Module II contd	Dr. Laina A. L
IV Sem BSc (M)	CHE4B04	Module III	Dr. Santhosh Paul.
VI Sem BSc (M)	CHE6B09	Module III	Ms. Maria Jose.
	CHE6B10	Module IV	Dr. Santhosh Paul.
	CHE6B11	Module IV	Ms. Anila Paul.
	CHE6B12	Module V	Dr. Laina A. L
	CHE6B13(Ee)	Module IV	Ms Maria Jose.
I Sem BSc (Sub)	CHE2C02	Module II	Ms. Maria Jose.
IV Sem BSc (Sub)	CHE4C04	Module V	Ms. Anila Paul.
BSc. (M)	Practicals.		Dr. Laina A. L.
BSc. (Sub)	Practicals.		Ms. Anila Paul.
I Sem MSc.	CHE2C05	Module III, IV	Dr. Rosabella K.
	CHE2C06	Module III	Ms. Linda Tresa.
	CHE2C07	Module IV	Ms. Heena P.
	CHE2C08	Module III, IV	Ms. Anila Paul.
IV Sem MSc.	CHE4C12	Module V, VI	Dr. Rosabella. K.
	CHE4E05	Module IV, V	Ms. Linda Tresa.
	CHE4E08	Module V	Ms. Heena P.
II Sem MSc.	Inorganic Practicals		Ms. Heena. P
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosabella. K.
IV Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosabella. K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

February 2020

II Sem BSc. (M)	CHE2B02	Module III	Ms. Maria Jose.
IV Sem BSc. (M)	CHE4B04	Module IV	Dr. Laina A.L
VI Sem BSc (M)	CHE6B09	Module IV	Dr. Santhosh Paul.
	CHE6B10	Module V	Dr. Laina A.L
	CHE6B11	Module V	Ms. Maria Jose.
	CHE6B12	Module VI	Ms. Anila Paul.
	CHE6B12(E2)	Module V	Dr. Santhosh Paul.
II Sem BSc. (Sub)	CHE2C02	Module III	Dr. Laina A.L.
IV Sem BSc. (Sub)	CHE4C04	Module VI	Ms. Maria Jose.
BSc. (M)	Practicals.		Dr Laina A.L
BSc. (Sub)	Practicals.		Ms. Anila Paul.
II Sem MSc.	CHE2C05	Module V	Dr. Rosabella. K.
	CHE2C06	Module IV, V	Dr. Laina A.L.
	CHE2C07	Module V	Ms. Heena. P.
	CHE2C08	Module V	Ms. Linda Tresa.
IV Sem MSc.	CHE4C12	Module VII	Dr. Rosabella K.
	CHE4E05	Module VI, VII	Ms. Heena P.
	CHE4E08	Module VI, VII	Ms. Linda Tresa
II Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals.		Dr. Rosabella. K.
IV Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosabella. K.

Department of Chemistry
Sacred Heart College
Chalakudy

Maria Jose

March 2020

II Sem BSc. (M)	CHE2B02	Module IV	Dr. Santhosh Paul.
IV Sem BSc. (M)	CHE4B04	Module V	Ms. Maria Jose.
VI Sem BSc. (M)	CHE6B09	Module V	Dr. Laina A.L
	CHE6B10	Module VI	Ms. Maria Jose.
	CHE6B11	Module VI	Dr. Santhosh Paul.
	CHE6B12	Module VII	Ms. Anila Paul.
	CHE6B12(E2)	Module VI	Dr. Laina. A.L
II Sem BSc. (Sub)	CHE2C02	Module IV	Dr. Santhosh Paul.
IV Sem BSc. (Sub)	CHE4C04	Module VII	Ms. Maria Jose.
BSc. (M)	Practicals		Dr. Laina. A.L
BSc. (Sub)	Practicals		Ms. Anila Paul.
II Sem MSc.	CHE2C05	Module VI	Dr. Rosabella. K.
	CHE2C06	Module VI	Ms. Heena. P.
	CHE2C07	Module VI	Ms. Linda Tresa.
	CHE2C08	Module VI	Ms. Heena P.
IV Sem MSc.	CHE4C13	Module VIII	Dr. Rosabella. K.
	CHE4E05	Module VIII	Ms. Heena. P.
	CHE4E08	Module VIII	Ms. Linda Tresa.
II Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosabella. K.
IV Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Linda Tresa.
	Physical Practicals		Dr. Rosabella. K.

Department of Chemistry
Sacred Heart College
Chalakudy

Mary

Maria Jose

June 2020

I Sem BSc (M)	CHE1B01	Module I, II	Dr. Santhosh Paul.
III Sem BSc (M)	CHE3B03	Module I	Dr. Laina A.L.
V Sem BSc (M)	CHE5B06	Module I, II	Ms. Anila Paul.
	CHE5B07	Module I, II	Dr. Laina A.L
	CHE5B08	Module I, II	Dr. Santhosh Paul
I Sem BSc (Sub)	CHE1C01	Module I (half)	Ms. Anila Paul.
III Sem BSc (Sub)	CHE3C03	Module I, II	Dr. Laina A.L.
BSc (M)	Practicals -		Dr. Santhosh Paul.
BSc (Sub)	Practicals.		Dr. Laina A.L.
I Sem MSc.	CHE1C01	Module I, II	Dr. Rosabella. K.
	CHE1C02	Module I, II	Ms. Limi V.G.
	CHE1C03	Module I	Ms. Heena. P.
	CHE1C04	Module I	Ms. Limi V.G.
III Sem MSc	CHE3C09	Module I, II	Dr. Rosabella. K.
	CHE3C10	Module I, II	Ms. Heena P.
	CHE3C11	Module I, II	Ms. Limi. V.G.
	CHE3E03	Module I	Ms. Anila Paul,
I Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi V.G.
	Physical Practicals		Dr. Rosabella. K.
III Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi V.G.
	Physical Practicals,		Dr. Rosabella K,

Dr. Santhosh Paul
HoD

Department of Chemistry
Sacred Heart College
Chalakudy

July 2020

I Sem BSc. (CM)	CHE1B01	Module III	Ms. Anila Paul.
III Sem BSc (CM)	CHE3B03	Module II	Dr. Santhosh Paul
V Sem BSc (CM)	CHE5B06	Module III, IV (half)	Dr. Laina A.L
	CHE5B07	Module III, IV	Dr. Laina A.L.
	CHE5B08	Module III	Ms. Anila Paul.
I Sem BSc (Sub)	CHE1C01	Module I (contd—)	Dr. Santhosh Paul
III Sem BSc (Sub)	CHE3C03	Module III, IV	Ms. Anila Paul
BSc (CM)	Practicals.		Dr. Santhosh Paul
BSc (Sub)	Practicals.		Dr. Laina A.L
I Sem MSc.	CHE1C01	Module III, IV	Dr. Rosabella. K.
	CHE1C02	Module III	Ms. Limi. V.G.
	CHE1C03	Module II, III	Ms. Heena. P
	CHE1C04	Module II, III	Ms. Limi V.G
III Sem MSc	CHE3C09	Module III	Dr. Rosabella. K.
	CHE3C10	Module III	Ms. Heena P.
	CHE3C11	Module III	Ms. Heena P.
	CHE3E03	Module II, III	Ms. Limi V.G.
I Sem MSc.	Inorganic Practicals		Ms. Heena. P.
	Organic Practicals		Ms. Limi V.G.
	Physical Practicals.		Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals		Ms. Heena. P.
	Organic Practicals		Ms. Limi V.G
	Physical Practicals		Dr. Rosabella. K.

IUY
Dr. Santhosh Paul.
HoD

Department of Chemistry
Sacred Heart College
Chalakudy

August 2020

I Sem BSc. (M)	CHE1B01	Module IV	Dr. Santhosh Paul
III Sem BSc. (M)	CHE3B03	Module III	Ms. Anila Paul.
V Sem BSc. (M)	CHE5B06	Module IV (contd.)	Dr. Laina A.L
	CHE5B07	Module V	Ms. Anila Paul.
	CHE5B08	Module IV	Dr. Laina A.L.
I Sem BSc. (Sub)	CHE1C01	Module II	Dr. Laina A.L.
III Sem BSc. (Sub)	CHE3C03	Module V	Dr. Santhosh Paul.
BSc. (M)	Practicals.		Dr. Santhosh Paul.
BSc. (Sub)	Practicals.		Dr. Laina A.L.
I Sem MSc.	CHE1C01	Module V, VI	Dr. Rosabella. K.
	CHE1C02	Module IV	Ms. Limi V.G
	CHE1C03	Module IV	Ms. Heena. P.
	CHE1C04	Module IV	Ms. Limi V.G.
III Sem MSc.	CHE3C09	Module IV, V	Dr. Rosabella K.
	CHE3C10	Module IV	Ms. Heena. P
	CHE3C11	Module IV	Ms. Heena. P
	CHE3E03	Module IV	Ms. Limi V.G
I Sem MSc.	Inorganic Practicals		Ms. Heena. P
	Organic Practicals		Ms. Limi V.G.
	Physical Practicals		Dr. Rosabella K.
III Sem MSc.	Inorganic Practicals		Ms. Heena. P
	Organic Practicals		Ms. Limi V.G
	Physical Practicals.		Dr. Rosabella. K

Department of Chemistry
Sacred Heart College
Chalakudy

Dr. Santhosh Paul
(H.O.D)

	September 2020		
I Sem BSc. (M)	CHE1B01	Module V	Ms. Anila Paul.
III Sem BSc. (M)	CHE3B03	Module IV	Dr. Laina A-L.
V Sem BSc. (M)	CHE5B06	Module V, VI	Dr. Santhosh Paul.
	CHE5B07	Module VI	Dr. Laina A-L.
	CHE5B08	Module V	Ms. Anila Paul.
I Sem BSc. (Sub)	CHE1C01	Module III	Ms. Anila Paul.
III Sem BSc. (Sub)	CHE3C03	Module VI	Dr. Laina A-L.
BSc. (M)	Practicals.		Dr. Santhosh Paul.
BSc. (Sub)	Practicals.		Dr. Laina A-L.
I Sem MSc.	CHE1C01	Module VII	Dr. Rosabella. K.
	CHE1C02	Module V	Ms. Heena. P.
	CHE1C03	Module V	Ms. Limi. V.G.
	CHE1C04	Module V	Ms. Anila Paul.
III Sem MSc.	CHE3C09	Module VI, VII	Dr. Rosabella. K.
	CHE3C10	Module V	Ms. Anila Paul.
	CHE3C11	Module V	Ms. Limi. V.G.
	CHE3E03	Module V	Ms. Heena. P.
I Sem MSc.	Inorganic Practicals		Ms. Heena. P.
	Organic Practicals		Ms. Limi. V.G.
	Physical Practials		Dr. Rosabella. K.
III Sem MSc.	Inorganic Practicals		Ms. Heena. P
	Organic Practicals		Ms. Limi V.G.
	Physical Practical.		Dr. Rosabella. K.

Dr. Santhosh Paul
HoD

Department of Chemistry
Sacred Heart College
Chalakudy

October 2020

I Sem BSc.(M)	CHE1B01	Module VI	Dr. Santhosh Paul
III Sem BSc. (M)	CHE3B03	Module V	Dr. Laina. A.L
V Sem BSc. (M)	CHE5B06	Module VII	Dr. Laina A. L.
	CHE5B07	Module VII	Ms. Anila Paul.
	CHE5B08	Module VI	Dr. Santhosh Paul
I Sem BSc. (Sub)	CHE1C01	Module IV	Dr. Laina A.L.
III Sem BSc. (Sub)	CHE3C03	Module VII	Ms. Anila Paul.
BSc. (M)	Practicals		Dr. Santhosh Paul
BSc. (Sub).	Practicals		Dr. Laina A.L.
I Sem MSc.	CHE1C01	Module VIII	Dr. Rosabella. K.
	CHE1C02	Module VI	Dr. Laina. A.L.
	CHE1C03	Module VI	Dr. Rosabella. K
	CHE1C04	Module VI	Ms. Heena. P.
III Sem MSc.	CHE3C09	Module VIII	Dr. Rosabella. K.
	CHE3C10	Module VI	Ms. Heena. P.
	CHE3C11	Module VI	Ms. Anila Paul.
	CHE3E03	Module VI	Ms. Limi V.G.
I Sem MSc.	Inorganic Practicals		Ms. Heena. P.
	Organic Practicals		Ms. Limi V.G.
	Physical Practicals		Dr. Rosabella. K.
III Sem MSc.	Inorganic Practicals		Ms. Heena. P.
	Organic Practicals		Ms. Limi V.G.
	Physical Practicals.		Dr. Rosabella. K

1/11/
Dr. Santhosh Paul
HoD

Department of Chemistry
Sacred Heart College
Chalakudy

	November 2020		
II Sem BSc. (M)	CHE2B02	Module I	Dr. Santhosh Paul
IV Sem BSc. (M)	CHE4B04	Module I	Dr. Santhosh Paul.
VI Sem BSc. (M)	CHE6B09	Module I	Anila Paul
	CHE6B10	Module I, II	Dr. Santhosh Paul
	CHE6B11	Module I, II	Dr. Laina. A. L
	CHE6B12	Module I, II	Dr Laina A.L
	CHE6B12(E2)	Module I	Ms Anila Paul
II Sem BSc. (Sub)	CHE2C02	Module I half	Ms Anila Paul
IV Sem BSc. (Sub)	CHE4C04	Module I, II	Dr. Laina A.L
BSc. (M)	Practicals.		Dr. Santhosh Paul
BSc. (Sub)	Practicals.		Dr. Laina. A. L
II Sem MSc.	CHE2C05	Module I	Dr. Rosabella.
	CHE2C06	Module I.	Ms. Heena. P.
	CHE2C07	Module I, II	Ms. Limi. V.G.
	CHE2C08	Module I	Ms. Heena. P
IV Sem MSc.	CHE4C12	Module I, II	Ms. Heena. P
	CHE4E05	Module I	Ms. Limi V.G.
	CHE4E08	Module I, II	Ms. Anila Paul
II Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi V.G
	Physical Practicals.		Dr. Rosabella. K.
IV Sem MSc.	Inorganic Practicals		Ms. Heena P.
	Organic Practicals		Ms. Limi. V.G
	Physical Practicals		Dr Rosabella. K.

Dr. Santhosh Paul
HoD

Department of Chemistry
Sacred Heart College
Chalakudy

December 2020

II Sem BSc. (M)	CHE2B02	Module II half	Dr. Santhosh Paul.
IV Sem BSc. (M)	CHE4B04	Module II	Dr. Laina A. L.
VI Sem BSc. (M)	CHE6B09	Module II	Ms. Anila Paul.
	CHE6B10	Module III	Ms. Anila Paul.
	CHE6B11	Module III	Dr. Santhosh Paul.
	CHE6B12	Module III, IV	Dr. Laina A. L.
	CHE6B13(E2)	Module II, III	Dr. Santhosh Paul
II Sem BSc (Sub)	CHE2C02	Module I contd.	Ms. Anila Paul.
IV Sem BSc (Sub)	CHE4C04	Module III, IV	Dr. Laina A. L.
BSc. (M)	Practicals.		Dr. Santhosh Paul.
BSc. (Sub)	Practicals.		Dr. Laina A. L.
II Sem MSc.	CHE2C05	Module II	Dr. Rosabella. K.
	CHE2C06	Module II	Ms. Heena. P.
	CHE2C07	Module III	Ms. Limi V. G.
	CHE2C08	Module II	Ms. Limi V. G.
IV Sem MSc.	CHE4C12	Module III, IV	Dr. Rosabella. K.
	CHE4E05	Module II, III	Ms. Limi V. G.
	CHE4E08	Module III, IV	Ms. Heena P.
II Sem MSc.	Inorganic Practicals		Ms. Heena. P
	Organic Practicals		Ms Limi V. G
	Physical Practicals.		Dr. Rosabella. K
IV Sem MSc.	Inorganic Practicals		Ms. Heena. P.
	Organic Practicals		Ms. Limi V. G
	Physical Practicals.		Dr. Rosabella K.

Dr. Santhosh Paul.
HoD

Department of Chemistry
Sacred Heart College
Chalakudy

	January 2021		
II Sem BSc.(M)	CHE2B02	Module II contd.	Ms. Anila Paul.
IV Sem BSc.(M)	CHE4B04	Module III	Dr. Laina A.L
VI Sem BSc.(M)	CHE6B09	Module III	Dr. Santhosh Paul
	CHE6B10	Module IV	Dr. Laina A.L
	CHE6B11	Module IV	Dr. Laina A.L
	CHE6B12	Module V	Dr. Santhosh Paul
	CHE6B13(E_2)	Module IV	Ms. Anila Paul
II Sem BSc.(Sub)	CHE2C02	Module II	Dr. Laina A.L
IV Sem BSc.(Sub)	CHE4C04	Module V	Ms. Anila Paul
BSc.(M)	Practicals.		Dr. Santhosh Paul
BSc.(Sub)	Practicals.		Dr. Laina A.L
II Sem MSc.	CHE2C05	Module III, IV	Dr. Rosabella. K.
	CHE2C06	Module III	Ms Heena. P
	CHE2C07	Module IV	Ms. Heena. P
	CHE2C08	Module III, IV	Ms Limi V.G.
IV Sem MSc.	CHE4C12	Module V, VI	Dr. Rosabella. K.
	CHE4E03	Module IV, V	Ms. Heena. P
	CHE4E08	Module V	Ms. Limi. V.G
I Sem MSc.	Inorganic Practicals		Ms. Heena. P.
	Organic Practicals		Ms. Limi. V.G.
	Physical Practicals.		Dr. Rosabella. K.
IV Sem MSc.	Inorganic Practicals		Ms. Heena. P
	Organic Practical		Ms. Limi V.G.
	Physical Practical		Dr. Rosabella. K

Dr. Santhosh Paul
HOD

Department of Chemistry
Sacred Heart College
Chalakudy

February 2021

II Sem BSc (CM)	CHE2B02	Module III	Dr. Santhosh Paul,
IV Sem BSc (CM)	CHE4B04	Module IV	Dr. Laina A. L.
VI Sem BSc (CM)	CHE6B09	Module IV	Ms. Anila Paul,
	CHE6B10	Module V	Dr. Laina A. L
	CHE6B11	Module V	Dr. Santhosh Paul
	CHE6B12	Module VI	Dr. Laina A. L
	CHE6B13 (E2)	Module V	Ms. Anila Paul.
II Sem BSc (Sub)	CHE2C02	Module III	Dr. Santhosh Paul
IV Sem BSc (Sub)	CHE4C04	Module VI	Ms. Anila Paul,
BSc. (CM)	Practicals		Dr. Santhosh Paul.
BSc. (Sub)	Practicals.		Ms. Anila Paul.
II Sem MSc.	CHE2C05	Module V	Dr. Rosabella. K.
	CHE2C06	Module IV, V	Dr. Rosabella. K
	CHE2C07	Module V	Ms Heena. P
	CHE2C08	Module V	Ms. Limi V. G.
IV Sem MSc.	CHE4C12	Module VII	Dr Rosabella. K.
	CHE4E05	Module VI, VII	Ms. Heena. P
	CHE4E08	Module VI, VII	Ms. Limi. V. G.
II Sem MSc.	Inorganic Practicals		Ms. Heena. P.
	Organic Practicals		Ms. Limi V. G.
	Physical Practicals.		Dr. Rosabella. K.
IV Sem MSc.	Inorganic Practical		Ms. Heena. P
	Organic Practical		Ms. Limi V. G
	Physical Practical.		Dr. Rosabella. K.

Dr. Santhosh Paul
HoD

Department of Chemistry
Sacred Heart College
Chalakudy

	March 2021		
II Sem BSc (M)	CHE2B02	Module IV	Ms. Anila Paul.
IV Sem BSc (M)	CHE4B04	Module V	Dr. Santhosh Paul
VI Sem BSc (M)	CHE6B09	Module V	Dr. Laina. A. L
	CHE6B10	Module VI	Ms. Anila Paul.
	CHE6B11	Module VI	Dr. Santhosh Paul
	CHE6B12	Module VII	Dr. Laina A. L
	CHE6B13 (E_2)	Module VI	Ms. Anila Paul
II Sem BSc. (Sub)	CHE2C02	Module IV	Dr. Santhosh Paul
IV Sem BSc (Sub)	CHE4C04	Module VII	Dr. Laina A. L
BSc. (M)	Practicals		Dr. Santhosh Paul
BSc. (Sub)	Practicals		Ms. Anila Paul
II Sem MSc	CHE2C05	Module VI	Dr. Rosabella. K.
	CHE2C06	Module VI	Ms. Heena. P
	CHE2C07	Module VI	Ms. Limi. V.G
	CHE2C08	Module VI	Ms. Heena. P
IV Sem MSc.	CHE4C12	Module VIII	Dr. Rosabella. K.
	CHE4E05	Module VIII	Ms. Limi V.G
	CHE4E08	Module VIII	Ms. Heena. P
II Sem MSc.	Inorganic Practicals		Ms. Heena. P.
	Organic Practicals		Ms. Limi. V.G
	Physical Practicals		Dr. Rosabella K
IV Sem MSc.	Inorganic Practicals		Ms. Heena. P
	Organic Practical		Ms. Limi. V.G
	Physical Practical		Dr. Rosabella K.

Dr. Santhosh Paul
HoD

Department of Chemistry
Sacred Heart College
Chalakudy

Lesson plan

Semester I

Course category: Core Course I

Paper name: TRENDS IN HISTORIOGRAPHY

Code: HIS1B01

Course Outcome:

- Expose the basic understanding regarding the development of History as a discipline.
- The emphasis will be on the major trends in the arena of Historical Writing and Thought.
- Illustrate how the methodological and philosophical shifts have contributed for the development of History as a discipline.

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	Meaning of Historiography – Quasi History	5	Lecture	Evaluation through question-answer session
	Past and History- Differentiation and Conceptualization	4	Lecture Debate	Debate on the topic 'Does history represents past accurately?'
	Nature and Character of Greek Historical Writings- Herodotus	6	Presentation on Greco-Roman traditions and writers	Reference reading and notes are evaluated.
	Nature of Medieval Historical Writings- St: Augustine – Ibn Khaldun	5	Presentation and Lecture	Class test including all the traditions of pre -modern historiographical writings.
Module II	Vico and New science – Positivism- Auguste Comte and Ranke	5	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Marx and Historical Materialism	7	Lecture Debate	Debate on the topic of 'relevance of Marxist ideologies'
	Cultural History- Jacob Burckhardt	3	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	A J Toynbee and the Study of Civilizations	3	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III	The Annales – Marc Bloch, Fernand Braudal	8	Lecture Debate Presentations	Question-answer sessions
	History of Mentalities- Philippe Aries	3	Debate	Debate on the 'relevance of mentalities in history'

	History from Below- E P Thompson	4	Discussion	Discussion on the application of the approach in sub-altern approach
	Post Modernism – Keith Jenkins	6	Lecture	Evaluation through question-answer session
Module IV	Gender History– Gerda Lerner	4	Lecture Debate	Debate on the role of Gender in history
	Food History – Felipe Fernandez- Armesto	4	Lecture Student Seminar	Seminar evaluation
	Environmental History – Alfred W Crosby	5	Lecture Student Seminar	Seminar evaluation
	Oral Tradition and Oral History – Jan Vansina and Allan Nevins	6	Lecture Discussion	Class test
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		95 hours		

Reference Materials

1. Shashi Bhushan Upadhyay, Historiography in the Modern World: Western and Indian Perspectives, OUP, 2016.
2. Gerda Lerner, The Creation of Patriarchy, OUP, 1987.
3. Felipe Fernandez- Armesto, Near A Thousand Tables: A History of Food, The Free Press, 2002
4. Alfred W Crosby, Ecological Imperialism: The Biological Expansion of Europe, 900-1900, Cambridge University Press, 2004.
5. Jan Vansina, Oral Tradition as History, The University of Wisconsin Press, 1985.
6. Gerald L Fetner, Immersed in Great Affairs: Allan Nevins and the Heroic Age of American History, State University of New York Press, 2004.

Semester II

Course Category: Core Course II

Paper name: Trends in Indian Historiography

Code: HIS2 B02

Course Outcome:

- Get the basic understanding regarding the development of Historical consciousness in India.
- Provide a basic understanding regarding the major trends in the arena of Historical Writing and Thought in India.
- Expose the students to the major paradigms associated with the study of Indian History, which will help them to understand the Indian History Courses in the following semesters.

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I - Historical Consciousness in Pre- British India	Concept of time in early India	3	Lecture	Evaluation through question-answer session
	Jain and Buddhist Tradition	3	Discussion Student seminar	Seminar evaluation
	Ithihasa – Purana Tradition	2	Discussion Student seminar	Seminar evaluation
	Charithas and Kavyas- Harshacharitha – Mooshakavamsa- Rajatharangani	3	Student Seminar Lecture	Evaluation through question-answer session
	Kitab-al- Hind- Al- Biruni	3	Lecture	Evaluation through question-answer session
	Historical Writings of Sultanate Period- Barani- Amir Khusrau	3	Lecture	Evaluation through question-answer session
	Historiography of Mughal period -AbulFazal	3	Lecture Discussion	Discussion on the merits of Mughal historical traditions.
	Historical consciousness in other parts of India - Ferishta- Sheikh Zainuddeen- Mangalkabya	3	Lecture	Evaluation through question-answer session
	Indology- William Jones- Max Muller	3	Lecture Reference	Students' reference notes are evaluated

Module II Colonial and Nationalist Historiography	James Mill and the Division of Indian History- The History of British India	3	Lecture Reference	Students' reference notes are evaluated
	Vincent A Smith- Great Men History	2	Lecture	Evaluation through question-answer session
	Nationalist Historiography- K.P Jayswal- R.C Majumdar- R.C Dutt- K.A.N Sastri- Elamkulam P N Kunjan Pillai	5	Lecture Debate	Debate on the topic ' Colonialist vs Nationalist historiography: representation of truth'
Module III Critique of Paradigms	Oriental Despotism	3	Lecture	Evaluation through question-answer session
	Asiatic Mode of Production	5	Lecture Student Seminar	Seminar evaluation
	Hydraulic Society	2	Lecture	Evaluation through question-answer session
	Aryan Racial Supremacy Theory	2	Lecture	Evaluation through question-answer session
	Romila Thapar's Critique on Colonial and Nationalist Historiography	5	Debate Lecture	Debate on the topic ' Reactions towards colonialist historiography from Indians'
Module IV Historiographical Trends in Independent India	Marxist approach to Indian history writing	6	Debate Lecture	Debate on the topic or 'merits of applying Marxist methodology into Indian history writing'
	Subaltern Studies- Ranajith Guha- Dipesh Chakraborthy	4	Lecture	Evaluation through question-answer session
	Cambridge and new Cambridge school- Anil Seal- C A Bayly	4	Lecture	Evaluation through question-answer session
	Gender History- Uma Chakravarti	4	Debate	Debate on the topic 'women representation in history'
	Environmental History- Ramachandra Guha	3	Lecture Discussion	Discussion on the topic 'Emergence of environmental history as a new discipline'
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.

Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference books

Dr. S P Sen, Historians and Historiography in Modern India, Institute of Historical Studies, 1973

Elliot and Dowson, History of India as told by its own Historians

Romila Thapar, The Past and Prejudice NBT 1975

Romila Thapar, Time as a Metaphor of History: Ancient India, OUP 1997

James Mill, The History of British India

Ranajit Guha (ed), Subaltern Studies, Vol. 1, OUP 1996

Shashi BhushanUpadhyay, Historiography in the Modern World: Western and Indian Perspectives, OUP, 2016.

Henry Schwarz, Writing Cultural History in Colonial and Postcolonial India, University of Pennsylvania Press, 1997

Semester III

Course category: Core Course III

Paper name: WORLD HISTORY – 1, State, Society and Civilisation in the Ancient World

Code: HIS3B03

Course Outcome:

- To know a general time line and outline of ancient civilisations, including key events and cultural achievements of different ancient civilisatiojs
- The course provides an overview of early cultures and meetings between cultures and similar trends across cultures
- Compares and contrasts past with current events, issues and problems
- Ability to recognise the multiple spatial and temporal contexts and to look at one's own society and civilisation in contrast to other societies and civilisations
- Ability to recognise the influence of global forces and identify their connections to local and national developments

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	Geological time and the phases of human evolution	5	Lecture	Evaluation through question-answer session
	Stone age	4	Lecture, seminar presentation	Evaluation through question-answer session
	Neolithic revolution	4	Presentation	Reference reading and notes are evaluated.
	Metal Age	3	Lecture	Class test
Module II	Mesopotamian Civilisation	6	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Babylonian Civilisation-Code of Hammurabi	7	Presentation	Evaluation of the notes prepared by the students
	Egyptian Civilisation	6	Lecture Student seminar	Evaluation through question-answer session
	Chinese Civilisation	6	Lecture Student seminar	Evaluation through question-answer session
Module III	Homeric age – Greek city state	9	Lecture Presentations	Question-answer sessions
	Roman Empire	9	Lecture	Evaluation through question-answer session
Module IV	Decline of Roman Empire	6	Lecture	Evaluation through question-answer session
	Impact of Christianity	4	Lecture	Evaluation through question-answer session
	Gothic invasion	3	Lecture	Evaluation through question-answer session

Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		97hours		

Reference Materials

1. Edward Gibbon, Decline of Roman Empire
2. Gordon Childe, Man Makes himself
3. Felipe Fernandez- Armesto, Near A Thousand Tables: A History of Food, The Free Press, 2002

Semester III

Course Category: Core Course IV

Paper name: INDIAN HISTORY-1

Code: HIS3 B04

Course Outcome:

- Provide a broad historic outline about the process of socio-political formations in the north and south India up to 1300 CE.
- Explain the emergence of the first urbanization in the north western part of early India during bronze age
- Understanding on the socio-political formations of Indo-Gangetic plains in the Iron Age.
- Understand the emergence of an empire under Mauryas in the north and Muvendars in the South and the formation of feudal cultures in the north and south.

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module- I Towards Civilization	Pre-Harappan cultures; - extension of the Harappan culture- features of the Harappan sites; Harappa, Mohenjodaro, Lothal, Dholavira, Kalibangan	6	Lecture Map reading Discussion Presentation of Harappan artefacts album	Question-Answer session is organized. Students have to submit the filled in maps.
	Debates on the nature of society and polity: Dravidian and Indo Aryan	5	Lecture Discussion Student seminar	Seminar evaluation
	Debate on the decline of Indus civilization	4	Lecture Discussion	Discussion on the various theories on the decline of Harappan civilisation
	Debate on Harappan script: Airavatham Mahadevan –Asko Parpola	5	Lecture Discussion Presentation of Harapan scripts	Student discussion on the 'Problems of reading Harappan scripts'.
Module-II Socio-Political Formations in the Indo-Gangetic Plains	Vedic literatures and Archaeological evidences - PGW, NBPW- early tribal pastoral and agrarian society in the Gangetic plains	5	Lecture Map reading	Question-Answer session is organized. Students have to submit the filled in maps.
	Aryan debate: Central Asian/indigenous theory	4	Lecture Debate	Debate on the topic ' origin of migration of Aryans'

	Early and later Vedic polity- formation of urban centers- Mahajanapadas	3	Lecture Discussion Student seminar	Question-answer sessions
	Nature of state; oligarchies, Monarchies and republics	4	Lecture	Students are evaluated through class tests
	Material setting of the formation of Jainism and Buddhism	4	Lecture Discussion	Question-Answer session is organized.
Module-III Mauryan and Muvendar	From Mahajanapadas to the empire- domination of Magadha- foundation of Mauryan polity	3	Lecture	Class test
	Asokan Edicts and Megasthenees's Indica	2	Discussion	Discussion on the contents written on Asokhan eddicts.
	Extension of the empire	2	Map reading	Students have to mark the important sites and routes.
	Arthasasthra and early Indian treatise on the theory of state; Sapthanga – nature of Asoka dharma	3	Debate Seminars	Debate on the 'application of Arthasastra in polity
	Debates on Mauryan polity	3	Lecture	Class test
	Tamizhakam – Tinai based production and exchange–Indo-Roman trade- nature of Muvendar polity- Chera, Chola and Pandya	4	Lecture Discussion	Question-answer session
Module-IV Into a Feudal Society	Land grants under Satavahanas and Gupta- revival of Vedic traditions- art- literature and architecture as the symbols of feudalism	5	Lecture	Question-answer session
	Debates on Indian feudalism; R.S Sharma, Herbans Mukhia	8	Discussion	Discussion on the topic 'characteristics of Indian feudalism in comparison with European'.
	South Indian feudalism- Temple based Bhakti traditions of Alwars and Nayanars in South India.	5	Lecture Student seminars	Class test. Seminar evaluation
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment	Assignments are corrected and feedbacks are given. CIE Internal mark is

			from any of the topics they're interested, but should avoid repetition	awarded on the basis of assignments too.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation , preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference materials.

R.S. Sharma. Material Culture and Social formations in Ancient India

…..... India's Ancient Past

RomilaThappar. From Lineage to State

…..... Early India

Upinder Singh. A History of Ancient and Early Medieval India

Semester IV

Course Category: Core Course V

Paper name:World History -2, Medieval World: State and Society

Code: HIS4 B05

Course Outcome:

- To create knowledge on medieval world through which students could able to understand different state system
- Focuses on the socio political and economic currents of medieval central Asia, West Asia and East Asia
- Understand the scientific and intellectual interactionsthat taken place between East and West

Course Outcome: Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I -	Europe after the fall of Rome	**6**	Lecture	Evaluation through question-answer session
	Byzantine Empire	**5**	Presentation	Evaluation of the notes prepared by the students
	Carolingian dynasty	**7**	Lecture	Evaluation through question-answer session
Module I I	Rise of Islam	**6**	Presentation	Evaluation of the notes prepared by the students
	Arab Empire	**9**	Presentation	Evaluation of the notes prepared by the students
Module III	Unification of China	**7**	Lecture	Evaluation through question-answer session
	Trade routes	**7**	Lecture	Evaluation through question-answer session
	Peasant revolts	**9**	Lecture	Evaluation through question-answer session
Module IV	Decline of Feudalism	**10**	Lecture	Evaluation through question-answer session
	Crusades	**9**	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're	Assignments are corrected and feedbacks are given.

			interested, but should avoid repetition	
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		100		

Reference Materials

1. Perry Anderson, Passage from Antiquity to Feudalism
2. Edward MC Nalls burn, Western Civilisation
3. Marc Bloch,Feudal Society

Semester IV

Course Category: Core Course IV

Paper Name:INDIAN HISTORY-2

Code : HIS4B06

Course Outcome

- It is framed to explicate the nature of state and society in Medieval India.
- It familiarizes the students with process of state formation; economic pattern of medieval India along with the social and cultural developments of the period.
- It explains the process of medieval trade related to Arabian Sea and Indian Ocean.
- Students could able to understand changing pattern of agrarian system in medieval India.
- Understanding of Delhi Sultanate
- Analyse Mughal rule administrations, art, and architecture
- Identify cultural synthesis
- . Analyse Medieval South India

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module 1	Concept of early medieval	5	**Lecture Discussion**	Evaluation through question answer session
	□ Indian Feudal model and its critics	5	**Lecture Debate**	Debate on the topic '□ Indian Feudal model
Module II-	Arab conquest of Sind- the Sultanate ascendancy in India- Battle of Tarain- Political consolidation under early Turkish Sultans- Reforms under Iltumish and Balban	6	**Lecture**	Evaluation through question answer session
	Delhi Sultanate under Khaljis and Thuglaqs; Alauddin Khalji- military measures and economic reforms – Administrative reforms and military experiments of Muhammadbin	6	Lecture Debate	. Evaluation through question answer session

	Thuglaq- Firozshah Thuglaq and welfare measures			
	Administrative system and institutions under Delhi sultanate- kingship- Administrationnobility – slavery-land revenue and forms of distribution- Iqta system	**6**	Lecture Student seminar	Question-answer sessions Seminar evaluation
	The Vijaya nagara Empire- Bahmani Kingdom : nature of Polity and cultural contributions	**5**	Lecture	Debate on the topic of ‘ The Vijaya nagara Empire- Bahmani Kingdom :
Module III	Babur- war fare- military technology- Afghan conflicts and formation of Surr dynasty	**5**	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Consolidation of the Mughal Empire under Akbar- expansion of the empire-economic reforms-Mansabdari system - Jagir and land revenue system- zabti – Akbar’s religious policy- Rajput policy- Aurengazeb and Decan policy	**6**	Lecture Student seminar	Question-answer sessions
	Rise of The Marathas- Shivaji and his administration- Land revenue policy	**5**	Lecture Discussion	Question-answer sessions
	Ahom Kingdom of North-east India	**5**	Lecture	Question-answer sessions
Module IV	Bhakthi movement in North and South India Sufism : general trend	**5**	Lecture Discussion	Discussion on Sufism : general trend
	Rural economy- agrarian system- trade, urbanization, Indian Ocean trade	**5**	Lecture	Evaluation through question-answer session

	⍰ Nature of medieval architecture	**5**	Lecture	Discussion on ⍰ Nature of medieval architecture
	⍰ Science and technology in Mugal India: basic feature	**6**	Lecture Debate	Discussion on Science and technology in Mugal India: basic feature
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Feedbacks are provided and marks are considered for CIE
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials:

Brain M Fagan. Ancient Lives: An Introduction to Archaeology and Pre-History
Gordon Childe. Man Makes Himself
M.C. Burkkit. The Old Stone Age
Hendrik Willem Van Loon. The Story of Mankind
Rev.JamesBaikie. Wonder Tales of the Ancient World
G. Dalton (ed.). Tribal and Peasant Economies: Readings in Economic Anthropology
L. De Blois and R. J. Van Der Spek. An Introduction to the Ancient World
Barbara Bender. Farming in Prehistory
Amar Farooqi. Early Social Formations
D. Rindos. The Origins of Agriculture, Academic Press, New York, 1984

Semester V

Course Category: Core Course 7

Paper name: World History – 3, Emergence of Modern World

Code: HIS5 B07

Course Outcome:

- Students acquaint with transition in history by looking at social, political, economic and technological changes from medieval to modern
- Develop new perspective on American War of Independence, English and French revolution
- Create a fresh look at Industrial revolution and consequent development in all walks of modern world
- Appreciate the mass mobilisation in third world countries and appreciate the democratic ideologies tagged along with it

Course Outcome: Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Renaissance- medieval origin – nature and characteristics	8	Lecture	Evaluation through question-answer session
	Reformation- Martin Luther	6	Presentation	Evaluation of the notes prepared by the students
	Geographical explorations	5	Presentation	Evaluation of the notes prepared by the students
	Nation states in Europe	4	Lecture	Evaluation through question-answer session
Module II	Scientific revolution	2	Lecture	Evaluation through question-answer session
	Enlightenment	6	Lecture	Evaluation through question-answer session
	Industrial revolution	6	Presentation	Evaluation of the notes prepared by the students
	Colonialism and Imperialism	5	Presentation	Evaluation of the notes prepared by the students
	Socialism	3	Lecture	Evaluation through question-answer session
Module III	English Revolution	4	Lecture	Evaluation through question-answer session

	American Revolution	4	Lecture	Evaluation through question-answer session
	French Revolution	4	Lecture	Evaluation through question-answer session
	Unification of Italy and Germany	5	Lecture	Evaluation through question-answer session
Module IV	First and Second World war	7	Lecture	Evaluation through question-answer session
	Russian Revolution	3	Lecture	Evaluation through question-answer session
	League of nation,Depression	2	Lecture	Evaluation through question-answer session
	Fascism and Nazism	4	Lecture	Evaluation through question-answer session
	Cold war and Globalisation	6	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested	Assignments are corrected and feedbacks are given.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		109		

Reference Materials

1. Edward mCNall Burns, World Civilisation, Vol -3
2. David S Mason, A Concise history of Modern Europe
3. Arjun Dev and Indira Arjun Dev, History of the world

Semester V

Course Category: Core Course 8

Paper name: Indian History – 3, Making of Modern India

Code: HIS5 B08

Course Outcome:

- Realise the impact of colonialism and its presence in contemporary India
- Appreciate the values and ideologies of freedom struggle
- Trace the mass basis of Indian national movement
- Trace the dynamics of Indian economy that have rooted in both colonial and Native practices
- Understand the process of class formations in Modern India

Course Outcome: Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	The British Imperialism in India; Interpreting colonialism-capitalism and imperialismideologies of the Raj ; mission civilization	8	Lecture	Evaluation through question-answer session
	Significance of the Battle of Plassey and the Buxa	6	Presentation	Evaluation of the notes prepared by the students
	Experience of colonialism and its impact in British India: New agrarian practiceschanges in native industries- capitalism and rural economy - revenue and tenurial system- condition of working class	5	Presentation	Evaluation of the notes prepared by the students
	The revolt of 1857: interpretations, causes and significance	4	Lecture	Evaluation through question-answer session
Module II	Social and religious consciousness in India- familiarisation of new ideologies- advent of printing and pres	2	Lecture	Evaluation through question-answer session
	Rajaran Mohan Roy and Brahmosamaj-Ramakrishna Mission and Vivekananda- Arya Samaj-	6	Lecture	Evaluation through question-answer session
	Theosophical Society- Jyothiba Phule	6	Presentation	Evaluation of the notes prepared by the students

	Sathyashodak Samaj- Aligarh movement	5	Presentation	Evaluation of the notes prepared by the students
	Singh Sabha movement	3	Lecture	Evaluation through question-answer session
Module III	The pre Gandhian phase : Political ideology and organisations- economic critique of colonialism-tribal uprising;Santhal-Munda uprising	4	Lecture	Evaluation through question-answer session
	Formation of INC – different interpretations	4	Lecture	Evaluation through question-answer session
	Moderates and extremists	4	Lecture	Evaluation through question-answer session
	Cultural nationalism	5	Lecture	Evaluation through question-answer session
Module IV	Mahatma Gandhi; ideology and practices- Champaran-Ahemadabad mill strikeKheda-Rowlet Act- Jalian walabag	7	Lecture	Evaluation through question-answer session
	Khilafat and Non co operation—Gandhian Constructive Programme	3	Lecture	Evaluation through question-answer session
	First world war and Revolutionary movements-Left wing ideologies and its practice-Trade union and Labour movements	2	Lecture	Evaluation through question-answer session
	Poorna Swaraj- Civil Disobedience Movement -Quit India movement and INA	4	Lecture	Evaluation through question-answer session
	Communal ideology and its practice-- RSS, Hindu Mahasabha-Muslim league	6	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested	Assignments are corrected and feedbacks are given.

Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		109		

References

A.R. Desai, Peasant Struggles in India
KS Singh, Tribal Movements in India

Semester V

Course Category: Core Course 9

Paper name: Kerala History -1

Code: HIS5 B09

Course Outcome:

- New thinking on major aspects of the evolution of Kerala history and culture in the light of new researches and findings.
- Realise the importance of landscape and seascape of Kerala and its climate and engage in the activities related to the balanced use of natural resourceTrace the mass basis of Indian national movement
- Realise the evolution of land relations in Kerala and its impact on social life
- Identify the trade items of Kerala related to Arabian Sea and Indian Ocean
- Realise the changes occurred in the landscape of Kerala especially its flora and fauna with the arrival of foreigners

Course Outcome: Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Geographical boundaries; Western Ghats and Arabian Sea	8	Lecture	Evaluation through question-answer session
	topographical features; highland midland and coastal line- passes and rivers – climatic conditions	6	Presentation	Evaluation of the notes prepared by the students
	Early human settlements- pre-historic evidences	5	Presentation	Evaluation of the notes prepared by the students
	-rock shelters and pre-historic arts- prehistoric societies.	4	Lecture	Evaluation through question-answer session
Module II	Sources; Archaeological evidences; Megaliths, Pattanam excavations- Tamil and Greek Roman literatures	2	Lecture	Evaluation through question-answer session
	Tinai and multiple subsistence forms - settlement patterns- the emergence of Brahmin, Jain and Buddhist sects	6	Lecture	Evaluation through question-answer session
	Exchange relations- Indo- Roman trade	6	Presentation	Evaluation of the notes prepared by the students

	Nature of early historic polity- Kizhar, Velir,	5	Presentation	Evaluation of the notes prepared by the students
	Vendar- early Chera in the Patittuppattu	3	Lecture	Evaluation through question-answer session
Module III	Sources; Epigraphs and literatures- Mushakavamsakavya, Keralolpatti, GranthavarisManiprvalam- travelers accounts	4	Lecture	Evaluation through question-answer session

	Proliferation Brahmin settlements and temples	4	Lecture	Evaluation through question-answer session
	Emergence of land ownership rights;Cherikkal, Devaswam, Brahmaswam- ViruttiKaranmai- Pattam and Otti/Kanam	4	Lecture	Evaluation through question-answer session
	Formation of Swarupam- Nediyiruppu, Perumpadappu, Kolathiri and Venad	5	Lecture	Evaluation through question-answer session
Module IV	Sources; Kerala Pazhama and Tuhafatul Mujahidheen, travelers records- Varthema	7	Lecture	Evaluation through question-answer session
	Major and Minor political entities - Malabar- Kochi and Travancore	3	Lecture	Evaluation through question-answer session
	Portuguese - Cartas and monopolization of trade in Indian Ocean- decline of Arab trade	2	Lecture	Evaluation through question-answer session
	Kunjali's resistance against Portuguese	4	Lecture	Evaluation through question-answer session
	Mysorian invasion and changes occurred in the land revenue system	6	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested	Assignments are corrected and feedbacks are given.

Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		109		

Essential Readings

A. Sreedhara Menon, A Survey of Kerala History

B. Rajan Gurukkal and RaghavaVarier. Keralcharithram Vol.2, History of Kerala-Prehistoric to the present

C. K.N.Ganesh, Keralathinte Innalekal

D. P.J. Cherian (ed.), Perspectives on Kerala History

E. Margret Franz. From Contact to Conquest

F. M.P. Mujeebu Rehman. The Other Side of the Story: Tippu Sultan, Colonialism and Resistence in Malabar

Semester V

Course Category: Core Course 10

Paper name: methodology of eriting History

Code: HIS5 B10

Course Outcome:

- Enable the student to understand the techniques of writing History and the evolution of such a techniques.
- Students will learn the theory and practice of historical research as practiced by professionals in the field including traditional and current research methodologies.
- It enables the student to develop a thesis/argument, evaluate its historical probability, and place that argument in a historiographical context
- It helps to develop a historian's skills, including reading, writing, speaking, and critical inquiry and would be able to execute and guided independent research projects in accord with the research manuals
- Distinguish between various forms of presentation of history and the basic elements of research in history
- Prepare students for writing the local history projects

Course Outcome: Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment

Module I	Literary review and identification of a Historical Problem	8	Lecture	Evaluation through question-answer session
	making hypotheses	6	Presentation	Evaluation of the notes prepared by the students
	drafting Synopsi	5	Presentation	Evaluation of the notes prepared by the students
	- Preliminary Bibliography	4	Lecture	Evaluation through question-answer session
Module II	Searching for historical sources	2	Lecture	Evaluation through question-answer session
	define historical facts- Primary and Secondary Sources	6	Lecture	Evaluation through question-answer session
	Archaeology - Epigraphy- Numismatics	6	Presentation	Evaluation of the notes prepared by the students
	Folklore –Toponymical – Literature	5	Presentation	Evaluation of the notes prepared by the students
	Archival Studies	3	Lecture	Evaluation through question-answer session
Module III	Notes – Footnotes – Endnotes – Text notes	4	Lecture	Evaluation through question-answer session
	Style of Footnoting and Text noting- MLA and APA– Style of Bibliography	4	Lecture	Evaluation through question-answer session
	Appendices – Tables - Charts – Diagrams	4	Lecture	Evaluation through question-answer session
	Photos – Maps – Glossary – Abbreviations – Index.	5	Lecture	Evaluation through question-answer session
Module IV	Research Paper – Project Report	7	Lecture	Evaluation through question-answer session
	Dissertation or Thesis	3	Lecture	Evaluation through question-answer session
	Oral History – Local History	2	Lecture	Evaluation through question-answer session
	Micro Histor	4	Lecture	Evaluation through question-answer session

	Life history	6	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested	Assignments are corrected and feedbacks are given.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		109		

Essential Readings

G.R. Elton, The Practice of History

Joseph Gibaldy, MLA Handbook for the Writers of Research Papers

Sharron Sorenson, How to Write Research Paper

Semester VI

Course Category: Core Course 11

Paper name: Indian History -4

Code: HIS6 B11

Course Outcome:

- Realise the social and economic issues of contemporary India and engage in the socially useful productive work
- Define a pluralistic society and its relationship to our democratic principle.
- Realise the importance of the constitution of India and recognize the contribution of leaders and personalities who prepared it.
- Aware of the environmental issues of the country and contributed to the sustainable development activities
- Identifying the cardinal principles of Foreign Policy of India and think highly of national leaders who contributed to the ideology of peaceful co existence

Course Outcome: Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**

Module I	Partition and challenges; integration of princely states- strategies of Sardar Vallabhai Patel	8	Lecture	Evaluation through question-answer session
	Framing of constitution; BR Ambedkar- significant features of Indian constitutionPreamble- Fundamental Rights and Duties- Directive Principles- nationality and citizenship	6	Presentation	Evaluation of the notes prepared by the students
	linguistic reorganisation of states-	5	Presentation	Evaluation of the notes prepared by the students
	- multi cultural system and the principle of unity in diversity	4	Lecture	Evaluation through question-answer session
Module II	Nehruvian era; Development and reconstruction- focus on technology-economic planning- mixed economy- industialisation-land reform measures-Green Revolution	2	Lecture	Evaluation through question-answer session
	Growth of parliamentary democracy	6	Lecture	Evaluation through question-answer session
	Indian foreign policy in the era of cold war	6	Presentation	Evaluation of the notes prepared by the students
	NAM and Panchsheel	5	Presentation	Evaluation of the notes prepared by the students
	India Pakistan Relations- Kashmir conflict- border disputes- relation with China	3	Lecture	Evaluation through question-answer session
Module III	Reforms of Indira Gandhi; Nationalisation- Growth of public sector- Morarji Desai and Demonetisation	4	Lecture	Evaluation through question-answer session
	Reforms of Rajiv Gandhi; New Education Policy	4	Lecture	Evaluation through question-answer session
	Changes after 1990; New economic reforms- Liberalization, Privatization, Globalization (LPG)- Responses to new reforms	4	Lecture	Evaluation through question-answer session
	Employment Generation Programmes; MGNREGP	5	Lecture	Evaluation through question-answer session
Module IV	Internal squabbles and declaration of Emergency in India	7	Lecture	Evaluation through question-answer session

	Regionalism and militant activities; Kashmir, Punjab and Assam	3	Lecture	Evaluation through question-answer session
	Revival of caste politics; VP Singh and Mandal Commission	2	Lecture	Evaluation through question-answer session
	Communalism and violence; The Delhi riots- Babri issue- Gujarat Carnage	4	Lecture	Evaluation through question-answer session
	Issues of human rights- RTI- Food Safety Bill- Right to education –Mass Media and Social Medi	6	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested	Assignments are corrected and feedbacks are given.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		109		

Essential Readings

Rama Chandra Guha. India after Gandhi

Shashi Tharoor. India from Midnight to the Millennium

Semester VI

Course Category: Core Course 12

Paper name: Kerala history -2

Code: HIS6 B12

Course Outcome:

- Identify the real nature of the colonial intervention in Kerala
- Trace the historical roots of progressive contemporary Kerala.
- Analyse critically the role of leaders and movements in the transformation of modern Kerala
- Familiarise with Kerala Model of Development and engage in the rebuilding process of Kerala econom
- Understand the issues in contemporary Kerala so as to be responsive to the same

Course Outcome: Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Malabar in Transition- Joint Commission Reports and Revenue Settlements- Malabar under Madras Presidenc	8	Lecture	Evaluation through question-answer session
	revenue and judicial Reforms- Civil and Criminal Procedure Codes 91	6	Presentation	Evaluation of the notes prepared by the students
	Changes in the Princely States- Col. Munroe- modernization of Cochin and TravancoreRevenue Settlements- Kandezhuthu and Kettezhuthu – Monopolization of Trad	5	Presentation	Evaluation of the notes prepared by the students
	Early Resistances- Pazhassi Raja- Velu Thampi- Kurichiya	4	Lecture	Evaluation through question-answer session
Module II	Dress code agitation- Kallumala Agitatio	2	Lecture	Evaluation through question-answer session
	Caste Reform and Religious Reform Movements	6	Lecture	Evaluation through question-answer session
	Spread of Modern Education- Role of Missionaries	6	Presentation	Evaluation of the notes prepared by the students
	Changes in the Matrilineal System	5	Presentation	Evaluation of the notes prepared by the students
	Kallumala Agitatio	3	Lecture	Evaluation through question-answer session
Module III	Agrarian Discontent in British Malabar- Peasant Uprisings in the 19th Century- Report of William Logan	4	Lecture	Evaluation through question-answer session
	Khilafat Movement- Malabar Struggle- debate on its nature- Civil Disobedience Movement- Quit India	4	Lecture	Evaluation through question-answer session

	Struggle for Responsible governments in Kochi and Travancore- Memorials- PunnapraVayalar Outbreaks	4	Lecture	Evaluation through question-answer session
	Aikya Kerala Movement- State Re-organizatio	5	Lecture	Evaluation through question-answer session
Module IV	Land Reforms and the end of Feudalism	7	Lecture	Evaluation through question-answer session
	Education Reforms- growth of Education	3	Lecture	Evaluation through question-answer session
	Kerala Model Development- Health and Medical Sector	2	Lecture	Evaluation through question-answer session
	Environmental issues	4	Lecture	Evaluation through question-answer session
	Social welfare measures	6	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested	Assignments are corrected and feedbacks are given.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		109		

Essential readings

Rajan Gurukkal & Raghava Varier, History of Kerala: Prehistoric to the Present

P. Radhakrishnan, Peasant struggles, Land Reforms and Social Change: Malabar 1836-1982

T.C. Varguese. Agrarian Changes and Economic Consequences: Land Tenures in Kerala 1850-1960

M. A. Oomman. A Study of Land Reforms in Kerala

M.A. Oommen (ed.). Rethinking Development: Kerala's Development Experience, Volume 1

K. N. Ganesh, Kerala Samooha Padanangal E M S, Keralam Malayalikalude Mathrubhoomi

Semester VI

Course Category: Core Course 13

Paper name: Gender Studies

Code: HIS6 B13

Course Outcome:

- Explain conventional social norms about male-female dichotomy and can device policies and strategies to foster gender equality and gender justice
- Contribute to creative interventions that may result in a world with less inequality
- Critically interrogate and actively engage in social processes related to the construction of gender
- Analyse social and cultural phenomena through the lens of gender in a way that appreciates a range of disciplinary perspectives

Course Outcome: Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I -	Conceptualising Gender:	6	Lecture	Evaluation through question-answer session
	Patriarchy and Matriarchy	5	Lecture	Evaluation through question-answer session
	Concept of feminism	7	Lecture	Evaluation through question-answer session
Module II	Division of labour:	4	Lecture	Evaluation through question-answer session
	Brahmanical patriarchy	8	Lecture	Evaluation through question-answer session
	Gayatri Spivak	7	Presentation	Evaluation of the notes prepared by the students
Module III	Changing Concept of family and marriage	4	Presentation	Evaluation of the notes prepared by the students
	Law Relating to Crimes against women and transgender	10	Presentation	Evaluation of the notes prepared by the students
Module IV	Contemporary issues	9	Lecture	Evaluation through question-answer session
	Gender identity	8	Lecture	Evaluation through question-answer session

	Third Gender	7	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		100		

Reference Materials

- Leela Dube, Anthropological explorations in gender
- Vandana Shiva, the Violence of Green Revolution
- Gayatri Spivak, Can Subaltern Speak
- Nivedita Menon, Gender and politics in India

Semester VI

Course Category: Core Course 14

Paper name: INDIAN HERITAGE

AND PLURALITY OF CULTURES

Code: HIS6 B14

Course Outcome:

- Realise the diverse nature of Indian culture
- Involve in nation building process with an understanding on multicultural system of the country
- Realise the values and ideologies of secular movements and ideologies of the Country

Course Outcome: Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I -	Pluralism; definition and scope-Monism- Coercive singular	6	Lecture	Evaluation through question-answer session
	Multiculturalism in the formation of Early India- the concept of VasudaivaKudumbak amthe idea of Tatwamasi	5	Lecture	Evaluation through question-answer session
	Dissent and protest to existing knowledge and philosophy; Ajitha Kesakambali and Indian materialism- Lokayatas	7	Lecture	Evaluation through question-answer session
Module II	Bhakti and Sufi tradition; making of a composite culture- cross fertilization of religious ideas – Kabirdas, Gurunanak; Adigranth and concept of equal justice Lal Ded- Basava cult	4	Lecture	Evaluation through question-answer session
	Akbar- Sulh-i-kul (Universal peace)-Ibadathkhana and idea of secular nationalism	8	Lecture	Evaluation through question-answer session
	Cultural confluence in Indo Islamic art-architecture and paintings	7	Presentation	Evaluation of the notes prepared by the students
Module III	1857 revolt and Hindu Muslim Unity- National Movement and practice of	4	Presentation	Evaluation of the notes prepared by the students

	multiculturalism			
	Tagore and the idea of Universal brotherhood-Geethanjali	10	Presentation	Evaluation of the notes prepared by the students
Module IV	The idea of cultural symbiosis; Tarisappally-Jewish and Muccunti inscriptions	9	Lecture	Evaluation through question-answer session
	Socio-religious movements and Kerala modernity;Vaikuntaswamy-Narayanaguru and idea of brotherhood - Ayyankali-Poyikayil Appacchan-Vakkom Abdul Khadar Moulavi	8	Lecture	Evaluation through question-answer session
	Modern education and accommodation of societal diversity	7	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		100		

Essential Readings

MGS Narayanan. Cultural Symbiosis in Kerala
MGS Narayanan. Perumals of Kerala
A Sreedhara Menon. A Survey of Kerala History K N Ganesh.KeralathinteInnalekal
RaghavaVarier and KesavanVeluthat. Tarisappallippattayam
A Sreedhara Menon, Kerala History and Its Makers
TK Ravindran,Institutions and Movements in Kerala History
KN Panikkar, Essays on the History and Society of Kerala

Semester VI

Course Category: Core Course 15

Paper name: Dissertation

Code: HIS6 B15

Semester V (open course)

Course Category: Open Course

Paper name: HISTORICAL

TOURISM Code: HIS5D01

Course Outcome:

- Realise the Tourism potential of India and Kerala
- Serve as mentors and tourism operators
- Realise the importance of eco tourism and sustainable tourism

Course Outcome: Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I -	Tourism; basic concepts-definitions-elements of tourism-types of tourism	2	Lecture	Evaluation through question-answer session
	Travelers and Travel accounts; Megasthanese- Pliny - Fa -Hien- Marcopolo - Ibn Batuta- Ralf Fitch –Buchanan	2	Lecture	Evaluation through question-answer session
	Transport and communication technology and Touris	**1**	Lecture	Evaluation through question-answer session
Module II	Geographical features-climate- biodiversity-multi cultural system	3	Lecture	Evaluation through question-answer session
	Hill stations; Shimla-Nainithal- Manali- Ooty	2	Lecture	Evaluation through question-answer session
	Wild life sanctuaries; Gir forest-Vedanthangal Bird Sanctuary, Silent Valley	1	Presentation	Evaluation of the notes prepared by the students
Module III	Tourism Potential of Kerala; 'Gods own country' - Geographical features of KeralaClimate-Cultural confluence	2	Presentation	Evaluation of the notes prepared by the students

	Backwaters and boat races: Aranmula -Nehru Trophy boat race	3	Presentation	Evaluation of the notes prepared by the students
	Pilgrim sites: Shabarimala, Guruvayur, Malayattur-Maramon- Cherman Juma Mosque;Kodungallur-Parasinikadavu	1	Lecture	Evaluation through question-answer session
	Palaces and its importance; Padmanabhapuram palace, Mattanchery Palace- Hill Palace:Thripunithura-Arakkal Palace	5	Lecture	Evaluation through question-answer session
	Muziris Heritage Project	6	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2 hours duration	2	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		50		

Essential Readings

A Sreedhara Menon. Cultural Heritage of Kerala

William Logan. Malabar Manual (2 Vol.)

Roughguide. Kerala and South India A SreedharaMenon. Cultural Heritage of Kerala

A Sreedhara Menon. Social and Cultural History of Kerala

A Sreedhara Menon. Legacy of Kerala

A Sreedhara Menon. Kerala Samskaram

B.K.Gururaja Rao. The Megalithic Culture of South India

Rajan Gurukkal. Cultural History of Kerala

Semester VI

Course Category: Core Course 16

Paper name: HISTORY OF ARCHAEOLOGY IN INDIA

Code: HIS6 B16

Course Outcome:

- Engaged in excavation process to recover historical traits and cultural sites
- Experimenting with various scientific dating methods
- Expertise in setting of Museum and conservation and preservation of artifacts

Course Outcome: Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I -	Definition- scope -basic concepts; Artifacts, Features, Eco-facts	6	Lecture	Evaluation through question-answer session
	Mount or site or tell, Assemblage, Industry, Culture	5	Lecture	Evaluation through question-answer session
	Antiquarianism- beginning of scientific archaeology- scientific exploration and excavation methods	7	Lecture	Evaluation through question-answer session
Module II	Asiatic society of Bengal and the beginning of Archaeological studies in the Colonial period- Alexander Cunningham and Archaeological Survey of India-Robert Bruce Foote and pre-historic studies	4	Lecture	Evaluation through question-answer session
	Discovery of Harappan civilization- John Marshal, DayaramSahni and Mortimer Wheeler	8	Lecture	Evaluation through question-answer session
	Post-independence Harappan archaeology- Amalananda Ghosh – RS Bisht- J.P. JoshiS.R. Rao	7	Presentation	Evaluation of the notes prepared by the students
Module III	Alexander Rea and Adichanellur excavation	4	Presentation	Evaluation of the notes prepared by the students
	Recent excavations at Keezhadi	10	Presentation	Evaluation of the notes prepared by the students

Module IV	Pre-historic Archaeology- F. Fawcett and the discovery of Edakkal caves-Marayur cave Paintings- P. Rajendran and Prehistoric studies	9	Lecture	Evaluation through question-answer session
	Megalithic Explorations and Excavations - J Babington's Chattaparamba- William Logan and Robert Sewell- A Ayyappan's Feroke excavation- B.K.Thappar's Porkkalam Excavation-T Sathyamurti's Mangadu excavation- Ummichipoyil excavation- Kadanad Excavation	8	Lecture	Evaluation through question-answer session
	Early Historic Sites – Pattanam excavations- Vizhinjam Excavations	7	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		100		

Essential Readings

William Logan. Malabar Manuel

Robert Sewell. Lists of the Antiquarian Remains in the Presidency of Madras

RajanGurukkal and RaghavaVarier. Cultural History of Kerala

T. Satyamurti. Iron Age in Kerala

P. Rajendran. Prehistoric Cultures and Environment: A Case Study of Kerala

YashodharMathpal. Rock Art in Kerala

V.Selvakumar. P.K.Gopi and K.P. Shajan, "Trial Excavation at Pattanam- A Preliminary Report", Journal of the Centre for Heritage Studies Volume 2, 2005, pp. 57-67.

M.R. Manmathan (ed.). Archaeology in Kerala-Past and Present

Ajit Kumar. Archaeology in Kerala: Emerging Trends

P.J. Cherian (ed). Pattanam Excavation Reports, KCHR

K.R. Sona (ed.). A Brief report on Archaeological Excavation at Kottappuram, Kerala State Archaeology Department

Semester I

Course Category:

ComplementaryCourse 13

Paper name: MODERN INDIAN

HISTORY (1857 TO THE

PRESENT): I

Code: HIS1(2) C01

Course Outcome:

- The focus of this course is on the Modern Indian History focusing the Colonialism and National Movement
- This course covers the History of Colonialism and National Movement up to the Gandhian Age.
- It will expose the students to the major events and periods which constructs the discourses in Modern Indian History, which will help them to understand the making of India as a Nation

Course Outcome: Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I -	Consolidation of Power by the British – The Methods of Conquests and Treaties	6	Lecture	Evaluation through question-answer session
	Economic and Land Reforms- Taxation System	5	Lecture	Evaluation through question-answer session
	Early Resistance Movements- Sanyasi-Fakir- Santhal– Kurichya Revol	7	Lecture	Evaluation through question-answer session
Module II	Background – Brahmosamaj – Arya Samaj	4	Lecture	Evaluation through question-answer session
	Aligarh Movement-SatyasodhakSamaj	8	Lecture	Evaluation through question-answer session
	Rama Bhai– Ramakrishna Mission- Sree Narayana Guru	7	Presentation	Evaluation of the notes prepared by the students
Module III	Surendranath Bannerjee and the East India Association	4	Presentation	Evaluation of the notes prepared by the students
	Indian National Congress-The Genesis- Safety Valve Debate	10	Presentation	Evaluation of the notes prepared by the students

Module IV	Partition of Bengal – Swedeshi and Boycott Movements	9	Lecture	Evaluation through question-answer session
	Identification of Cultural Icons and Programmes	8	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		100		

BOOKS FOR STUDY

1. Percival Spear, The History India, Vol 2
2. SekharaBandyopadhyaya, From Plassey to Partition: A History of Modern India
3. A. R, Desai, Social Background of Indian Nationalism
4. Bipan Chandra et.al., India's Struggle for Independence
5. Uma Chakravarti, Rewriting History: The Life and Times of PanditaRamabai
6. Ishita Banerjee- Dube, A History of Modern India

Semester IV

Course Category:

ComplementaryCourse 13

Paper name: MODERN INDIAN HISTORY (1857 TO THE PRESENT): I

Code: HIS4(3) C01

Course Outcome:

- The focus of this course is on the Modern Indian History focusing the Colonialism and National Movement.
- This course covers the History of Colonialism and National Movement from the Gandhian Age to the Age of Globalization
- Students will be exposed to the nature and methods of Indian National Movement and the serious debates happened in the period.

Course Outcome: Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I -	Gandhian Ideology	6	Lecture	Evaluation through question-answer session
	Rowlatt Act – Hartal – Jallian Walla Bagh	5	Lecture	Evaluation through question-answer session
	Quit India – Do or Die	7	Lecture	Evaluation through question-answer session
Module II	Anti Caste Movements – Temple Entry Programmes	4	Lecture	Evaluation through question-answer session
	Khadi and Village industrie	8	Lecture	Evaluation through question-answer session
	Anti CommunalProgrammes	7	Presentation	Evaluation of the notes prepared by the students
Module III	Ambedkar and His programme	4	Presentation	Evaluation of the notes prepared by the students

	Jawaharlal Nehru – Congress socialist	10	Presentation	Evaluation of the notes prepared by the students
Module IV	Indian constitution – Act of 1935- Rights and Duties	9	Lecture	Evaluation through question-answer session
	Liberalisation – Privatisation – Globalisation –Narasimha Rao – Man Mohan Singh	8	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		100		

BOOKS FOR STUDY

1. Percival Spear, The History India, Vol 2
2. Bipan Chandra et.al., India's Struggle for Independence
3. Sumit Sarkar, Modern India 1885- 1947

4. SekharaBandyopadhyaya, From Plassey to Partition: A History of Modern India
5. Bipan Chandra et.al., India after Independence
6. Bipan Chandra, In the Name of Democracy: JP Movement and the Emergency
7. Ramachandra Guha, India after Gandhi: The History of World's Largest democracy
8. T T Ram Mohan, Privatisation in India: Challenging the Economic Orthodoxy
9. Ramanuj Ganguli, Globalisation in India: New Frontiers and Emerging Challenges

	Third Gender	7	Lecture	Evaluation through question-answer session
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated Feedbacks are given individually.
Assignments	Any topic	10	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	10	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided
		100		

Course/ Lesson Plan

B. A. English

Semester V 2020-2021, 2021-2022

Course category: Core Paper VII

Paper name: Appreciating Drama and Theatre

Code: ENG5B07

Contact Hours: 90 (5 hrs per week) **Credits : 4**

Course Outcome:

- **To introduce the students to the basic elements of drama, including the historical progress of drama in different continents.**
- **To foster an ability in the students for appreciating drama as an art form.**
- **To familiarize the students with the different genres and masters of drama.**
- **To facilitate the learners to critically go beyond the theatrical performances to the texts and approach them critically from various standpoints.**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I : Drama - Some Key Concepts	Basic Elements of Drama: Tragedy, Comedy, Tragicomedy; The Constituent Parts of Drama – Plot, Character, Thought, Song, Spectacle, Diction, Three Unities, Tragic Hero, Chorus, Simple plot and Complex plot; The basic structure of tragedy	5	Lecture	Evaluation through question-answer sessions

	History of Drama: Greek Theatre and Drama, Miracle Plays and Morality Plays, University Wits, Shakespearean Theatre, Restoration Drama, Sentimental Drama, Anti-sentimental Drama, Comedy of Manners, Drama of the Romantic Period, Decadence, Problem Play, Realism, Ibsen and Bernard Shaw.	5	Lecture Seminar Presentation on 'History of Drama'	Write-ups of students are to be evaluated. Seminar evaluation
	Avant-garde: Expressionism & Epic Theatre, Angry Young Man, The Theatre of the Absurd, Comedy of Menace	5	Lecture Debate on the different types of theatres	Reference reading and notes are evaluated.
	The Theatre of Cruelty, Feminist theatre, Street theatre, Ritualistic Theatre, The Poor theatre, Radio Drama.	1	Presentation and Lecture	Class test including all the topics of Module I.
Module II : Classical Drama	William Shakespeare: Othello	5	Lecture Student seminar	Question-answer sessions Seminar evaluation
		5	Lecture Debate	Presentation on 'Shakespeare: Life and Works'
		5	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
		5	Lecture Student seminar	Question answer sessions Seminar evaluation
		5	Lecture Discussion	Discussion on 'Shakespearean tragedies'
		5	Lecture Debate on 'Iago as a Villain'	Question-answer sessions Debate evaluation
Module III : World Plays	Anton Chekov: The Bear/ The Boor	5	Lecture Debate Presentations	Question-answer sessions Seminar evaluation
	Edward Albee: Zoo Story	5	Lecture Student seminar	Question-answer sessions

		5	Student Seminar	Presentation on the theme of 'Zoo Story' Seminar evaluation
	Kobo Abe: The Man who turned into a Stick – trans. Donald Keene	5	Lecture Discussion Critical analysis of the play.	Evaluation through question-answer session.
Module IV : Drama Adaptation	Roman Polanski: Macbeth (1971)	5	Lecture Debate Presentations	Question-answer sessions
		2	Debate	Debate on the significance of Drama Adaptations Evaluation of the debate.
	Syamaprasad: Akale (2004)	5	Lecture Discussion	Discussion on the various aspects of 'Akale'. Evaluation through question-answer session.
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedback is given. CIE Internal marks are awarded on the basis of assignments as well.
Seminars	Any topic	7	All students are required to present a topic with the help of a powerpoint presentation, preferably.	Feedback is provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Catherine Belsey. The Subject of Tragedy- Identity and Difference in Renaissance Drama. London: Methuen, 1985.
- Jean Chothia. English Drama of the Early Modern Period, 1890-1940. London: Longman, 1996.
- A C Bradley, Shakespearean Tragedy. London: Elibron, 1904.
- H. Granville-Barker, Study of Drama. London: Sedgwick, 1931.

- Peter Womack and Simon Shepherd. English Drama: A Cultural History. Cambridge: Blackwell, 1996.

Teacher/s –in Charge:

- Ms. Bindu Jose
- Ms. Sandra Juliet Jose

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June	Bindu Jose
Module 2	July - August	Bindu Jose
Module 3	September	Sandra Juliet Jose
Module 4	October	Sandra Juliet Jose

Course/ Lesson Plan

Semester III

Course category: Core Paper III

Paper name: Appreciating Prose

Code: ENG3B03

Contact Hours: 72 (4 hrs per week) **Credits : 4**

Course Outcome:

- **To familiarize the students with different types of prose writing.**
- **To introduce to them the basic concepts of style and literary devices in prose.**
- **To acquaint them with cultural diversity and divergence in perspectives.**
- **To develop their critical thinking abilities and write creatively and critically.**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I : Introduction to Prose	Etymology - Functions of prose.	4	Lecture	Evaluation through question-answer session
	Prose varieties – Fiction/Short Story/Tales - Autobiography/Biography- Newspaper/Journal Articles	4	Lecture Debate	Debate on the topic "Prose as a Literary Genre"
	-Philosophical/Scientific Essays –Travelogues – Speech.	2	Presentation on different prose varieties	Reference reading and notes are evaluated.
	Evolution of Prose - Early translations- King Alfred- the Anglo Saxon Chronicle- homilies	4	Presentation and Lecture	Class test including all the topics related to 'evolution of prose'.
	Essay – formal/impersonal essay and informal/personal essay •Types of formal essays: periodical essay, critical essay 16	4	Lecture Presentation on types of essays	Reference reading and notes are evaluated.
	•Personal essays /Life Writing: biography, autobiography, memoir and diaries	4	Lecture Seminar	Question-answer sessions Seminar evaluation
	- bible translations-secular prose-Morte D'arthur- Elizabethan prose-tracts, pamphlets and treatises-	4	Lecture Debate	Presentation on Elizabethan prose
	eighteenth century prose – Victorian and modern prose.	4	Lecture Student seminar	Class test of all the topics of Module I Seminar evaluation

Module II : Reflections and speeches	1. Francis Bacon : Of Studies Speech	4	Lecture Student seminar	Question-answer sessions Seminar evaluation
	2. Charles Lamb : Dream Children :A Reverie.	2	Lecture Debate	Question-answer session
	3. G. K Chesterton : On Running After One's Hat	4	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	4. Albert Camus : Nobel Acceptance	4	Lecture Student seminar	Class test of topics 1- 4 Seminar evaluation
	5. Arundhati Roy : Come September	4	Presentation and Lecture	Reference reading and notes are evaluated.
	6. Pico Iyer : In Praise of the Humble Comma (Biography/Autobiography/Memoir)	4	Lecture Student seminar	Seminar evaluation
	7. Chinua Achebe : The Education of a British Protected Child(extract from the text.)	4	Lecture Debate	Reference reading and notes are evaluated.
	8. Marcel Junod : The First Atom Bomb. (extract from Warrior Without Weapons, translated by Edward Fitzgerald.) 9. Usha Jesudasan : Justice vs Mercy	4	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedback is given. Also, CIE Internal mark is awarded on the basis of assignments.

Seminars	Any topic	7	All students are required to present a topic with the help of a powerpoint presentation, preferably.	Feedback is provided and marks are considered for CIE
		72 hours		

Reference Materials :

- A Concise Companion to Literary Forms. Emerald, 2013.(Chapter IV)
- Dr. Takashi Nagai : Letter from Nagasaki & Dr. Tamiki Hara : Letter from Hiroshima
- Doris Lessing: On not winning the Nobel Prize (Nobel Lecture, December 7,2007)
- Bertrand Russell: Ideas that have helped mankind.
- Marilynne Robinson : When I Was a Child
- Thomas de Quincey : The Literature of Knowledge and The Literature of Power
- J.B Priestley : On Doing Nothing
- Robert Lynd : On Forgetting
- AG. Gardiner : On Living Again

Teacher –in Charge:

- Ms. Bindu Jose

Module Division:

Module	Month	Teacher-in--charge
Module 1	June-August	Ms. Bindu Jose
Module 2	August - October	

Course/ Lesson Plan

Semester IV

Course category: Core Paper V

Paper name: Appreciating Fiction

Code: ENG4B05

Contact Hours: 90 hrs (5 hrs per week) **Credits : 4**

Course Outcome:

- **To help students discover the pleasures in reading fiction.**
- **To aid students gain an insight into the human condition and the complexities of life.**
- **To acquaint the students with different types of fiction and analyze them.**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I : Understanding Fiction	What is fiction?	5	Lecture	Evaluation through question-answer session
	- Plot- Character- Atmosphere- Narrative Techniques	5	Lecture Debate	Debate on the topic "Narrative Techniques"
	Points of view- Difference between long and short fiction	5	Presentation on long and short fiction	Reference reading and notes are evaluated.
	Different types of fiction	5	Presentation and Lecture	Class test including all the topics related to types of fiction
Module II : Short Fiction	O Henry- The Cactus	5	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Maxim Gorky- Her Lover	5	Lecture Debate	Presentation on 'Gorky: Life and Works'
	James Joyce- Eveline	5	Lecture Student seminar	Write-ups of students are to be evaluated.
	Ray Bradbury- Sound of Thunder	5	Lecture Student seminar	Seminar evaluation
	Sally Morgan- The Letter	5	Lecture	Evaluation through question-answer session
	Arun Joshi- The Homecoming	5	Lecture	Evaluation through question-answer session
	Ken Liu- The Paper Menagerie	5	Lecture Presentation	Class test including of all Module II topics
Module III : Long Fiction	George Orwell- Animal Farm	5	Lecture Debate Presentations	Question-answer sessions Seminar evaluation

		5	Lecture Student seminar	Question-answer sessions
		5	Student Seminar	Presentation
			Discussion	Discussion on the different aspects of 'Animal Farm'
Module IV : Film	Moby Dick: dir John Huston	5	Lecture Debate Presentations	Question-answer sessions
		3	Debate	Debate on the various themes of 'Moby Dick'
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedback is given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of a powerpoint presentation, preferably.	Feedback is provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Craft, Stephen and Helen D Cross. Literature, Criticism and Style: A Practical Guide to Advanced Level English Language. Oxford: OUP,2000.
- Watt, Ian. The Rise of the Novel. University of California Press, 2001.
- Booth, Wayne C. Rhetoric and Fiction. University of Chicago Press, 1983
- Lubbock, Percy. Craft of Fiction. Penguin 2017.
- Lazar ,Gillian. Literature and Language Teaching: A Guide for Teachers and Learners. Cambridge University Press, 2008.

Teacher –in Charge:

- Ms. Bindu Jose

Module Division:

Module	Month	Teacher-in--charge

Module 1	November	Ms. Bindu Jose
Module 2	December - January	
Module 3	February	
Module 4	March	

Course/ Lesson Plan

Semester II

Course category: Core Paper II

Paper name: Appreciating Poetry

Code: ENG2B02

Contact Hours: 108 (6 hrs per week) **Credits : 5**

Course Outcome:

- **To introduce the students to the basic elements of poetry, including the stylistic and rhetorical devices employed in poetry, and to various genres of poetry.**
- **To facilitate students to attain various perspectives in reading poetry like gender, race, caste, ethnicity, religion, region, environment and nation.**
- **To familiarize the learners with different forms of poetry written in British and American literature.**
- **To create an awareness among the learners about different forms and themes of poetry produced across the globe in the history of literature.**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I : Poetry- Some Key Concepts	Basic Elements of Poetry: Prosody: Rhythm, Meter – Rhyme - hard rhyme, soft rhyme, internal rhyme - Alliteration, Assonance – Diction.	6	Lecture	Evaluation through question-answer session
	Figures of Speech: Metaphor, Simile, Personification, Oxymoron, Metonymy, Synecdoche, Transferred Epithet.	6	Lecture Seminar presentation	Presentation on the topic “Figures of Speech”
	Poetic Forms: Lyric, Ode, Sonnet, Haiku, Ballad, Couplet, Villanelle, Dramatic Monologue, Elegy, Satire, Mock Epic, Free Verse, Tanka, Jintishi, Ghazal, Rubai, Prose poetry, Narrative poetry, Performance Poetry.	4	Presentation on Poetic Forms	Reference reading and notes are evaluated.

Module II : Poetic Forms	Sonnet: William Shakespeare: Shall I Compare thee to a Summer's Day (Sonnet XVIII), John Milton: On His Blindness. Ballad: John Keats: La Belle Dame sans Merci.	6	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Ode: P B Shelley: Ode to a Skylark	6	Lecture Debate	Presentation on 'P B Shelley: Life and Works'
	Elegy: W H Auden: In Memory of W. B. Yeats	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Villanelle: Dylan Thomas: Do not go Gentle into that Good Night	6	Lecture Student seminar	Class test of topics 1-5 Seminar evaluation
	(Dramatic) Monologue: Robert Browning: My Last Duchess	6	Lecture Debate on Dramatic Monologue	Debate evaluation
	Heroic Couplet: Alexander Pope: Extract from Essay on Man (Epistle I, Section II), "Presumptous man! The reason wouldst thou find…"	6	Discussion on 'Essay on Man'	Question-answer sessions
	Free Verse: Stanley Kunitz: The Layers. Song: Leonard Cohen: I'm your Man	4	Lecture Seminar	Question-answer sessions Write-ups of students are to be evaluated.
Module III : World Poetry	Childhood: Rainer Maria Rilke: Childhood. Love and Loss: Pablo Neruda: Tonight I Can Write the Saddest Lines.	6	Lecture Debate Presentations	Question-answer sessions Seminar evaluation
	Protest: Nazim Hikmet: Some Advice to those who will Serve Time in Prison. Family: Langston Hughes: Mother to Son.	6	Lecture Student seminar	Question-answer sessions
	Survival: Namdeo Dhasal: Stoneman, My Father & Me. Alienation: Diane Glancy: Without Title.	6	Student Seminar	Presentation

	War: Yehuda Amichai: Anniversaries of War. Environment: Joao Cabral de Melo Neto: Landscape of the Capibaribe River.	6	Discussion	Discussion on the different aspects of War
	Commitment and Passion: Charles Baudelaire: Be Drunk. Cultural Difference: Bassey Ikpi: Homeward.	6	Lecture Debate	Discussions, question-answer sessions Debate evaluation
Module IV : Appreciation of Poetry	Poem Analysis, practical analysis of poems, critical appreciation	6	Lecture Debate Presentations	Evaluation through question-answer session
		4	Debate	Discussion on the aspects of critical appreciation of poems
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedback is given. Also, CIE Internal marks are awarded on the basis of assignments as well.
Seminars	Any topic	7	All students are required to present a topic with the help of a powerpoint presentation, preferably.	Feedback is provided and marks are considered for CIE
		108 hours		

Reference Materials :

- A Concise Companion to Literary Forms. Emerald, 2013.
- Bernard Blackstone. Practical English Prosody: A Handbook for Students. Longman, 2009.
- C. T. Thomas Ed. Chaucer to Housman Vol I .New Delhi: B.I. Publications 1990.
- Katherine Washburn and John S. Major Ed. World Poetry: An anthology of Verse from Antiquity to Our Time. New York: W. W. Norton, 1998.

- Margaret Ferguson, Mary Jo Salter and Jon Stallworthy. The Noeton Anthology of Poetry. 5th Ed. New York: W. W. Norton, 2005.
- Neil Corcoran. English Poetry since 1940. London: Longman, 1993.

Teacher/s –in Charge:

- Ms. Darly Mathew
- Ms. Ms Bindu Jose

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	November	Darly Mathew
Module 2	December - January	Bindu Jose
Module 3	February	Darly Mathew
Module 4	March	Darly Mathew

Course/ Lesson Plan

Semester II

Course category: Common Course

Paper name: Writing for Academic & Professional Success

Code: A03

Contact Hours: 72(4 hrs/wk) **Credits: 3**

Course Outcome:

- **To develop writing skills, to learn to integrate writing and thought and to apply the conventions of academic writing correctly**
- **To acquire the correct sense of format, syntax, grammar, punctuation and spelling**
- **To acquire concepts, principles and vocabulary of resoning and argumentation and use analysis, synthesis and evaluation to advance arguments**
- **To gain an understanding of discourse conventions ranging from structure and paragraphing to tone and mechanics**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I The Process of Writing	Introduction to Academic Writing: What is Academic Writing – Purpose of Academic Writing- types of academic writing – Features of academic writing	5	Lecture	Evaluation through question-answer session
	Structuring the essay: planning an essay – brain storming- organizing and outlining- writing a thesis statement- nature of supporting sentences- writing paragraphs- structure of an essay	4	Lecture/ Writing	Practice on Writing Paragraphs
	Vocabulary for writing: selection of vocabulary- Abbreviations_ choice of nouns and- adjectives- Appropriate verbs and adverbs- conjunctions	4	Presentation of new vocabulary	Reference reading and notes are evaluated.

	andprepositions Prefixes and suffixes- Synonyms- Common errors			
	Composing the content: writing introductions and conclusions- ordering the paragraphs - Proof-reading and editing_ Finalising the final draft.	5	Presentation and Lecture	Class test
Module II Elements of Writing	shaping strategies: Discussions, persuasions and arguments Mechanics and conventions of writing:	4	Lecture Student seminar	Question-answer sessions Seminar evaluation
	- comparison and contrast cause and effect-	4	Lecture	Presentation
	Defining and classifying problems and solutions	2	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Punctuation, Use of articles, Relevance of examples, Generalizations, Academic style.	2	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III Writing for Professional Purpose 1	writing Reviews: Reviewing books - Reviewing movies - writing product reviews Writing Case Studies	5	Lecture Presentations	Question-answer sessions Seminar evaluation
	Writing Reports: Feasibility report, progress reports, Evaluative reports	5	Lecture Student seminar	Question-answer sessions
	Surveys::Conducting surveys- Designing questionnaires,	4	Student Seminar	Presentation
	Collecting data _ Writing descriptive reports	4	Discussion	Discussion on the different aspects
Module IV Writing for Professional Purpose II	Writing CVs Letter Writing:	3	Lecture	Question-answer sessions
	Transmittal and cover letters	3	Presentations	Discussion
	Emails, Writing summaries	3	Discussion	Discussion on various aspects

	Writing memos, On writing blogs, Etiquette in writing	3	Lecture	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		72hours		

Core Text: Author PublisherENG2 A03 WRITING FOR ACADEMIC AND PROFESSIONAL SUCCESS

Dr. Jacob George &Dr. Anwar Sadath University ofCalicut

Teacher/s –in Charge: Dr. Sr. A. Princy Anto

Ms. Darly Mathew

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Dr. Sr. A. Princy Anto
Module 2	June, July	Ms. Darly Mathew
Module 3	August	Dr. Sr. A. Princy Anto
Module 4	September	Ms. Darly Mathew
Module 5	August, September	Dr. Sr. A. Princy Anto
Module 6	October	Ms. Darly Mathew

Course/ Lesson Plan

Semester III

Course category: Core Course

Paper name: English Grammar and Usage

Code: ENG3BO4

Contact Hours: 90(5hrs/wk) **Credits: 4**

Course Outcome:

- To familiarize the students with the key concepts of English grammar and to use them more sensitively in their day-to-day communication needs.
- To help students towards a better language use through the understanding of the sentence patterns in English.
- To help the students develop a sense of English grammar, idioms, syntax, semantics and their usage.
- To develop the logical and analytical skills in the use of language for communication. e. To familiarize students with contemporary English usage

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I Basic Grammatical Units	Form class and Function words 6. English Morphology – Compounding, Affixation, Inflexion, Derivation 7. Phrasal verbs and idioms	3	Lecture	Evaluation through question-answer session
	Identifying the Grammatical labels and Functional labels of words	3	Lecture/ Writing	Practice on Writing
	Verb in Function—Gerund , Infinitives, Participles—their uses	3		
	Synonyms, Antonyms, Precise Use	3		
	Mood and Modality	3		

	English Morphology – Compounding, Affixation, Inflexion, Derivation Phrasal verbs and idioms	3		
Module II The Sentence	Word order and Sentence Pattern	5	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Coordination and Subordination	5	Lecture	Presentation
Module III Sentence Transformations: A Relook at Traditional Categories	Tag questions	3	Lecture Presentations	Question-answer sessions Seminar evaluation
	Active passive	3	Lecture Student seminar	Question-answer sessions
	Direct and indirect	3		
	Simple, complex, Compound	3		
	Movement – Collocation	3		
Module IV Important Grammatical Concepts:	Time, Tenses and Aspects	3	Lecture	Question-answer sessions
	Lexical Verbs and Auxiliary verbs: Their uses	3		
	Anomalous Finites	3		
	Subject—Verb agreement in sentences	3		
	Degrees of Comparison	3		
Module V	Reorder jumbled sentences	5		
	Correct the given sentences according to accepted Modern usage and justify the changes made	5		
	Paragraph Editing	5		

	(with more focus on grammatical corrections)			
	Translate a passage from Mother Tongue to English	5		
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials

Gleason, H. A. Linguistics and English Grammar. Holt, Rinehart & Winston, Inc. 1965.

Leach, Geoffrey & Ian Savaitvik. A Communicative Grammar of English. ELBS.

Murphy, Raymond. English Grammar. Cambridge University Press, 2005

Quirk R. & Sidney Greenbaum. A University Grammar of English. ELBS.

Swan, Michael. Practical English Usage. Oxford University Press, 2005.

Thomson, A. J. and Martinet. A Practical English Grammar Combined Exercises Vol. 1 & 2. . Oxford University Press.

Quirk, Randolph. The Use of English. Longman, 1968. 19

Sailaja, Pingali. Indian English. Edinburgh University Press, 2009

Teacher/s –in Charge:DrSr A PrincyAnto

MsDarly Mathew

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June	DrSr A PrincyAnto
Module 2	July	DrSr A PrincyAnto
Module 3	August - October	DrSr A PrincyAnto
Module 4	June - August	MsDarly Mathew
Module 5	September - October	MsDarly Mathew

Course/ Lesson Plan

Semester V

Course category: Core Course

Paper name: Indian Writing

Code: ENG5B10

Contact Hours: 90(5hrs/wk) **Credits: 4**

Course Outcome:

- To provide an overview of the various phases of the evolution of Indian writing in English
- To introduce students to the thematic concerns, genres and trends of Indian writing in English
- To expose students to the pluralistic aspects of Indian culture and identity

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I Poetry	Rabindranath Tagore: Two verses - one each from The Gitanjali and The Gardener.	5	Lecture	Evaluation through question-answer session
	Sarojini Naidu: The Coromandel Fishers	5	Lecture/ Writing	Discussion
	Kamala Das: Introduction. ArunKolatkar: Old Woman	5	Lecture/ Writing	Reference reading and notes are evaluated.
	Agha Shahid Ali: Country without a Postcard	5	Presentation and Lecture	Class test
Module II Prose	B R Ambedkar: Speech at Mahad	7	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Salman Rushdie: Imaginary Homelands.	8	Lecture	Presentation
Module III Fiction	R K Narayan: The Fortune Teller	7	Lecture Presentations	Question-answer sessions Seminar evaluation
	2. TemsulaAo: Laburnum for my Head.	9	Lecture Student seminar	Question-answer sessions
	3. JhumpaLahiri: The Interpreter of Maladies	9	Lecture Discussion	Presentation
Module IV	GirishKarnad: Fire	13	Lecture	Question-answer

Drama & Film	and Rain		Role Play Discussion	sessions
	Charulatha: dir. SatyajitRay	5	Film Screening Discussion	Discussion
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials

Iyengar, Sreenivasa. Indian Writing in English. Delhi: Sterling, 1984.

Naik, M.K. A History of Indian English Literature. Delhi: Sahitya Academy, 1982.

Mehrotra, A.K. A Concise History of Indian Literature in English. Delhi: Permanent Black, 2008

Naik, M.K. Perspectives on Indian Poetry in English. Delhi: Abhinav Publication, 1984

N.V. Bhairava and V. Sarang ed. Indian English Fiction 1980-1990:An Assessment. Delhi: Permanent Black, 1994.

Naik, M.K. and S.M. Panekar ed. Perspectives on Indian Drama in English. Delhi: Permanent Black, 1977.

Amga, H.I., Indo-English Poetry. Jaipur: Surabhi Publication, 2000.

Roy, Nelson, F.S., Reworlding: The Literature of Indian Diaspora. New York: Permanent Black, 1992.

Williams, H.M. Indo Anglian Literature, 1800-1970. Bombay: Orient Longman, 1976.

Anuradha. Patterns of Feminist Consciousness in Indian Women Writers: Some Feminist Issues. Delhi: Prestige Books, 1999

Teacher/s –in Charge:

MsBindu Jose

DrSr A PrincyAnto

Module Division:

Module	Month	Teacher/s-in—charge
Module 1	June - July	MsBindu Jose
Module 2	August - October	MsBindu Jose
Module 3	June - July	DrSr A PrincyAnto
Module 4	August - October	DrSr A PrincyAnto

Course/ Lesson Plan

Semester V

Course category: Core Course

Paper name: Language and Linguistics

Code: ENG5BO2

Contact Hours: 90(5hrs/wk) **Credits: 5**

Course Outcome:

- To lead lo a better understanding 0fthehumanmindofhuman communicative action and relations through an objective study of language.
- Tofamiliarisestudents with keyconcepts oflinguisticsanddevelopawareness of latest trends in languageStudy.
- To help students towards better pronunciation and to improvethegeneral standard of pronunciation in everyday conversation and in reading.
- To help the students developa sense of English grammar, idioms. syntaxand usage
- To improve writing and speech skills.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I Language &Linguistics	Language - definitions - Theories related to the origin of language - Properties of human language as opposed to animal communication - Speech & Writing	4	Lecture	Evaluation through question-answer session
	Linguistics - definition - levels of linguistic analysis- Phonetics, phonology, morphology, syntax, semantics, semiology, discourse	5	Lecture/ Writing	Practice on Writing
	Branches of linguistics - psycho-linguistics, ethno-linguistics, socio-linguistics Language Varieties - Idiolect – Dialect - Isogloss- Register – Pidgin, Creole - Bilingualism	5		

	- Diglossia. (Concepts of linguist & polyglot)			
	Approaches to the study of linguistics - synchronic & diachronic - descriptive& prescriptive - traditional & modern Concepts of langue, parole, competence. performance	4		
Module II	Airstream mechanism -Organs of speech Classification & description of speech sounds - vowels - monophthongs, diphthongs, triphthongs - cardinal vowels - consonants	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Phonology - phoneme - allophones- - transcription- IPA symbols, diacritics Phonemes in English - vowels, consonants, some important allophonic variants Homophones, homonyms	8	Lecture	Presentation
	Syllable- definition/description - structure - syllabic consonant - consonant clusters, abutting consonants Word accent Accent & rhythm in connected speech - weak forms Intonation	7	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Juncture- Assimilation & Elision Transcription	7	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation

	Need for uniformity - RP & GIE.			
Module III	Morpheme, allomorph & morph	7	Lecture Presentations	Question-answer sessions Seminar evaluation
	Free & bound morphemes - content/lexical & functional/structural words - root, stem, affixes - derivational & inflectional affixes -Word-formation Semantics - Synonymy, antonymy, hyponymy, polysemy, ambiguity Semantic changes	8	Lecture Student seminar	Question-answer sessions
Module IV Writing for Professional Purpose II	Types of phrases, clauses & sentences	6	Lecture	Question-answer sessions
	Syntactic models - IC Analysis, labelled IC Analysis - PS Grammar - TG Grammar - kernel sentences & transforms - deep structure & surface structure - Some transformations - obligatory & optional - Interrogative - Do support - Negation - Passivisation - Co-ordination & subordination	9	Presentations	Discussion
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are	Feedbacks are provided

			required to present a topic with the help of power point presentation, preferably.	and marks are considered for CIE
		90 hours		

Refernce Materials

Lyon, John. Language and Linguistics: An Introduction

Gimson, A.C. An Introduction to the Pronunciation of English

Murphy, Raymond. English Grammar

Trask, R. I. Key Concepts in Language and Linguistics

Martinet, Andre. Elements of General Linguistics

Swan, Michael. Practical English Usage.

Gleason, H.A. Linguistics and English Grammar Lyons,

John. Ed. New Horizon in Language

Hencock, Mark. English Pronunciation in Use

Hall, Christopher J. An Introduction to Language and Linguistics

Odden, David. Introducing Phonology

Matthews, P.H. Linguistics: A Very Short Introduction

Yule, George: The Study of Language.

Teacher/s –in Charge:DrSr A PrincyAnto

Ms Noble A Paliath

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	DrSr A PrincyAnto
Module 2	June, July	Ms Noble A Paliath
Module 3	August - October	DrSr A PrincyAnto
Module 4	August - October	Ms Noble A Paliath

Course/ Lesson Plan

Semester I

Course category: Common Course

Paper name: Transactions:Essential English language Skills

Code: ENG1A01

Contact Hours: 72 **Credits: 3**

Course Outcome:

- **Students become able to pronounce the words correctly**
- **The speech of the students sound more natural and fluent with the use of phrasal verbs and idioms**
- **The vocabulary of the students become rich with synonymous expressions**
- **Students become capable to comprehend the reading materials.**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Pronounciation-Introduction--speech sounds-vowels-consonants-	3	Presentation,Language lab,Drilling session,videos	Evaluation through test pacers,question-answer session
	basics of word/sentence	3	Lecture videos,presentation	Group activity games,test paper, question-answer session
	stress-	3	Language lab,presentation,lecture	Oral tests conducted individually
	resolving issues of L1 interference-e/m-learning corner.	3	Presentation and Lecture	Test Paper-question-answer session
Module II	Module 2: Vocabulary Introduction-synonyms-collocations-phrasal verbs-idiomatic expressions-vocabulary in everyday social contexts- e/m-learning corner.	3	Lecture Role plays,Dictionary,word games	Question-answer sessions ,Test papers
	synonyms-collocations-	3	Role plays, seminars,lecture'Dictionary	Oral test,Question-answer sessions

	phrasal verbs- idiomatic expressions- vocabulary in everyday social contexts- e/m-learning corner.	3	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	vocabulary in everyday social contexts- e/m-learning corner.	3	Lecture Student seminar,Role plays	Class test of all the topics of Module II Seminar evaluation
Module III	Introduction- major tenses-	3	Lecture Exerxises	Test papers,Question-answer sessions
	present-past-	3	Tense exercises,lecture, interactive sessions	Students must prepare sentences indicating the specified tenses and is to be evaluated.
	future-questions and negatives-	3	Tense exercises,lecture, interactive sessions	Students must prepare sentences indicating the specified tenses and is to be evaluated.
	modals-conditionals-e/m-learning corner	3	Tense exercises,lecture, interactive sessions	Students must prepare sample sentences based on the modals/conditionals and is to be evaluated.
Module IV	Social Communication: Introduction –	3	Lecture Discussion	Discussion on decorum to be kept in social communication
	sounding very polite-making a point/persuading-	3	Lecture ,Role plays, interactive sessions,	Oral tests,Students must prepare sentences expressing persuasion,request etc and is to be valuated
	opinions/preferences-encouraging/comforting- making suggestions/regrets.-complimenting-guessing telephoning in English.	3	Lecture ,Role plays, interactive sessions,	Oral tests,Students must prepare sentences expressing opinion preference,suggestions,regrets,complimenting,comforting etc and is to be valuated.Students must be divided into groups regarding the role play for telephonic conversation and is to be vealuated
	Academic Communication: discussion skills – presentation skills-debating skills- e/m-learning corner.	3	Lecture Discussion,presentation,	Seminars must be evaluated

Module V	Reading Skills Introduction-implicationst.	3	Lecture,discussion	Vocabulary tests to be conducted and evaluated
	/Tone/attitude/ viewpoint-	3	Loud reading&silent reading,Discussion,lecture	Students must prepare summary of the given paragraph and is to be evaluated
	effective reading comprehension skills-understanding generic/specific ideas /factual information--	3	Loud reading&silent reading,Discussion,lecture	Students must answer the comprehension questions and is to be evaluated
	vocabulary in context	3		
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 60 marks and 2 hours duration	7	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		72hours		

Reference Materials :

- English Pronounciation in Use Elementary by Jonathan M
- Better English Pronounciation by J. D O'Connor

Teacher/s –in Charge:

- Ms.Darly Mathew
- Dr.Sr.A Princy anto

Module Division:

Module	Month	Teacher/s-in--charge

Module 1	June-July	Darly Mathew
Module 2	August	Dr.Sr.Princy Anto
Module 3	September	Ms.Darly
Module 4	October	Dr.Sr.Princy anto

Course/ Lesson Plan

Semester :4

Course category: Core Course I

Paper name:Literary Criticism

Code: ENG4BO6

Contact Hours: 72 **Credits: 4**

Course Outcome:

- **The students identify the difference between literary criticism and theory**
- **They read literature keeping in mind the traditional principles of criticism**
- **The students write literature from the perspective of the theory**
- **The students produce critique of literature**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Classical Literary Criticism 1. Plato: Concept of Art - Mimesis, His attack on poetry, Moral Concerns of literature, Views on Drama. 22	5	Lecture ,seminar presentation	Evaluation through question-answer session
	2. Aristotle: Poetics - Mimesis, Catharsis, Hamartia - Defence of Poetry - Definition of Tragedy-Parts of Tragedy, Plot, Tragic Hero, Three Unities, Comedy, Epic, Poetic style.	4	Lecture Discussion	Seminar presentations by students to be evaluated
	3. Horace: Ars Poetica - Definition of art, Views on Poetry and Drama.	3	Lecture and Discussion	Reference reading and notes are to be evaluated.
	4. Longinus: Romanticism, Sublimity in literature – Its sources.	3	Lecture.Discussion,Seminar	Class test including all the topics of module 1

Module II	English Literary Criticism – The Sixteenth to the Nineteenth Century 1. Philip Sidney: Apology for Poetry – Reply to Stephen Gosson, The Argumentative Method .2.John Dryden: Neoclassicism – The function of Poetry, Dramatic Poesy, Observations on tragedy, comedy, satire, epic	5	Lecture Student seminar	Question-answer sessions Seminar evaluation
	3.Dr. Samuel Johnson: Neoclassicism, Biographical Criticism, Historical approach, Observations on Poetry, Drama, Shakespeare, Tragicomedy, Three unities.–	3	Lecture Discussion	Evaluation through question-answer sessions
	The Nineteenth Century 1.William Wordsworth: "Preface to Lyrical Ballads" – The Romantic Creed - Difference between Neoclassicism and Romanticism - definition of poetry – poetic diction and language.2.S. T. Coleridge: Theory of Imagination, Fancy and Imagination, Primary Imagination and Secondary imagination, Poetic Genius.	4	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation

	3.P. B. Shelley: The Defence of Poetry – Concept of Poetry. 4.Mathew Arnold: Classicism - Concept of Culture – the use and function of poetry - Touchstone method – Moralistic criticism – Function of criticism – High seriousness and Grand Stylefcc	3	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III	The Twentieth Century 1.T.S. Eliot: "Tradition and Individual Talent" – Historical Sense – Impersonality – Poetic Emotion – Objective Correlative – Dissociation of Sensibility.	3	Lecture Discussion	Question-answer sessions
	2.I. A. Richards: Poetry and Communication, Practical Criticism - The Four Kinds of Meaning – Scientific and Emotive uses of Language. 3.F.R. Leavis: Concept of Literature and Criticism	5	Lecture Discussion	Student seminar presentations to be evaluated
	4.Formalism: Key Features of Formalism - Its Origin, Focus on language, Form, Literariness, Defamiliarization, Fabula/Syuzet, Motivation.	3	Lecture,Discussion	Question-answer sessions,seminar presentations

	5.New Criticism: The origin - Close reading and explication - Ambiguity, Paradox, Irony, Tension, Intentional Fallacy and Affective fallacy. 6.Archetypal Criticism: Myth, Archetype, Collective Unconscious, Northrop Frye	4	Lecture,presentation,discussion	Evaluation through question-answer session
Module IV	Glossary 1. Indian Aesthetics: Rasa, Dhwani,	6	Presentation,Discussion	Seminar presentations by students are to be evaluated
	Vyanjana, Alamkara, Thinai. 2. Literary Movements: Classicism, Neoclassicism,	4	Presentation,lecture	Seminar evaluation
	Romanticism, Humanism, Realism, Naturalism, symbolism.	2	Lecture Presentation	Seminar evaluation
	3. Literary Concepts: Catharsis, Mimesis, Objective Correlative, Ambiguity, Negative Capability	3	Lecture Discussion	Class test
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		72 hours		

Reference Materials :

- B Prasad, An Introduction to English Criticism.
- Lois Tyson, Critical Theory Today.
- David Daiches, Critical Approaches to Literature.
- Harry Blamires. A History of Literary Criticism.
- Ramaswamy S & Sethuraman V.S. The English Critical Tradition.
- Das B. B., Literary Criticism: A Reading

Teacher/s –in Charge:

- Ms.Darly Mathew
- Ms.Bindu Jose

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Ms.Darly Mathew
Module 2	August	Ms.Darly Mathew
Module 3	September	Ms.Bindu Jose
Module 4	October	Ms. bindu Jose

Course/ Lesson Plan

Semester I

Course category: Core Course I

Paper name:Introducing Literature

Code: ENG1BO1

Contact Hours: 108 **Credits:5**

Course Outcome:

- **The students read and enjoy theory**
- **The students theorise social issues**
- **The students become able to identify the constituents of language**
- **The students analyse events systematically**
- **The students acquire vocabulary**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	The Syntax: Verb Phrases, Adjuncts, Collocations, Linkers, Sense Groups	6	Lecture Presentation	Evaluation through question-answer session
	The Poetic: Comparisons, Exaggerations, Images, Symbols, Iamb, Trochee, Caesura, Enjambment	6	Lecture Presentation	Seminar presentations by students are to be evaluated
	Texts: 1. Ruskin Bond “Eyes of the Cat” 2. Anton Chekhov “The Death of a Clerk” 3.	6	Lecture Discussion	Reference reading and notes are evaluated.
	Alfred Lord Tennyson “The Oak” 4. Langston Hughes “Dreams” 5. Emily Dickinson “Because I could not Stop for Death”	6	Lecture Discussion	Class test including all the topics of module 1
Module II	Point of view (diegesis),	6	Lecture Student seminar	Question-answer sessions Seminar evaluation
	polyphony and its rationale, single perspective and its dangers Texts:	6	Lecture Presentation	Evaluation through question-answer sessions

	1. Freya Stark Winter in Arabia (excerpts)	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	2. Laura Bohannan "Shakespeare in the Bush" 3. Akira Kurosawa dir. Rashomon	6	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III	: Literature and Ideology The workings of power structures in literature; explication of the terms - ideology, hegemony, interpellation,	6	Lecture Debate Presentations	Question-answer sessions
	discourse, grand narratives, little narratives – using literary texts;	6	Lecture Discussion	Seminar Presentations
	literary devices like irony and paradox and their role in reinforcing ideology. Texts: 1. Arundhati Roy "The God of Small Things"	6	Lecture,presentation	Seminar presentations by students to be evaluated
	Charlotte Bronte "Jane Eyre" 3. George Orwell "A Hanging" 4. Hansda Sowvendra Shekhars "The Adivasi will not Dance"	6	Lecture Discussion	Evaluation of write-ups by students
Module IV	Perspective of the Subaltern Dominant voices, marginalized voices, Kingston "No Name Woman"	6	Lecture Debate	Evaluation of write ups by studentsc
	subaltern identities, resisting the norm/authority Texts: 1. RK Narayan Swami and Friends (Excerpt from Chapter XI "In Father's Presence")	6	Lecture Student Seminar	Seminar evaluation
	2. Arun Kamble "Which language should I Speak?" and FM Shinde "Habit" 3. The	6	Lecture Student Seminar	Seminar evaluation

	Letter Q: Ely Shipley 4. Maxine Hong	6	Lecture Discussion	Class test
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		108 hours		

Reference Materials :

- Achebe, Chinua. Things Fall Apart. Penguin, 1994.
- Angelou, Maya. I know Why the Caged Bird Sings. Bantam, 1971.\
- Austen, Jane. Pride and Prejudice. Penguin, 2003.
- Bond, Ruskin. "The Night the Roof Blew Off" Tigers Forever: Poems and Stories. RatnaSagar, Delhi, 1996

Teacher/s –in Charge:

- Ms.Bindu Jose
- Ms.Darly Mathew
- Ms.Keerthana Kannan

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Ms Darly Mathew
Module 2	August	Ms. Bindu Jose
Module 3	September	Ms.Keerthana Kannan
Module 4	October	Ms.Darly Mathew

Course/ Lesson Plan

Semester V & VI

Course category: Core Course I

Paper name: Project

Code: ENG6B21

Contact Hours: Nil **Credits:2**

Course Outcome:

- **The students prepare the bibliography of the project as per the MLA format**
- **The students present the ideas in a logical and coherent manner**
- **The students do the in-text citation as per the MLA format**
- **The students practice academic writing**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Methodology of Research-The Principles of MLA style-The core elements		Lecture	Evaluation through question-answer session
	'The Mechanics of scholarly prose-formatting and ordering of the works cited list,in-text citation		Lecture Debate	Test paper
	Plagiarism		Presentation on Greco-Roman traditions and writers	Reference reading and notes are evaluated.
	Principles of Academic Writing-Difference between academic and non-academic writing,Characteristics of academic writing-Vocabulary		Presentation and Lecture	Class test including all the topics of the module
Module II	Library Work and data collection-Author&Primary Sources		Lecture Student seminar	Question-answer sessions Seminar evaluation
	Review of Litrerature		Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation

	Synopsis Preparation		Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III	Data analysis-Collection of Secondary Materials		Lecture Debate Presentations	Seminars are to be evaluated
	Note taking		Lecture and materials on note-taking	Notes are to be evaluated
	Organisation of the data		Discussion	Arranged data is to be evaluated
	Analysis of the data		Discussion	Seminars are to be evaluated
Module IV	Project presentation and submission-Outline Preparation		Discussion	Outline is to be evaluated
	Rough Draft		Discussion	Rough draft is to be evaluated
	Fair Copy presentation and submission		Discussion	Seminar evaluation
	Viva-voce		Discussion	viva-voce
Evaluation: (12 hrs)				
Internal Examinations	Viva voce of 15 marks is to be conducted	20mts.	Viva Voce	Performance during the viva as well as organization, originality and methodology are evaluated
Assignments	Topics regarding the project		All students are required to prepare assignments regarding the project topic	Assignments are corrected and feedbacks are given.
Seminars	Topics regarding the project	7	All students are required to present topics with the help of power point preferably.	Feedbacks are provided
		Nil		

Reference Materials :

- MLA Handbook Eighth Edition
- Primary Sources of the respective project
- Secondary sources regarding the respective project

Teacher/s –in Charge:

- Ms.Darly Mathew
- Ms.Sandra Juliet Jose

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July ,August	Ms.Darly&Ms.Sandra
Module 2	September,October	Ms.Darly &Ms.Sandra
Module 3	October,November,Decembr	Ms.Darly&Ms.Sandra
Module 4	January,February,March	Ms.Darly &Ms.Sandra

Course/ Lesson Plan

Semester :V

Course category: Core Course

Paper name: Literary Theory

Code: ENG5B08

Contact Hours: 90 **Credits: 4**

Course Outcome:

- **Students read on the important texts and movements of literary theory.**
- **Students prepare critique of literature and culture in the context of literary theory.**
- **Students analyse the various arguments presented in literary theory**
- **Students look into the various literary texts and**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Liberal Humanism versus Theory- Introduction	3	Lecture	Evaluation through question-answer session
	1. Liberal Humanism: Dominant aspects of Liberal humanism with examples	3	Lecture Discussion	Evaluation through question-answer sessionn
	2. Literary Theory: Dominant aspects of literary theory with examples.	4	Lecture,discussion,Presentation on literary theory	Evaluation through question-answer sessioReference reading and notes are evaluated.
	Linguistic Turn – Critical turn – Paradigm shif	5	Lecture and discussion	Class test including all thetopics of Module 1
Module II	1. Structuralism: Saussure - Sign, Signifier, Signified – Claude Levi-Strauss and Roland Barthes – Structuralist narratology	4	Lecture,Discussion Student seminar	Question-answer sessions Seminar evaluation
	2. Poststructuralism: Derrrida, Logocentrism, Aporia, Decentering	4	Lecture,Discussion Student seminars	Student Seminars are to be evaluated

	3. Psychoanalytic Theory: Unconscious. Fre ud – Id, Ego, Superego, Oedipus Complex.	3	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Lacan – Imaginary, Symbolic, Real, Mirror Stage	4	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III	1.Marxism: Base, Superstructure, Materialism, ideology. The Frankfurt School – Culture industry.	4	Lecture Discussion Presentations	Question-answer sessions
	Antonio Gramsci – The formation of the intellectuals, Subaltern. Louis Althusser – Ideological State apparatus and Interpellation. 2.Cultural Studies: Culturalism, New Left, CCCS,	3	Lecture Discussion	Seminar evaluation
	Raymond Williams' definition of Culture, Structure of feeling, Stuart Hall and the 'popular', and the two paradigms of Cultural Studies.3.Cultural Materialism	4	Lecture Discussion	Seminar evaluation
	New Historicism: Marxist framework of Culture and History, Historiography, Foucauldian notion of Power, Difference with Old Historicism, Stephen Greenblatt, Louis Montrose	4	Lecture,Discuss ion , Seminars	Evaluation through question-answer session
Module IV	. Feminism: The three waves in feminism, Gynocriticism,,	3	Lecture Debate	Debate on the various perspectives of feminism

	French Feminism - Ecriture feminine, Sexual Politics, Marxist Feminism, Lesbian Feminism	4	Lecture,Discussion Student Seminar	Seminar evaluation
	Backlash, Black Feminism, Dalit Feminism, Postfeminism, Womanism.	4	Lecture,Discussion Student Seminar	Seminar evaluation
	Queer Theory: Social constructionism of gender and sexuality, LGBTIQ, Transgender identity	4	Lecture, Discussion	Debate on 'gender as performative'
Module V	Postcolonialism: Eurocentrism, Orientalism, Alterity,	5	Lecture,Discussion	Seminar evaluation
	Diaspora, Hybridity, Uncanny, Strategic Essentialism, Subaltern Studies, Postcolonial Critique of Nationalism.	4	Lecture,Discussion	Seminar evaluation
	. Postmodernism: Critique of Enlightenment and Universalism, Habermas's notion of Modernity as an Incomplete Project, Lyotard's concept of incredulity towards metanarratives, Baudrillard's ideas of Simulation, Simulacra and hyperreality, Brian McHale's concept of Postmodernist literatures.	5	Lecture,Discussion,Discussion	Seminar evaluation
	. Ecocriticism: Anthropocentrism, Shallow Ecology vs Deep Ecology, Environmental Imagination, Ecofeminism	4	Lecture,Discussion,Discussion	Debate on 'How to maintain the balance between nature and culture'
Evaluation: (12 hrs)				

Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Hans Bertons. Literary Theory.
- Terry Eagleton. Literary Theory: An Introduction.
- Aijaz Ahmad. In Theory: Classes, Nations, Literatures.
- Jonathan Culler. Literary Theory: A Very Short Introduction.
- Terry Eagleton. After Theory. 27 Peter Barry. Beginning Theory.

Teacher/s –in Charge:

- Ms.Darly Mathew.
- Ms.Sandra Juliet Jose

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Ms.Sandra Juliet Jose
Module 2	August	Ms.Darly Mathew
Module 3	September	Ms.Darly Mathew
Module 4	October	Ms.Sandra Juliet Jose

Course Plan

Semester **:** III

Course Category **:** Complementary Course II

Paper Name : Introduction to TV and Cinema

Code **:** JOU3C02

Contact Hours **:** 108 (6 hrs per week)

Credits **:** 4

Course Outcomes

- Introduce the TV Broadcast journalism to the students
- Introduce the students the medium cinema and its characteristics

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I: Evolution of Television	Television: Characteristics, Scope and Limitations - Origin and Development of Television	5	Lecture	Evaluation through question-answer session
	DD Cable TV, Satellite TV, DTH; News Channels with Special Reference to Malayalam	4	Lecture Debate	Debate on the topic "Advantages of Cable TV"
	Organisational Structure of News Wing of a TV Channel	4	Presentation on Organisational Structure of News Wing of a TV Channel	Reference reading and notes are evaluated.
	TV on Web, TV on Mobile	5	Presentation and Lecture	Class test including all the topics related to Evolution of Television
Module II: Television News Programmes	Structure and Types of TV News – TV News Gathering - News Writing – Voice Over, News Production, Anchoring, PCR,	5	Lecture Student Seminar	Question-answer sessions Seminar evaluation

	Teleprompter			
	Scripting for Television Programmes -	4	Lecture Debate	Presentation on "Scripting for Television"
	TV Interviewing, Discussion, TV Magazines, Live Programmes	3	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Special Audience Programmes, Sting Operation	3	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III: An Overview of Cinema	Cinema; Characteristics and Types Cinema: A Brief History. - Lumiere Brothers and Early Experiments Major Film Movements – An Overview	4	Lecture Debate Presentations	Question-answer sessions Seminar evaluation
	German Expressionism- Cabinet of Dr. Caligary by Robert Wiene. Soviet Montage - Battleship Potemkin by Sergie Eisentein	5	Lecture Student seminar	Question-answer sessions
	Italian Neo Realism - Bicycle Thieves by Vittorio Desseca	1	Student Seminar	Presentation
	A Few Great Masters: Charles Spencer Chaplin - Akira Kurosawa, Kim Ki Duk and Mohsen Makmalbaf	2	Discussion	Discussion on the filmic aspects of eminent film makers
Module IV: Indian Cinema	Indian Cinema: Early Experiments, New Wave and Commercial Cinema, FTII – Indian Masters	6	Lecture Presentations	Question-answer sessions
	H.S. Bhatwadekar, DG Phalke, Satyajith Ray	3	Presentations	Topics related to the module
	Ritwik Ghatak, Mrinal Sen	3	Discussion	Discussion on the topics taught
	Girish Kasaravalli, K Balachandar	6	Lecture	Evaluation through question-answer session
	Malayalam Cinema – A dDecade-wise Overview	4	Lecture	Evaluation through question-answer session

Module V: Malayalam Cinema	Masters: - Adoor Gopalakrishnan - G Aravindan	4	Debate	Debate on "Adoor Gopalakrishnan Films: Merits and Demerits"
	John Abraham, P.N. Menon	3	Discussion and Student Seminar	Evaluation through question-answer session
	K.G. George; Contemporary Malayalam Cinema	3	Lecture and Discussion	Class test
Module VI: Basics of Film Making	Steps in Film Making	4	Lecture	Evaluation through question-answer session
	Pre Production	4	Lecture Student Seminar	Seminar evaluation
	Production	5	Lecture Student Seminar	Seminar evaluation
	Post Production	6	Lecture Discussion	Class test
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		108 hours		

Reference Materials :

- Herbert Zettl. Television Production Handbook, 7th Edition.
- Arthur Asa Berger. Scripts, Writing for Radio and Television. SAGE Publications.
- Virginia Wright Wexman. A history of Film. 6 th edition.
- Jarek KUPSC. The History of Cinema for beginners.

- Keval J. Kumar, Mass Communication in India‘, Jaico Publishing House, New Delhi.

Teacher/s –in Charge:

- Ms. Sandra Juliet Jose
- Ms. Noble A. Paliath

Module Division

Module	Month	Teacher/s-in--charge
Module 1	June-July	Noble A. Paliath
Module 2	June-July	Sandra Juliet Jose
Module 3	August	Sandra Juliet Jose
Module 4	September	Sandra Juliet Jose
Module 5	August-September	Noble A. Paliath
Module 6	October	Sandra Juliet Jose

Course Plan

Semester **: II**

Course Category **: Common Course**

Paper Name **: Zeitgeist: Readings on Society and Culture**

Course Code **: ENG2A04**

Contact Hours **: 90 (5 hrs/wk)**

Credits **: 4**

Course Outcomes:

- To inculcate the values enshrined in the constitution of India and to provide an insight on the secular framework of the country.
- To familiarize the learners with concepts such as conservation, sustainability and the life of the marginalized and their interconnectedness.
- To foster among learners an awareness of the diverse problems faced by women and the sexual minorities and to promote a culture of inclusion.
- To understand the "human" as articulated among the various cultures and promote a multicultural and plural understanding of rights.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ Plans**	**Assessment**
Module I: **Indian Constitution and Secularism**	Preamble to the Constitution of lndia	5	Lecture	Evaluation through question-answer session
	Should Gandhi's Assassin be Killed?	4	Lecture Debate	Debate on the topic "Should Gandhi's assassin be killed?"
	Toba Tek Singh	6	Presentation and lecture	Reference reading and notes are evaluated.
	Freedom	5	Presentation and lecture	Evaluation through question-answer session
Module II: **Sustainable Environment**	The End of Living and the Beginning of Survival	5	Lecture Listen To The Original Speech As Made By Chief Seattle	Question-answer sessions Seminar evaluation
	The End of Living and the Beginning of Survival	7	Lecture Debate	Debate on the topic "Is there an immediate need to protect nature?"
	Zlateh the Goat	3	Lecture Student Seminar	Write-ups of students are to be evaluated. Seminar evaluation
	On Killing a Tree	3	Lecture Explore More Poems By Gieve Patel	Class test of all the topics of module ii Seminar evaluation
		8	Lecture	Question-answer

			Debate Presentations	sessions
Module III: **Gender**	The Story of an Hour	3	Debate	Debate on the "Marriageable age of boys as 21?"
	Refugee Blues	4	Discussion	Discussion on the application
	What it Means to be a Transgender?	6	Lecture	Evaluation through question-answer session
Module IV: **Human Rights**	Refugee Blues	4	Lecture Debate	Debate on "Are human rights completely violated?"
	Amnesty	4	Lecture Student Seminar	Seminar evaluation
	Akkarmashi	5	Lecture Student Seminar	Seminar evaluation
	Chemical Happiness and the Meaning of Life	6	Lecture Discussion	Class test
Evaluation: (12 hrs)				
Internal Examinations	Two Internals of 80 Marks and 2.5 Hours Duration	5	Written exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any Topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE internal mark is awarded on the basis of assignments too.
Seminars	Any Topic	7	All students are required to present the assigned topics	Feedbacks are provided and marks are considered for CIE.
		90 hours		

Reference Materials:

- Wagner G., T. Kåberger, S. Olai, M. Oppenheimer, K. Rittenhouse and T. Sterner, "Push Renewables to spur carbon pricing", *Nature*, 525:27-29 (3 September 2015) [DOI:10.1038/525027a]
- Jensen S., K. Mohlin, K. Pittel and T. Sterner (2015) "The green paradox: a brief introduction to Climate policy and intertemporal emissions leakage", *Review of Environmental Economics and Policy* (Summer 2015) 9 (2): 246-265

- Management, Gender, Race**,** by Margaret F. Karsten, with contributions from Joan E. Riedle (2005)
- Contemporary Women Novelists: New Voices for the New Millennium: A Selected List, by Helene Androski (2005).
- (Inter)disciplining Chinese Women: An Introduction to the English-Language Literature on Women's Studies in China, by Patricia Arend (October, 2000)

Teachers -in-Charge:

- Ms. Noble A. Paliath
- Ms. Sandra Juliet Jose

Module Division:

Module	**Month**	**Teachers-in-Charge**
Module 1	October, November, December	Ms. Noble A. Paliath
Module 2	January, February, March	Ms. Noble A. Paliath
Module 3	October, November, December	Ms. Sandra Juliet Jose
Module 4	January, February, March	Ms. Sandra Juliet Jose

Course Plan

Semester : III

Course Category : Common Course

Paper Name : Signatures: Expressing the Self

Code : ENG3 A05

Contact Hours : 90 (5hrs/wk)

Credits : 4

Course Outcomes:

- To enable the students to read and critically appreciate the different genres of expressing the self
- To appreciate the fluid and flexible narratives of self expression that transcend the conventions of genre
- To understand how personal narratives intersect with the larger social realities
- To read personal narratives that move beyond the individual self to express the collective self
- To understand how the distinctions between fact and fiction blur in personal narratives

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I: Autobiographical Writings and Memo	Memoirs	5	Lecture	Evaluation through question-answer session
	Pilgrim at Tinker Creek	4	Lecture	Evaluation through question-answer session
	I Stand With You Against the Disorder	6	To trace the history of Okanagan Community	Reference reading and notes are evaluated.
	When I was Growing Up	5	Presentation and Lecture	Class test including all the covered topics of module I
Module II: Speeches and Testimonies	Art, Truth and Politics	5	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Charlie Chaplin's Final Speech in the Movie 'The Great Dictator'	7	Lecture Debate	Debate on the topic of "Is the concept of democracy fully enjoyed by the masses?"
	Voices from Chernobyl	3	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation

	Breaking Silence	3	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III: Diary Entries and Letters	A Diary of a Young Girl	8	Lecture Debate Presentations	Question-answer sessions
	The Secret Diary of Adrian Mole Aged 13 3/4	3	Reading based on the entire diary of Anne Frank	Question-answer sessions
	Letters from the Mothers of Nenjamparambu to the Supreme Court	4	Discussion on the impact of the use of Endosulphan	Recap of the discussion through question-answer sessions
	Letter to Adolf Hitler	6	Reading based on the two autobiographies, viz, Gandhi's and Hitler's	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 Marks and 2.5 hours duration	5	Written exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE.
		90 hours		

Reference Materials:

- Harner, James L. Literary Research Guide: An Annotated Listing of Reference Sources in English Literary Studies. 5th ed
- Marcuse, Michael J. A Reference Guide for English Studies.
- Howard-Hill, T. H. Bibliography of British Literary Bibliographies. 2nd ed.

- Watson, George, ed. The Shorter New Cambridge Bibliography of English Literature
- Watson, George & I.R. Wilson, eds. The New Cambridge Bibliography of English Literature.

Teachers-in-Charge:

- Dr. Sr. A. Princy Anto
- Ms. Darly Mathew
- Ms. Noble A. Paliath

Module Division:

Module	**Month**	**Teachers-in-Charge**
Module 1	June - October	Ms. Darly Mathew
Module 2	June - October	Dr. Sr. A. Princy Anto
Module 3	June - October	Ms. Noble A. Paliath

Course Plan

Semester : V

Course Category : Open Course

Paper Name : English for Competitive Examinations

Code : ENG5D01

Contact Hours : 54 hrs (3 hrs per week)

Credits : 3

Course Outcomes:

- To prepare the students for competitive exams such as UPSC, Defence, SSC, Banking, KPSC, Insurance and other examinations.
- To help the students to approach and qualify competitive examinations by introducing the usually discussed areas in the exams.
- To enable the learners to acquire necessary professional skills in the usage of English.
- To provide opportunities for the students to improve their listening and reading comprehension skills.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assessment
Module I: Word Based Questions	Synonyms, Antonyms, One Word Substitution	4	Lectures/ Sample exercises/ references and practical activities based on previous years' question papers	Evaluation through question/answer sessions
	Analogy, Idiomatic Use of Verbs	4	Lectures/ Sample exercises/ references and practical activities based on previous years' question papers	Peer tutoring
	Test of Spellings	4	Lectures/ Sample exercises/ references and practical activities based on previous years' question papers	Periodical test papers
	Correct Use of Prepositions and Articles	4	Lectures/ Sample exercises/ references and	Timely submission of assignments and presentation of seminars

			practical activities based on previous years' question papers	based on the assigned topics
Module II: Sentence Based Questions	Error Identification	4	Lectures/ Sample exercises/ references and practical activities based on previous years' question papers	Evaluation through question/answer sessions
	Sentence Correction	4	Lectures/ Sample exercises/ references and practical activities based on previous years' question papers	Peer tutoring
	Jumbled Words in a Sentence	3	Lectures/ Sample exercises/ references and practical activities based on previous years' question papers	Periodical test papers
	Sentence Completion	3	Lectures/ Sample exercises/ references and practical activities based on previous years' question papers	Timely submission of assignments and presentation of seminars based on the assigned topics
Module III: Passage Based Questions	Jumbled Sentences in a Paragraph	4	Lecture/individual presentations	Periodical test papers
	Reading Comprehension	4	Reading exercises from the best-selling existing catalogue of secondary materials	Random passages are selected from the best-selling existing catalogue of secondary materials and are finally assessed through test papers
	Reading Comprehension	3	Reading exercises from the best-selling existing catalogue of secondary materials	Discussions on the application procedure
	English Comprehension	3	Lecture sessions followed by practical examples	Individual students are asked to work out on the assigned topic and the performances are

				evaluated and graded
Evaluation: (10 hrs)				
Internal Examinations	Two Internals of 60 Marks and 2 Hours Duration	4	Written exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any Topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE internal mark is awarded on the basis of assignments too.
Seminars	Any Topic	6	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE.
		54 Hours		

Reference Materials:

- Edgar Thorpe and Showick Thorpe : Objective English for Competitive Exams.
- Michael Swan : Practical English Usage.
- Wren and Martin : High School English Grammar & Topic

Teachers–in- Charge:

- Ms. Darly Mathew
- Ms. Noble A. Paliath

Module Division:

Module	**Month**	**Teachers-in--charge**
Module 1	July - October	Ms. Noble A. Paliath
Module 2	July, August	Ms. Darly Mathew
Module 3	September, October	Ms. Darly Mathew

Course/ Lesson Plan

Semester **:I**

Course category **: Common Course I**

Paper name **: WAYS WITH WORDS:LITERATURES IN ENGLISH**

Code **: ENGlA02**

Contact Hours **: 90** **Credits: 3**

Course Outcome:

- **To help students develop the acumen to read, appreciate and discuss literature.**
- **To introduce students to the linguistic qualities of a literary text and to unravel the many meanings of the text**
- **To acquaint the students with different genres of literature and to analyse them**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Shakespeare. Keats	5	Lecture	Evaluation through question-answer session
	Frost, Chitre	4	Lecture Debate	Discussion on Modernism in poetry
	Maya Angelou, Okara	6	Presentation on Greco-Roman traditions and writers	Reference reading and notes are evaluated.
	Bob Dylan	5	Presentation and Lecture	Class test including all the Module 1
Module II	Appointment in Samarra	5	Lecture Student seminar	Question-answer sessions Seminar evaluation
	A Shocking Accident: Graham Greene	7	Lecture Debate	Discussion on short stories
	Lamb to the Slaughter: Roald Dahl	3	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	1t Used to be Green Once	3	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III	Bores: E. V Lucas	8	Lecture Debate Presentations	Question-answer sessions
	Night- walkers and Mystery Mongers: sense and Nonsense at the Edge of science: Carl Sagan	3	Discussion	Discussion on the application
	Night- walkers and Mystery Mongers:	4	Discussion	Discussion on the application

	sense and Nonsense at the Edge of science: Carl Sagan			
	Night- walkers and Mystery Mongers: sense and Nonsense at the Edge of science: Carl Sagan	6	Lecture	Evaluation through question-answer session
Module IV	Something Unspoken: Tennesee Williams	4	Lecture Debate	Discussion on plays
	One Act play	4	Lecture Student Seminar	Seminar evaluation
	Different shades of the play	5	Lecture Student Seminar	Seminar evaluation
	Summarising the entire book	6	Lecture Discussion	Class test
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- ENGl A02 WAYS WITH WORDS : LITERATURES IN ENGLISH, BoS, University of Calicut, University of Calicut

Teacher/s –in Charge:

- Ms. Bindu Jose, Ms. Noble A. Paliath, Ms. Sandra Juliet Jose

Module Division:

Module	Month	Teacher/s-in—charge
Module 1	June-September	Ms Bindu Jose
Module 2	June- August	Ms. Bindu and Ms Noble
Module 3	June- August	Ms. Sandra
Module 4	Sptember, October	Ms. Sandra and Ms. Noble

Course/ Lesson Plan

Semester II

Course category: Complementary Course II/ Complementary Course in Electronic Media

Paper name: Introduction to Electronic Media

Code: JOU2C02

Contact Hours: 108 **Credits : 4**

Course Outcome:

- **Make them aware of communication and radio**
- **Stress the importance of radio as a mass media**
- **Introduce them to the New Media and the writing practices**

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	Definition, elements and types of communication, mass communication - nature, characteristics, functions and dysfunctions of mass	5	Lecture	Evaluation through question-answer session
	Mass media - types of media: print, radio, TV	4	Lecture Debate	Debate on the topic "Media and its influences"
	Film and new media	4	Presentation on Greco-Roman traditions and writers	Reference reading and notes are evaluated.
	News: types of news - news determinants – news story structure- print VS broadcast news.	5	Presentation and Lecture	Class test including all the topics related to News Media
Module II	Characteristics, scope and limitations of Radio	5	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Brief history of radio and AIR; Organisational set up of AIR;	4	Lecture Debate	Presentation on AIR
	Types of radio stations: AM, FM, Community radio	3	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Private F M Stations in Malayalam; Online Radio, Radio on Mobile.	3	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III	Basic elements of radio	4	Lecture	Question-answer sessions

	programme- sound, music and effects		Debate Presentations	Seminar evaluation
	Writing for the ear - radio news writing, news reading- script writing for different radio programmes – interview, talk, feature, commentary, magazine programmes, radio drama, documentary;	5	Lecture Student seminar	Question-answer sessions
	Radio Jockeying	1	Student Seminar	Presentation
	Outside Broadcasting- Cultural event and Sports event.	2	Discussion	Discussion on the different aspects
Module IV	Internet as a medium of communication: history and evolution of internet	6	Lecture Debate Presentations	Question-answer sessions
	characteristics of new media: immediacy,	3	Debate	Debate on the pros and cons of Internet
	interactivity, universality, hypertext, multimedia, media convergence	3	Discussion	Discussion on the aspects of Internet
	Cyber laws and IT Act	6	Lecture	Evaluation through question-answer session
Module V	Online reporting: language and style of online journalism,	4	Lecture	Evaluation through question-answer session
	tools for newsgathering, news determinants in cyberspace, dos and don‘ts of online reporting;	4	Debate	Debate on Online reporting and accuracy
	Online News writing: Types of Online news	3	Discussion and Student Seminar	Evaluation through question-answer session
	writing breaking news, writing features, editing – HL writing	3	Lecture and Discussion	Class test
Module VI	Social media: evolution, definition and types,	4	Lecture Debate	Debate on Social Media: Boon or Bane?
	social media as a tool for news gathering, social media activism: Jasmine Revolution, India Against Corruption movement,	4	Lecture Student Seminar	Seminar evaluation
	, Social media as a tool for Political Communication, social media as a tool for Public Relations,	5	Lecture Student Seminar	Seminar evaluation
	Political	6	Lecture	Class test

	Communication and Propaganda.		Discussion	
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		108 hours		

Reference Materials :

- Joseph A Devito : Communicology: An Introduction to the study of Communication, Harper and Row, New York, 1985.
- Joseph R. Dominick : The Dynamics of Mass Communication, McGraw Hill, New Delhi.
- Agee, Ault & Emery : Introduction to Mass Communications, Harper and Row, New York, 1985.
- Spencer Crump : Fundamentals of Journalism, McGraw Hill Book Company.
- Oxford : International Encyclopedia of Communications

Teacher/s –in Charge:

- Ms. Sandra Juliet Jose
- Ms. Noble A. Paliath

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Noble A. Paliath
Module 2	June, July	Sandra Juliet Jose
Module 3	August	Sandra Juliet Jose
Module 4	September	Sandra Juliet Jose
Module 5	August, September	Noble A. Paliath

Module 6	October	Sandra Juliet Jose

Course/ Lesson Plan

Semester : **IV**

Course category : **Common Course**

Paper name : **SPECTRUM: LITERATURE AND CONTEMPORARY ISSUES**

Code : **ENG4A06**

Contact Hours: 90 **Credits: 4**

Course Outcome:

- **The learner's are aware of the humanist dimensions of literature**
- **Learner's understand the concepts like globalisation, commercialisation and intellectual property rights**
- **The spirit of universal brotherhood is deeply engraved in students**
- **Students are aware of the rights of the minorities.**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I Literature and Media	Divided Times	5	Lecture	Evaluation through question-answer session
	Concepts of othering and influence of Media	4	Lecture Debate	Debate on the topic Media and its effects
	Komala	6	Presentation on Greco-Roman traditions and writers	Reference reading and notes are evaluated.
	Komala	5	Presentation and Lecture	Class test including all the topics
Module II	Cheriya Meenukalum Valiya Malsyavum	5	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Cheriya Meenukalum Valiya Malsyavum	7	Lecture Debate	Debate on the topic of globalization and its effects
	Turmeric	3	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	What Work Is	3	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III	Home	8	Lecture Debate Presentations	Question-answer sessions
	Love Across the Salt Desert	3	Debate	Debate on the Migrants and the attitude towards them
	No men are Foreign:	4	Discussion	Discussion on the

	James Kirkup, Death Fugue: Paul Celan			application
	Jamaican Fragment: A. L. Hendricks	6	Lecture	Evaluation through question-answer session
Module IV	UN Speech: Malala Yousufzai	4	Lecture Debate	Debate on women rights
	Caring for Animals: Jon Silkin	4	Lecture Student Seminar	Seminar evaluation
	The Cry of the Gull: Emmanuelle Labroire (Excerpts)	5	Lecture Student Seminar	Seminar evaluation
	Average Waves in Unprotected Waters: Anne Tyier'	6	Lecture Discussion	Class test
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	5	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	2	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- ENG4 A06 Spectrum: Literature and Contemporary Issues, BoS, Calicut University published by Calicut University

Teacher/s –in Charge:

- Sr. A. Princy Anto
- Ms. Darly Mathew
- Ms. Noble A.Paliath
- Ms. Sandra Juliet Jose

Module Division:

Module	Month	Teacher/s-in—charge
Module 1	June-August	Ms. Darly, Ms. Sandra
Module 2	June- August	Sr. Princy, Ms. Noble
Module 3	September- October	Sr. Princy, Ms. Noble
Module 4	September- October	Ms. Darly, Ms. Sandra

Course/ Lesson Plan

Semester VI

Course category: Core Course

Paper name: Voices of Women

Code: ENG6B11

Contact Hours: 90

Credits: 4

Course Outcomes:

a. To equip students to steer clear of misconceptions regarding women and to evolve a human perspective about them.
b. To arouse a keen interest in analysing critically the diversity of women's experiences across the world and to marvel at their creative skills.
c. To perceive gender as a social construct

Modules	Contents	Hours	Procedure/Plan	Assessment
Module 1: Essays	1. Chimamanda Ngozi Adichie: We Should All Be Feminists	9	Lecture	Question-answer sessions
	2.Virginia Woolf: Shakespeare's Sister	9	Lecture	Extended reading exercises
Module II: Poetry	1. Eunice D Souza: Bequest 2. Amy Lowell: Vintage	5	Lecture Student seminars	Question-answer sessions Seminar evaluation
	3. Sappho: To Anactoria in Lydia	7	Lecture	Extended reading exercises
	4. Inez Hernandez Avila: To Other Women Who Were Ugly Once	3	Lecture Student seminars	Seminar evaluation
	5. Judith Wright: Eve to her Daughters	3	Lecture Student seminars	Assessment of learning progress of students through class test
Module III: Fiction	Novel: Kate Chopin : *The Awakening*	15	Lecture Assignments	Extended reading exercises
	Short stories 1. Clarice Lispector : Preciousness	8	Lecture and Discussion	Nuances of the short stories
	2. Alice Walker: The Flowers	7	Discussion	Extended reading exercises
Module IV: Drama and Film	Thozhilkendrathilekku Makhmalbuf	4	Lecture Debate Seminar	Seminar and discussion
	At Five in the Afternoon : dir.	4	Lecture Student Seminar	Seminar evaluation
	Samira Mustang : dir Denize Gamze	4	Lecture Student Seminar	Seminar evaluation

	Erguven			
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration		Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic relevant to the subject under discussion	5	All students are required to prepare an assignment from any of the topics relevant to the subject under discussion	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic relevant to the subject under discussion	7	All students are required to present a topic with the help of power point presentation, preferably	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials:

- Kamala Bhasin---What is Patriarchy?
- Nivedita Menon--Seeing like a Feminist
- Naomi Wolf--Beauty Myth
- Alice Walker ---Colour Purple
- Caryl Churchill---Vinegar
- Tom Deepa Mehta's films---Earth, Fire, Water
- Rina Das' Film---The Village Rockster

Teachers–in-charge:

- Dr. Sr. A. Princy Anto
- Ms. Noble A. Paliath

Module Division:

Module	**Month**	**Teachers-in-charge**
Module 1	Nov-Dec	Ms. Noble A. Paliath
Module 2	December	Ms. Noble A. Paliath
Module 3	January	Dr. Sr. A. Princy Anto
Module 4	February	Dr. Sr. A. Princy Anto

Course/ Lesson Plan

Semester VI

Course category: Core Course

Paper name: Classics of World Literature

Code: ENG6B12

Contact Hours: 90 (5hrs per week) **Credits: 4**

Course Outcome:

- **To help them to appreciate great Classics**
- **To introduce different cultural perspectives**
- **To enhance the literary sensibility of students**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I Introduction to the ancient world	Introducing epics of the world and conventions: The Iliad, Odyssey, Aeneid, The Epic of Gilgamesh	5	Lecture	Evaluation through question-answer session
	Introduction to Mahabaratha and Ramayana	2	Lecture Debate	Debate on the topic "Mahabaratha and Ramayana"
	Introduction to Greek Theatre and Indian Theatre	3	Presentation	Reference reading and notes are evaluated.
Module II Poetry	Dante: Divine Comedy Canto IV	4	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Goethe: The Violet	4	Lecture Debate	Question-answer sessions
	Alexander Pushkin: A Flower Shrivelled Bare of Fragrance	4	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Rilke: Adam.	4	Lecture Student seminar	Seminar evaluation
	Omar Khayyam: The Rubaiyat: 68-72	5	Lecture Student seminar	Seminar evaluation
	Rumi: Let go of Your Worries, Look at Love, I died from Minerality	5	Lecture Student seminar	Seminar evaluation
	Matsuo Basho: In the Twilight Rain	4	Lecture Student seminar	Seminar evaluation

Module III Drama and Film	Sophocles: Oedipus Rex	6	Lecture Debate Presentations	Question-answer sessions Seminar evaluation
	Bhasa: Urubhangam	6	Lecture Student seminar	Question-answer sessions
	Les Miserables: dir. Bille August	6	Lecture Student Seminar	Presentation
Module IV Fiction	Maupassant: Mother Savage	4	Lecture Debate Presentations	Question-answer sessions
	Tolstoy: The Three Questions	4	Lecture Debate	Question-answer sessions
	Firdausi: Shahnamah: The Story of Sohrab and Rustum	4	Lecture Discussion	Discussion
	Ryunosuke Akutagawa: In a Grove	4	Lecture	Evaluation through question-answer session
	P U Songling: The Painted Wall	4	Lecture	Question-answer sessions
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Boccaccio Giovanni, The Decameron
- Virgil. Aenied. Trans. Edward McCrorie. USA: University of Michigan Press, 1996.
- Songling P U, Strange Stories From Chinese Studio. 1880
- www.rumi.org.uk and www.khamush.com
- Pushkin Alexander. The Complete works of Alexander Pushkin

Teacher/s –in Charge:

- Dr Sr A Princy Anto
- Ms. Noble A. Paliath

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Noble A. Paliath
Module 2	June, July	Dr Sr A Princy Anto
Module 3	August	Noble A. Paliath
Module 4	September	Dr Sr A Princy Anto
Module 5	August, September	Noble A. Paliath
Module 6	October	Dr Sr A Princy Anto

Signature/s of Teacher/s- in- charge Signature of Head of the Department

Course/ Lesson Plan

Semester VI

Course category: Core Course I

Paper name: FILM STUDIES

Code: ENG6B13

Contact Hours: 90 **Credits: 4**

Course Outcome:

- **To appreciate film as an art form and its aesthetics**
- **To understand how film connects with history, politics, technology, society and performance.**
- **To critically appraise the nature of representation on screen.**
- **To develop analytical skills for the close reading of films.**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Basic terminology of film making	5	Lecture	Evaluation through question-answer session
	Editing, Sound in cinema, Colour in Cinema	4	Lecture Debate	Discussion on the various editing techniques
	Introduction to various film genres	6	Presentation on Greco-Roman traditions and writers	Reference reading and notes are evaluated.
	Major movements and theories in film studies	5	Presentation and Lecture	Class test including all the topics on Terminologies
Module II	Andre Bazin: Evolution of Language of Cinema	5	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Gilbert Harman: Semiotics	7	Lecture Debate	Debate on the topic: Cinema and relevance of semiotic considferation
	Laura Mulvey: Visual Pleasure and Narrative Cinema	3	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Bill Nichols: Voice of Documentary	3	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III	Charlie Chaplin: The Goldrush	8	Lecture Debate Presentations	Discussion on the political signification of the movie and its nuances.

	Francois Truffaut: 400 Blows	3	Presentation and Discussion	Nuances of the Cinema
	Federico Fellini: 8 1/2	4	Discussion	Discussion on the movie
	Andrei Tarkovsky: The Mirror	6	Lecture	Evaluation through question-answer session
Module IV	Milos Forman: One Flew Over Cukoos Nest	4	Lecture Debate Seminar	Seminar and Discussion
	Adoor Gopalakrishnan: Elippathayam	4	Lecture Student Seminar	Seminar evaluation
	Ousmane Sembene: Guelwar	5	Lecture Student Seminar	Seminar evaluation
	Kim Ki Duk: Spring, Summer, Winter, Autumn, Spring	6	Lecture Discussion	Class test
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Core Textbook
- Virginia Wright Wexman: A History of Film, Pearson, Delhi.
- Susan Heyward: Key Concepts in Cinema Studies, Routledge, London

Teacher –in Charge:

- Ms. Sandra Juliet Jose

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	Nov- Dec	Ms. Sandra
Module 2	December	Ms. Sandra
Module 3	January	Ms. Sandra
Module 4	February	Ms. Sandra

Signature/s of Teacher/s- in- charge

Signature of Head of the Department

Course/ Lesson Plan

Semester 6

Course category: Core Course

Paper name: New Literatures in English

Code: BNG6B14

Contact Hours: 90 **Credits: 4**

Course Outcome:

- **The students produce critiques of prose, fiction, drama and film**
- **The students point out the trends of literary growth in the various national varieties of literature**
- **The literary appetite in the students gets enhanced and they turn to advanced reading of global literature**
- **The humanitarian side of the students get nourished and their concern for nations,races,sufferings, and genders empower the writers in them**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Module 1: Introduction:A brief introduction to the canon of English literature, Commonwealth literature,	1	Lecture	Evaluation through question-answer session
	post Colonialism	1	Lecture Debate	Debate on the topic 'Postcolonialism-Merits and Drawbacks'.
	context of New Literatures	1	Presentation on various literatures	Reference reading and notes are evaluated.
	New Literatures	2	Presentation and Lecture	Class test including all the given categories of postcolonial literatures
Module II	Module 2: Poetry 1. Alice Walker: Remember Me? (U.S) 2. A D Hope: Australia (Australia)	5	Lecture Student seminar	Question-answer sessions Seminar evaluation
	3. Derek Walcott: A Far Cry from Africa (Caribbean) 4. Faiz Ahmed Faiz: When Autumn Came (Pakistan)	5	Lecture Presentation	Question-answer sessions Seminar evaluation

	5. Li Young Lee: I Ask my Mother to Sing (China) 6. Tenzin Tsundue : When it Rains in Dharamsala (Tibet)	5	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	7. David Diop: The White Man Killed my Father(West Africa)8. Margaret Atwood: Helen of Troy Does Countertop Dancing	5	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III	Module 3: Prose and Short Fiction :1. Gabriel Garcia Marquez: The Handsomest Drowned Man in the World	6	Lecture Presentations	Question-answer sessions
	2. Alice Munroe: Voices	6	Lecture Presentation	Evaluation of seminar presentations
	. Robyn Davidson: Tracks: One Woman's Journey across 1700 miles of Australian Outbreak	13	Lecture Presentation Discussion	Evaluation of the seminar presentations,question-answer sessions,Test papers
Module IV	Module 4: Drama 1. Wole Soyinka: Death and the King's Horseman	10	Lecture Presentation Role play	Seminar Presentations Test papers
	2. Eugene O'Neil: Long Day's Journey into Night	10	Lecture Role play Presentation	Evaluation of the seminar presentations,question-answer sessions,Test papers
Module V	Module 5: Film 1. Kite Runner: dir Marc Forster	4	Lecture Role play Discussion	Seminar evaluation
	2. Embrace of the Serpent: dir Ciro Guerra	4	Lecture Role play Discussion	Seminar evaluation
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	2	All students are required to prepare an assignment from any of the topics they're interested, but should avoid	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.

			repetition	
Seminars	Any topic	4	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Gray, Richard. A Brief History of American Literature.London:Wiley-Blackwell,2011.
- Pierce, Peter. The Cambridge History of Australian Literature: Queensland: James Cook University,2017.
- Young, Robert C. Post Colonialism: A Very Short Introduction. London: Oxford,2003.
- Atwood, Margaret. Survival: A Thematic Guide to Canadian Literature. Toronto: Anansi, 2004

Teacher/s –in Charge:

- Ms.Bindu Jose
- Ms.Darly Mathew

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	November -December	Ms.Bindu Jose
Module 2	January	Ms. Bindu Jose
Module 3	February	Ms.Darly Mathew
Module 4	March	Ms.Darly Mathew

Signature/s of Teacher/s- in- charge Signature of Head of the Department

Course/ Lesson Plan

Semester I

Course category: Core Course I

Paper name: Shakespeare

Code: ENG6B20

Contact Hours: 54 (3 hours per week) **Credits: 3**

Course Outcome: To initiate students to read and appreciate the master.

- **To expose students to the universality of Shakespeare and his relevance for all times.**
- **To appreciate the polyphonic quality of Shakespeare's works and to learn the different modes of approaching Shakespeare.**
- **To develop the students' skill of formulating his/her own critical position.**
-

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	The influence of Shakespeare in the 21st century	3	Lecture	Evaluation through question-answer session
	Popular quotes	2	Lecture Debate	Debate on the topic --- Shakespeare's relevance
	How to do things with Shakespeare: New Approaches.	2	Presentation on Greco-Roman traditions and writers	Reference reading and notes are evaluated.
	New essays	3	Presentation and Lecture	Class test including all the relevant plays.
Module II	The four phases of Shakespeare's dramatic career	3	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Shakespearean Tragedy	3	Lecture Debate	Debate on the topic of movie adaptations
	Shakespearean Comedy	2	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Shakespeare's characters	2	Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III	The Twelveth Night	5	Lecture Debate Presentations	Question-answer sessions
			Debate	Debate on the plays

Edit with WPS Office

			Discussion	Discussion on the application of Shakespeare's philosophy
	The Tempest	5	Lecture	Evaluation through question-answer session
Module IV	The trial scene in 'The Merchant of Venice' Act IV Scene 1 lines 1-163	6	Lecture Debate	Debate on the male-female dichotomy in Shakespeare's plays
	Antony's speech in 'Julius Caesar' Act III Scene 2	6	Lecture Student Seminar	Seminar evaluation
				Class test
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic		All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	7	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		54 hours		

Reference Materials :

- Maguire, Laurie. Ed. How to do things with Shakespeare: New Approaches, New Essays. Wiley-Blackwell, 2007.

Teacher/s –in Charge:

- Ms. Bindu Jose

Edit with WPS Office

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	Nov-Dec	Ms Bindu Jose
Module 2	January	Ms Bindu Jose
Module 3	February	Ms Bindu Jose
Module 4	March	Ms Bindu Jose

Signature/s of Teacher/s- in- charge

Signature of Head of the Department

Edit with WPS Office

Course/ Lesson Plan

Semester V & VI

Course category: Core Course I

Paper name: Project

Code: ENG6B21

Contact Hours: Nil **Credits:2**

Course Outcome:

- **The students prepare the bibliography of the project as per the MLA format**
- **The students present the ideas in a logical and coherent manner**
- **The students do the in-text citation as per the MLA format**
- **The students practice academic writing**

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Methodology of Research-The Principles of MLA style-The core elements		Lecture	Evaluation through question-answer session
	'The Mechanics of scholarly prose-formatting and ordering of the works cited list,in-text citation		Lecture Debate	Test paper
	Plagiarism		Presentation on Greco-Roman traditions and writers	Reference reading and notes are evaluated.
	Principles of Academic Writing-Difference between academic and non-academic writing,Characteristics of academic writing-Vocabulary		Presentation and Lecture	Class test including all the topics of the module
Module II	Library Work and data collection-Author&Primary Sources		Lecture Student seminar	Question-answer sessions Seminar evaluation
	Review of Litrerature		Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation

	Synopsis Preparation		Lecture Student seminar	Class test of all the topics of Module II Seminar evaluation
Module III	Data analysis-Collection of Secondary Materials		Lecture Debate Presentations	Seminars are to be evaluated
	Note taking		Lecture and materials on note-taking	Notes are to be evaluated
	Organisation of the data		Discussion	Arranged data is to be evaluated
	Analysis of the data		Discussion	Seminars are to be evaluated
Module IV	Project presentation and submission-Outline Preparation		Discussion	Outline is to be evaluated
	Rough Draft		Discussion	Rough draft is to be evaluated
	Fair Copy presentation and submission		Discussion	Seminar evaluation
	Viva-voce		Discussion	viva-voce
Evaluation: (12 hrs)				
Internal Examinations	Viva voce of 15 marks is to be conducted	20mts.	Viva Voce	Performance during the viva as well as organization, originality and methodology are evaluated
Assignments	Topics regarding the project		All students are required to prepare assignments regarding the project topic	Assignments are corrected and feedbacks are given.
Seminars	Topics regarding the project	7	All students are required to present topics with the help of power point preferably.	Feedbacks are provided
		Nil		

Reference Materials :

- MLA Handbook Eighth Edition
- Primary Sources of the respective project
- Secondary sources regarding the respective project

Teacher/s –in Charge:

- Ms.Darly Mathew
- Ms.Sandra Juliet Jose

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July ,August	Ms.Darly&Ms.Sandra
Module 2	September,October	Ms.Darly &Ms.Sandra
Module 3	October,November,Decembr	Ms.Darly&Ms.Sandra
Module 4	January,February,March	Ms.Darly &Ms.Sandra

Course Plan 2020-2021

Course/ Lesson Plan

Semester I

Course category: Core Course I

Paper name: British Literature from Chaucer to 18th Century

Code: ENG 1 C01

Contact Hours: 90 **Credits: 5**

Course Outcome:

- Familiarize the students with various trends in British literature from the 14th century to the 18th century.
- Introduce them to various movements in British literature

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Section A: Poetry	Geoffrey Chaucer : "The General Prologue to Canterbury Tales" (first 100 lines)	6	Lecture	Evaluation through question-answer session
	William Shakespeare : Sonnet 18. "Shall I Compare thee to a Summer's Day" John Donne : "The Canonization"	6	Lecture Debate	Debate on the topic – Compare and Contrast Shakespeare and John Donne.
	Andrew Marvell : "To His Coy Mistress" John Dryden : "Mac Flecknoe"	6	Presentation on Literary Qualities in Mac Flecknoe	Reference reading and notes are evaluated.
	John Milton : "Paradise Lost" Book 1 (lines up to 270) Thomas Gray : "Elegy written in a Country Churchyard"	8	Lecture	Evaluation through Annotation questions
Section B: Drama	Shakespeare : Hamlet	8	Lecture Student seminar	Question-answer sessions Seminar evaluation

	Shakespeare : Hamlet & Webster : The Duchess of Malfi	6	Lecture Debate	Debate on the topic Elucidate the soliloquies in the Hamlet.
	Webster : The Duchess of Malfi	6	Lecture	Write-ups of students are to be evaluated.
			Student seminar	Seminar evaluation
	Sheridan : The Rivals	6	Lecture Student seminar	Class test of all the topics of Section II Seminar evaluation
Section C : Prose And Fiction	Swift : Gulliver's Travels	6	Lecture Debate Presentations	Question-answer sessions
	Henry Fielding : Joseph Andrews	6	Debate	Debate on the how far the term "picaresque" applied to Joseph Andrews.
	Francis Bacon : "Of Marriage", Joseph Addison : Sir Roger at Church	8	Discussion	Discussion in group on the topic, "Is being married better than remaining single?
	Daniel Defoe : Robinson Crusoe	6	Lecture	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	2	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point	Feedbacks are provided and marks are considered for CIE

			presentation, preferably.	
		90 hours		

Reference Materials:

- Carter, Ronald and John McRae. The Routledge History of Literature in English Britain and Ireland. Malcolm Bradbury, 2001.
- O' Neill, Michael. The Cambridge History of English Poetry. Cambridge University Press, 2010.

Teacher/s –in Charge: Dhanisha K.S.

Module Division:

Module	Month	Teacher/s-in—charge
Module 1	June-July	Dhanisha K.S.
Module 2	August-September	Dhanisha K.S.
Module 3	October-November	Dhanisha K.S

Course/ Lesson Plan

Semester I

Course category: Core Course II

Paper name: British Literature 19th century

Code: ENG1CO2

Contact Hours: 90 **Credits: 5**

Course Outcome:

- This course will train students to examine and interpret the long eighteenth century and its multiple revolutions through a transnational and cross-cultural perspective.
- Students will be trained to understand the continuities between the eighteenth century and high modernity.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	The Tiger, The Lamb Lines Composed a Few Miles above Tintern Abbey	6	Lecture	Evaluation through question-answer session
	Kubla Khan Ozymandias Ode to a Nightingale	6	Lecture Debate	Debate on the topic John Keats
	She Walks in Beauty Tithonus Fra Lippo Lippi	6	Presentation on Fra Lippo Lippi	Reference reading and notes are evaluated.
	A Musical Instrument Dover Beach The Blessed Damozel	8	Presentation and Lecture	Class test including all the poems
Module II	Oscar Wilde	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	The Importance of Being Earnest	6	Lecture Debate	Debate on the topic of Victorian tradtions and hypocrisy
	The Importance of Being Earnest	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	The Importance of Being Earnest	6	Lecture Student seminar	Class test of Module II Seminar evaluation

Module III	Charles Lamb : "Dream Children – A Reverie"	6	Lecture Debate Presentations	Question-answer sessions
	William Hazlitt : On Reading Old Books			
	Charles Dickens : A Tale of Two Cities	6	Lecture Debate	Debate on the Characterisation
	Emily Bronte : Wuthering Heights	8	Lecture Debate Discussion	Discussion on Heathcliff and Catherine
	Thomas Hardy : Tess of the D'Urbevilles	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Elizabeth Gaskell : *North and South*
- George Eliot : *The Lifted Veil* OXFORD WORLD'S CLASSICS
- Thomas Hardy : *Tess of the D'Urbervilles*
- Raymond Williams : Introduction *In the English Novel from Dickens to Lawrence*

Teacher/s –in Charge: Femin Sunny

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Femin Sunny
Module 2	August-September	Femin Sunny
Module 3	October-November	Femin Sunny

Course/ Lesson Plan

Semester I

Course category: Core Course III

Paper name: History of English Language

Code: ENG1CO3

Contact Hours: 90 **Credits: 5**

Course Outcome:

- The course offers an overview of the History of English Language from its origin to the present.

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	Language families - The Indo-European family of languages; Germanic Family of languages and the origin of English	6	Lecture	Evaluation through question-answer session
	The early history of English language; Old English Period - Scandinavian invasions - Middle English Period: The Impact of the Norman Conquest on the English Language; - Middle English Literature.	6	Lecture Debate	Debate on the topic Origin of Language
	Modern English Period – Latin and Greek influence – Loan words - The impact of the Renaissance- Bible Translations	6	Presentation on Latin and Greek influence	Reference reading and notes are evaluated.

	Sound changes in English – The Great Vowel Shift - Changes in Grammar,	8	Presentation and Lecture	Class test including all the Topics
	vocabulary, phonology and morphology – Semantics – word formation			
Module II	Foreign influences on English in the Seventeenth, Eighteenth and the Nineteenth Centuries	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Colonialism and the English language	6	Lecture Debate	Debate on the topic of Colonialism and the English language
	Expansion of Vocabulary – Semantic change- Pidgins and Creoles.	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Contributions of major writers to the growth of English vocabulary	6	Lecture Student seminar	Class test of Module II Seminar evaluation
Module III	The discrepancy between spelling and pronunciation - Attempts to reform English spelling	6	Lecture Debate Presentations	Question-answer sessions
	Evolution of Standard English - Dialects of English: British and American – English in India	6	Lecture Debate	Debate on Dialects of English

	English in the postcolonial world – English as a global language — The rise of 'englishes' – impact of Science and Technology –	8	Lecture Debate Discussion	Discussion on impact of Science and Technology
	English in the digital age.	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- F. T. Wood : An Outline History of the English language
- C. L. Wrenn : The English Language
- A. C. Baugh : A History of the English Language
- David Crystal : English as a Global Language
- David Crystal: The English Language: A guided Tour of the Language
- Bill Ashcroft, et al : The Empire Writes Back
- Christian Mair :The Politics of English as a World Language

- Andreas Sedlatschek : Contemporary Indian English: Variation and Change
- Pingali Sailaja : Indian English
- Michael Hanrahan& Deborah L Madsen (Ed.): Teaching, Technology, Textuality: Approaches to New Media

Teacher/s –in Charge: Anju Rose Anto

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Anju Rose Anto
Module 2	August-September	Anju Rose Anto
Module 3	October-November	Anju Rose Anto

Course/ Lesson Plan

Semester I

Course category: Core Course IV

Paper name: Indian Literature in English

Code: ENG1 C04

Contact Hours: 90 **Credits: 5**

Course Outcome:

- Familiarize the students with the various trends and movements in Indian English literature from its inception to the present.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Section A: Poetry	Toru Dutt : "Our Casuarina Tree" Rabindranath Tagore : "The Child"	5	Lecture	Evaluation through question-answer session
	Nizzim Ezekiel : "In the Country Cottage" Jayantha Mahapatra : "Hunger" A.K. Ramanujan : "Obituary"	4	Lecture Debate	Debate on the topic: Compare and Contrast the writers Ezekiel and Mahapatra.

	R. Parthasarathy : "River, Once" Kamala Das : "The Old Playhouse" Gieve Patel : "The Ambiguous fate of Gieve Patel.	6	Presentation on Kamala Das as a Confessional Poet of India	Reference reading and notes are evaluated.
	Meena Alexander : "Blue Lotus" Arundhathi Subramaniam : "Home" MeenaKandasamy :"Dead Woman Walking"		Presentation and Lecture	Class test including all the annotation portion of Section A.
Section B: Fiction	Mulk Raj Anand : Coolie		Lecture Student seminar	Question-answer sessions Seminar evaluation
	R.K. Narayanan : The Guide	7	Lecture Debate	Debate on the topic of literary techniques of a frame narrative in "The Guide"

	Salman Rushdie : Midnight's Children	3	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	AmitavGhosh : The Hungry Tide		Lecture Student seminar	Class test of all the topics of Section -B Seminar evaluation
Section: C Drama	GirishKarnad : Yayati (English Translation by the author)	8	Lecture Debate Presentations	Question-answer sessions
	GirishKarnad : Yayati		Debate	Debate on the GirishKarnad : Yayati
	Mahesh Dattani : Tara	4	Discussion	Discussion on the Characteristics of Tara
	Mahesh Dattani : Tara	6	Lecture	Evaluation through question-answer session
Section-D Prose	JawaharLal Nehru : "What is Culture?"		Lecture Debate	Debate on Nehru's Writing Style
	AmartyaSen : "Reason and Identity" (From: The Argumentative Indian, Part IV)		Lecture Student Seminar	Seminar evaluation

	AmartyaSen : "Reason and Identity" Section 1-4)	5	Lecture Student Seminar	Seminar evaluation
	AmartyaSen : "Reason and Identity" (Section 58)		Lecture Discussion	Class test
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration		Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	2	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic		All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials:

- Agrawal K.A. Indian Writing in English: A Critical Study. Atlantic Publishers, 2003.
- Tiwari, Shubha. Indian Fiction in English Translation. Atlantic Publishers, 2005.

Teacher/s –in Charge: Dhanisha K.S.

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Dhanisha K.S.
Module 2	August-September	Dhanisha K.S.
Module 3	October-November	Dhanisha K.S.

Course/ Lesson Plan

Semester II

Course category: Core Course I

Paper name:: Twentieth Century British Literature up to 1940 Code:

ENG2C05

Contact Hours: 90 **Credits: 5**

Course Outcome:

- This course will train students to examine and interpret the Twentieth century and its multiple revolutions through a transnational and cross-cultural perspective.
- Students will be trained to understand the different perspectives of modernity.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	G.M. Hopkins - : "The Windhover"	6	Lecture	Evaluation through question-answer session
	W.B. Yeats - : The Second Coming, Byzantium	6	Lecture Debate	Debate on the topic W.B. Yeats
	TS Eliot - : The Waste Land	6	Presentation on The Wasteland	Reference reading and notes are evaluated.
	W.H.Auden - : Funeral Blues Wilfred Owen : A Strange Meeting	8	Presentation and Lecture	Class test including all the poems
Module II	GB Shaw : Caesar and Cleopatra	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	TS Eliot : Murder in the Cathedral	6	Lecture Debate	Debate on the topic of Theme of martyrdom
	TS Eliot : Murder in the Cathedral	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	JM Synge : Juno and The Paycock	6	Lecture Student seminar	Class test of Module II Seminar evaluation

Module III	Virginia Woolf - : "Modern Fiction"	6	Lecture Debate Presentations	Question-answer sessions
	Joseph Conrad -: Heart of Darkness	6	Lecture Debate	Debate on the Characterisation
	D.H. Lawrence : Sons and Lovers	8	Lecture Debate Discussion	Discussion on female characters
	James Joyce - : A Portrait of the Artist as a Young Man	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Baum, Paull F. "Sprung Rhythm". PMLA, IX.XIV (1959),pp.418-25.
- Bender, Todd K. Gerard Manley Hopkins: The Classical Background and Critical Reception of his Work.
- Bergonzi, Bernard. Gerard Manley Hopkins. New York:Macmillan, 1977.

- Aiken, Conrad ‘An Anatomy of Melancholy’, T.S.Eliot:TheWasteLand(CaseBook), Ed. Dyson,Macmillan,London, 1968
- Bradbury,Malcolm.The Modern World Ten great Writers, KalyaPublishers,New Delhi,1989
- Brooks, Cleanth.Modern Poetry and Tradition, Oxford University Press, New York, 1939

Teacher/s –in Charge: Sr. Alphonsa P.J.

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	December	Sr. Alphonsa P.J.
Module 2	January	Sr. Alphonsa P.J.
Module 3	February-March	Sr. Alphonsa P.J.

Course/ Lesson Plan

Semester II

Course category: Core Course II

Paper name:Literary Criticism and Theory – Part 1(Up to New Criticism)

Code: ENG1CO6

Contact Hours: 90 **Credits: 5**

Course Outcome:

- The course offers an overview of the History of English Language from its origin to the present.

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	Plato : The Republic (Books 2 and 3)	6	Lecture	Evaluation through question-answer session
	Aristotle - : Poetics	6	Lecture Debate	Debate on the topic Poetics
	Aristotle - : Poetics	6	Presentation on Latin and Greek influence	Reference reading and notes are evaluated.
	Longinus - : On the sublime (Chapters 7 – 9)	8	Presentation and Lecture	Class test including all the Topics
Module II	Sir Philip Sydney - : An Apology for Poetry William Wordsworth : Preface to Lyrical Ballads	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	F. R Leavis : Hard Times: An Analytic note (From 'The Great Tradition')	6	Lecture Debate	Debate on the topic of Criticism on Dickens
	T.S. Eliot - : Tradition and Individual Talent	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation

	Cleanth Brooks - : The Language of Paradox			
	Northrop Frye - : The Archetypes of Literature	6	Lecture Student seminar	Class test of Module II Seminar evaluation
Module III	S.N. Das Gupta - : The Theory of Rasa	6	Lecture Debate Presentations	Question-answer sessions
	S.N. Das Gupta - : The Theory of Rasa	6	Lecture Debate	Debate on Rasa
	Kunjunni Raja - : Theory of Dhwani	8	Lecture Debate Discussion	Discussion on impact of Dhwani
	Kunjunni Raja - : Theory of Dhwani	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Day, Gary. Literary Criticism: A New History. Edinburgh UP, 2008
- Allan, William. Classical Literature: A Very Short Introduction. Oxford UP, 2014.
- Habib, M. A. R. A History of Literary Criticism. Blackwell Press, 2005.
- Day, Gary. Literary Criticism: A New History. Edinburgh UP, 2008.
- Allan, William. Classical Literature: A Very Short Introduction. Oxford UP, 2014.
- Abercrombie, Lascellas. Principles of Literary Criticism. Greenwood P, 1979.

Teacher/s –in Charge: Anju Rose Anto

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	December	Anju Rose Anto
Module 2	January	Anju Rose Anto
Module 3	February-March	Anju Rose Anto

Course/ Lesson Plan

Semester II

Course category: Core Course III

Paper name: American Literature

Code: ENG2C07

Contact Hours: 90 **Credits: 5**

Course Outcome:

- Aimed at acquainting students with the dominant trends in American Literature from the early colonial period to the twentieth century.
  Gain in-deep knowledge of the subject.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Section A: Poetry	Robert Frost - Home Burial Wallace Stevens - The Emperor of Ice Cream EE Cummings - Buffalo Bill	6	Lecture	Evaluation through question-answer session
	Langston Hughes - I Too Robert Lowell - For the Union Dead Allen Ginsberg - America		Lecture Debate	Debate on the topic – Compare and Contrast the writers Langston Hughes and Lowell.
	Sylvia Plath - Edge Gloria E. Anzaldua : To live in the Borderlands means you		Presentation on Sylvia Plath as a Confessional Poet.	Reference reading and notes are evaluated.
	Edgar Allan Poe - The Raven Walt Whitman - A passage to India Emily Dickinson - There is a certain slant of light	8	Lecture	Evaluation through Annotation questions
Section B: Prose and Fiction	Ralph Waldo Emerson - “Selfreliance” Herman Melville - Moby Dick		Lecture Student seminar	Question-answer sessions Seminar evaluation

	Mark Twain - Huckleberry Finn		Lecture Debate	Debate on the topic the role of religion in the novel.
	William Faulkner - The Sound and the Fury	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Tony Morrison - Tar Baby	6	Lecture Student seminar	Class test of all the topics of Section-B Seminar evaluation
SECTION C: Drama	Eugene O'Neill- The Emperor Jones	6	Lecture Debate Presentations	Question-answer sessions
	The Emperor Jones (cont.) & Tennessee Williams - The Glass Menagerie	6	Debate	Debate on the Tennessee Williams' The Glass Menagerie as a Memory Play.
	Tennessee Williams - The Glass Menagerie	8	Discussion	Discussion on the Characteristics of Tara
	Amiri Baraka (LeRoi Jones) – Dutchman	6	Lecture	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	2	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials:

- Belasco, Susan. A Companion to American Literature. Wiley Publishers, 2020.
- Rozakis E, Laurie. The Complete Idiot's Guide to American Literature. Alpha Publishers, 1999.

Teacher/s –in Charge: Femin Sunny

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	December	Femin Sunny
Module 2	January	Femin Sunny
Module 3	February-March	Femin Sunny

Course/ Lesson Plan

Semester II

Course category: Core Course IV

Paper name:Postcolonial Writings

Code: ENG2C08

Contact Hours: 90 **Credits: 5**

Course Outcome:

- This course on Postcolonial literature will explore colonialism and its cultural impacts,throughwritings produced by people from countries with a history of colonialism,primarily those concernedwith the workings and legacy of colonialism and the postcolonial resistance to them.

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	A. K. Ramanujan : "Self Portrait" Dom Moraes : "A Letter", "Sinbad" Leopold Senghor : "New York"	6	Lecture	Evaluation through question-answer session
	Gabriel Okara : "The Mystic Drum" David Diop : "Africa" Allen Curnow : "House and Land"	6	Lecture Debate	Debate on the topic Africa.
	A.D. Hope : "Australia" Jack Davis : "Aboriginal Australian" Margaret Atwood : "Journey to the Interior"	6	Presentation on Postcolonialism	Reference reading and notes are evaluated.

	Derek Walcott : "Ruins of a Great House" E. E. Tiang Hong : "Arrival" Almaghir Hashmi : "So What if I Live in a House Made by Idiots"	8	Presentation and Lecture	Class test including all the poems
	Kamau Brathwaite : "Negus"			
Module II	Wole Soyinka : *The Road*	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	GirishKarnad : *Hayavadana*	6	Lecture Debate	Debate on the topic of Importance of chorus
	GirishKarnad : *Hayavadana*	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Timberlake Wertenbaker : *Our Country's Good*	6	Lecture Student seminar	Class test of Module II Seminar evaluation
Module III	Chinua Achebe : *Things Fall Apart*	6	Lecture Debate Presentations	Question-answer sessions
	V. S. Naipaul : *A House for Mr.Biswas*	6	Lecture Debate	Debate on the Characterisation
	Khaled Hosseini : *The Kite Runner*	8	Lecture Debate Discussion	Discussion on Afghan Politics
	Margaret Laurence : *Stone Angel*	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.

Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Ashcroft, Bill, Gareth Griffiths, and Helen Fiffin. The Empire Writes Back: Theory and Practice in Post-Colonial Literatures.
- Bhabha, Homi. "Postcolonial Criticism."
- Boehmer, Elleke. Colonial and Postcolonial Literature. Oxford University Press, 2005.
- Bové, Paul A. Intellectuals in Power: the Genealogy of Critical Humanism. New York: Columbia University Press, 1986.
- Brydon, Diana ed. And introduction. Postcolonialism: Critical Concepts in Literary and Cultural Studies. 5 vols. New York: Routledge, 2006

Teacher/s –in Charge: Sr. Alphonsa P.J.

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	December	Sr. Alphonsa P.J.
Module 2	January	Sr. Alphonsa P.J.
Module 3	February-March	Sr. Alphonsa P.J.

Course/ Lesson Plan

Semester III

Course category: Core Course I

Paper name: Twentieth Century British Literature Post 1940

Code: ENG3CO9

Contact Hours: 90 **Credits: 5**

Course Outcome:

- This course will train students to examine and interpret the long twentieth century and its multiple revolutions through a transnational and cross-cultural perspective.
- Students will be trained to understand the perspectives on post modernity.

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	Dylan Thomas : "Fern Hill" Philip Larkin : "Church Going"	6	Lecture	Evaluation through question-answer session
	Thom Gunn : "On the Move" Ted Hughes : "View of a Pig", Seamus Heaney : "Punishment	6	Lecture Debate	Debate on the topic bog poetry
	Charles Tomlinson : "Swimming Chenango Lake" Geoffrey Hill : "In Memory of Jane Frazer	6	Presentation on Charles Tomlinson	Reference reading and notes are evaluated.
	Elizabeth Jennings : "One Flesh" Andrew Motion : "The Last Call"	8	Presentation and Lecture	Class test including all the poems
Module II	Samuel Beckett : *Waiting for Godot*	8	Lecture Student seminar	Question-answer sessions Seminar evaluation

	Caryl Churchill : *Top Girls*	6	Lecture Debate	Debate on the topic of female characters
	Harold Pinter : *The Birthday Party*	6	Lecture	Write-ups of students are to be evaluated.
			Student seminar	Seminar evaluation
	Edward Bond : *Lear*	6	Lecture Student seminar	Class test of Module II Seminar evaluation
Module III	John Fowles : *The French Lieutenant's woman*	6	Lecture Debate Presentations	Question-answer sessions
	Kingsley Amis *: Lucky Jim*	6	Lecture Debate	Debate on the Characterisation
	Alan Sillitoe : *Loneliness of the Long Distance Runner*	8	Lecture Debate Discussion	Discussion on the character Smith
	Kazuo Ishiguro : Remains of the Day	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE

		90 hours		

Reference Materials :

- Book by Martin Esslin : The Theatre of the Absurd
- Michael Y. Bennett : Reassessing the Theatre of the Absurd: Camus, Beckett, Ionesco, Genet, and Pinter
- Michael Y. Bennett : The Cambridge Introduction to Theatre and Literature of the Absurd
- Perry Anderson : The Origins of Postmodernity
- Fredrick Jameson : Postmodernism, or, the Cultural Logic of Late Capitalism
- William Hutchings :Samuel Beckett's Waiting for Godot: A Reference Guide

Teacher/s –in Charge: Dhanisha K.S.

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Dhanisha K.S.
Module 2	August-September	Dhanisha K.S.
Module 3	October-November	Dhanisha K.S.

Course/ Lesson Plan

Semester III

Course category: Core Course II

Paper name: Literary Criticism and Theory: Part 2

Code: ENG3C10

Contact Hours: 90 **Credits: 5**

Course Outcome:

- Familiarize the students with Literary Criticism and Theory
  Introduce them to various theories and help them to have in-depth knowledge of the major theorists and key concepts.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Section A: 1.Structuralism 2. PostStructuralism/ Deconstruction 3.Psychoanalysis: An Overview	Major theorists, Key concepts. Structure, Sign, Signifier, Signified, Semiology, Semiotics, Langue and Parole, Mythemes, Structuralist Narratology.	6	Lecture	Evaluation through question-answer session
	Text for Detailed Study: Roland Barthes: "Structuralist Activity"		Lecture Debate	Debate on the topic – Major theorists of Structuralism Post-Structuralism.
	Major theorists, Key concepts. Text for Detailed Study: Jacques Derrida: "Structure, Sign and Play in the Discourse of Social Sciences"		Presentation on key concepts	Reference reading and notes are evaluated.

	Major theorists, Key concepts. Text for Detailed Study: Jacques Lacan: "The Mirror Stage as Formative of the Function of the I"	8	Lecture	Evaluation through quiz

Section B: 4. Feminism 5. Cultural Materialism/ New Historicism 6. Post colonialism: An Overview	Major theorist: : Virginia Woolf, Kate Millet, Elaine Showalter, Helene Cixous, Adrienne Rich. Key concepts.	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Text for Detailed Study: Elaine Showalter: "Towards a Feminist Poetics"	6	Lecture Debate	Debate on the topic of phases of feminism.
	Major theorists. & Louis Montrose: "Professing the Renaissance: The Poetics and Politics of Culture"	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Major theorists, Key concepts. Text for Detailed Study: Edward Said: "Jane Austen and Empire"	6	Lecture Student seminar	Class test of all the topics of Section-II Seminar evaluation
Section C: 7. Ecocriticism 8.Critiquing Theory: An Overview	Major theorists: Jonathan Bate, CheryllGlotfelty, Laurence Coupe, Patrick DMurphy, William Rueckert.	6	Lecture Debate Presentations	Question-answer sessions

	Key concepts: Anthropocentrism, Shallow Ecology vs Deep Ecology, The Crisis of Humanism, Nature/Culture, Green Studies, Environmental Imagination, Ecofeminism.	6	Debate	Debate on the key terms of Ecocriticism
	Text for Detailed Study: Cheryll Glotfelty: "Introduction: Literary Studies in an age of Environmental Crisis"	8	Discussion	Discussion on "Introduction: Literary Studies in an age of Environmental Crisis"
	Text for Detailed Study: Graham Good: "Presentism: Postmodernism, Poststructuralism, Postcolonialism"	6	Lecture	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	2	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE

		90 hours		

Reference Materials :

- Habib, M.A.R. Modern Literary Criticism and Theory. Blackwell Publishing,2008.
- Bennett, Andrews. An Introduction to Literature Criticism and Theory. Routledge Publishers, 2016.

Teacher/s –in Charge: Anju Rose Anto

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Anju Rose Anto
Module 2	August-September	Anju Rose Anto
Module 3	October-November	Anju Rose Anto

Course/ Lesson Plan

Semester III

Course category: Elective Course I

Paper name: EUROPEAN FICTION IN TRANSLATION Code: ENG3E02

Contact Hours: 90 Credits: 5

Course Outcome:

- This course will explore different trends in European fiction and its cultural impacts, through writings produced by people from different countries.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Cervantes Don Quixote	6	Lecture	Evaluation through question-answer session
	Gustave Flaubert Madame Bovary	6	Lecture Debate	Debate on the topic morality
	Gustave Flaubert Madame Bovary	6	Presentation on Madame Bovary	Reference reading and notes are evaluated.

	Leo Tolstoy Anna Karenina	8	Presentation and Lecture	Class test including all the topics
Module II	Franz Kafka The Trial	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Kazantzakis Zorba, the Greek	6	Lecture Debate	Debate on the topic of contrast between Zorba and Boss
	Kazantzakis Zorba, the Greek	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Gunter Grass The Tin Drum	6	Lecture Student seminar	Class test of Module II Seminar evaluation
Module III	Milan Kundera The Joke	6	Lecture Debate Presentations	Question-answer sessions
	Jose Saramago Blindness	6	Lecture Debate	Debate on the Characterisation
	Orhan Pamuk Snow	8	Lecture Debate Discussion	Discussion on Pamuk
	Italo Calvino If on a winter's night a traveller	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.

Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Walter Cohen : A History of European Literature: The West and the World from Antiquity to the Present
- Dr. Usha Jain : European Classics in Translation
- John Lucas : The Literature o f Change: Studies in the Nineteenth Century Provincial Novel
- John Galsworthy : The Creation o f Character in Literature
- Jonathan Culler : The Uses of Madame Bovary
- Stirling Haig : The Madame Bovary Blues: The Pursuit o f Illusion in Nineteenth Century French Fiction
- Ruth Crego Benson : Women in Tolstoy.
- Laura J Gorfkle : Discovering the Comic in Don Quixote

Teacher/s –in Charge;
Femin Sunny
Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Femin Sunny
Module 2	August-September	Femin Sunny
Module 3	October-November	Femin Sunny

Course/ Lesson Plan

Semester III

Course category: Elective Course II

Paper name: Introduction to Linguistics Code: ENG 3 E04

Contact Hours: 90 **Credits: 5**

Course Outcome:

- The course is intended to familiarize learners with the nature and organization of language. The history of Linguistics and its key concepts are discussed.

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	Unit 1 Origin of Language – Features of Language – language behavior and language system- – Language Families – Language Typology – Language Acquisition Introduction to Linguistics	6	Lecture	Evaluation through question-answer session
	Linguistics as a science - History of Linguistics: Ancient Greece and Rome	6	Lecture Debate	Debate on the topic History of Linguistics
	Ancient India – Medieval Arabic and Hebrew Traditions	6	Presentation on Arabic and Hebrew influence	Reference reading and notes are evaluated.
	Branches of Linguistics - Comparative Philology – Saussure's theories – Schools and	8	Presentation and Lecture	Class test including all the Topics

	movements – Historicism – Structuralism – Functionalism – Generativism .			
Module II	Sounds – Phonology and Phonetics - (The sound system, classification of sounds, phonological rules) – Articulatory Phonetics	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Vocoids and Contoids – Allophones – Suprasegmental features – Auditory phonetics	6	Lecture Debate	Debate on the topic of suprasegmental features
	Morphology (Morphemes, Word formation, Morphological rules) – Morphophonemics – Semantics (Semantic properties, semantic fields, semantic change) - Syntax	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	- Transformational Generative Grammar – Chomsky's contributions to Linguistics – Derivation – Constituent Structure – Immediate Constituents - Tagmemics.	6	Lecture Student seminar	Class test of Module II Seminar evaluation
Module III	Language and the brain – Psycholinguistics	6	Lecture Debate Presentations	Question-answer sessions

	Sociolinguistics – Ethnolinguistics Neurolinguistics –	6	Lecture Debate	Debate on sociolinguistics
	Ecolinguistics – Forensic Linguistics	8	Lecture Debate Discussion	Discussion on the features of Forensic Linguistics
	Computational Linguistics. Cognitive Science and Artificial Intelligence	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- R H Robins :*A Short History of Linguistics*
- William O'Grady, Michael Dobrovsky& Mark Arnoff :*Contemporary Linguistics: An Introduction*
- Charles F. Hockett : A Course in Modern Linguistics • John Lyons : Language and Linguistics, An Introduction.
- Danny D Steinberg & Natalia V Sciarini :*An Introduction to Psycholinguistics*

- Malcolm Coulthard& Alison Johnson: *An Introduction to Forensic Linguistics*
- Peter Trudgill :*Sociolinguistics: An Introduction to Language and Society*
- Elizabeth Ahlsen :*Introduction to Neurolinguistics*
- Alvin Fill. : *Eco-linguistics*: *State of the Art 1998*
- PaninianLinguistics :https://web.stanford.edu/class/linguist289/encyclopaedia001.pdf
- Keith Allan :*The Routledge Handbook of Linguistics*
- E F K Koerner : "The Chomskyan Revolution," *Towards a History of American Linguistics*

Teacher/s –in Charge: Dhanisha K.S.

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Dhanisha K.S.
Module 2	August-September	Dhanisha K.S.
Module 3	October- November	Dhanisha K.S.

Course/ Lesson Plan

Semester IV

Course category: Core Course I

Paper name: English Literature in the 21st Century

Code: ENG4C11

Contact Hours: 72 **Credits: 4**

Course Outcome:

- Familiarize the students with various trends in English Literature in the 21st Century. Introduce them to various movements.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Section A: Poetry	Simon Armitage : "A Vision" Benjamin Zephaniah : "Rong Radio Station" Martin Espada : "Alabanza: In Praise of Local 100"	5	Lecture	Evaluation through question-answer session
	Evan Boland : "Atlantis - A lost Sonnet" DaljitNagra : "Look We Have Coming to Dover" Sean O'Brien : "Water- Gardens"		Lecture Debate	Debate on the topic – Evan Boland : "Atlantis - A lost Sonnet"
	Ocean Vuong : "DetoNation" Terrance Hayes : "I Lock You in an American Sonnet that is Part Prison" Sarah Howe : "Yangtze"		Presentation on Literary Qualities in Ocean Vuong : "DetoNation"	Reference reading and notes are evaluated.
	Jorie Graham : "Fast" Vijay Nambisan : These were my Homes		Lecture	Evaluation through Annotation questions
Section B: Drama	Tracy Letts : August: Osage County		Lecture Student seminar	Question-answer sessions Seminar evaluation

	Tracy Letts : August: Osage County Part-2		Lecture Debate	Debate on the topic of Tracy Letts : August: Osage County
	Lucy Kirkwood : Chimerica	5	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	AyadAkhtar : Disgraced	5	Lecture Student seminar	Class test of all the topics of Section-B Seminar evaluation
Section C: Fiction and Prose	Kazuo Ishiguo's Never Let Me Go. Mohsin Hamid : The Reluctant Fundamentalist	5	Lecture Debate Presentations	Question-answer sessions
	Richard Powers : The Echo Maker Viet Thanh Nguyen : The Sympathizer	5	Debate	Debate on the Nguyen : The Sympathizer
	Ali Smith : Autumn AmitavGhosh : Chapters 1-4	5	Discussion	Discussion on the Ali Smith : Autumn
	David Lodge : "Consciousness and the Two Cultures" Chimamanda Ngozi Adichie : Purple Hibiscus	5	Lecture	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	2	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.

Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		72hours		

Reference Materials :

- Bryant N. Kendra. Engaging 21st century Writers with Social Media.IGI Global Publishers, 2017.
- Antakyalioglu, Zekiye English Studies in 21st Century, Cambridge Scholars Publishers, 2020

Teacher/s –in Charge: Sr. Alphonsa P.J.

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	December	Sr. Alphonsa P.J.
Module 2	January	Sr. Alphonsa P.J.
Module 3	February-March	Sr. Alphonsa P.J.

Course/ Lesson Plan

Semester IV

Course category: Elective Course I

Paper name: INDIAN ENGLISH FICTION

Code: ENG4E14

Contact Hours: 72 **Credits: 4**

Course Outcome:

- This course intends to familiarise students with the different trends in Indian English fiction

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Raja Rao Kanthapura	5	Lecture	Evaluation through question-answer session
	Mulk Raj Anand Coolie	5	Lecture Debate	Debate on the topic Indian English fiction
	Khushwant Singh *Train To Pakistan*	5	Presentation on narration	Reference reading and notes are evaluated.
	RohintonMistry *A Fine Balance*	5	Presentation and Lecture	Class test including all the topics
Module II	ArvindAdiga *The White Tiger*	5	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Deepak Unnikrishnan *Temporary People*	5	Lecture Debate	Debate on *Temporary People*
	Chitra Banerjee Divakaruni The*Palace Of Illusions*	5	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Chitra Banerjee Divakaruni The*Palace Of Illusions*	5	Lecture Student seminar	Class test of Module II Seminar evaluation

Module III	JhumpaLahiri *The Namesake*	5	Lecture Debate Presentations	Question-answer sessions
		5	Lecture Debate	Debate on the Characterisation
	Kiran Desai *The Inheritance Of Loss*	5	Lecture Debate Discussion	Discussion on Kiran Desai
	AneesSalim *The Blind Lady's Descendants*	5	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 120 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		72 hours		

Reference Materials :

- Naik M K : History of Indian English Literature
- Ran Sharma : Critical Explorations in Indian English Literature
- Ajay Kumar Sharma : Critical Perspectives of Indian English Literature
- Shyamala A Narayan : Indian English Literature 2001- 2015 A Critical Survey

Teacher/s –in Charge: Anju Rose Anto

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	December	Anju Rose Anto
Module 2	January	Anju Rose Anto
Module 3	February-March	Anju Rose Anto

Course/ Lesson Plan

Semester IV

Course category: Elective Course II

Paper name: Malayalam Literature in English Translation

Code: ENG4E18

Contact Hours: 72 **Credits: 4**

Course Outcome:

- This Course introduces the learners to movements and trends in Malayalam literature since the 1970s, offering representative texts for study.

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	Kumaran Asan : "The Fallen Flower" Vallathol : "Akroon to Ambadi" Ulloor : "Music of Love"	5	Lecture	Evaluation through question-answer session
	Changampuzha : "Manaswini" G. Sankara Kurup : "The Master Carpenter"	5	Lecture Debate	Debate on the topic Romanticism
	Balamani Amma : "Mother's Heart" Vyloppilli : "The Mother Tigress in the Zoo"	5	Presentation on Poetic techniques	Reference reading and notes are evaluated.

	N.V. Krishna Variyar : "The Rats" Sugatha Kumari : "Colossus" O.N.V. Kurup : "Blue Fish"	5	Presentation and Lecture	Class test including all the topics
Module II	O. Chandu Menon : *Indulekha* Basheer : *My Granddad had an Elephant*	5	Lecture Student seminar	Question-answer sessions Seminar evaluation

	C.V. Raman Pillai : *Marthanda Varma* Thakazhi : *Chemmeen*	5	Lecture Debate	Debate on Chemmeen
	O.V. Vijayan : *The Legend of Kazak*	5	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Kesava Dev : *From The Gutter* M.T. Vasudevan Nair : *Mist*	5	Lecture Student seminar	Class test of Module II Seminar evaluation
Module III	N. Krishna Pillai : *Investmen*t (Kerala Sahitya Akademi, Thrissur)	5	Lecture Debate Presentations	Question-answer sessions
	C.J. Thomas : *Behold, He Comes Again*	5	Lecture Debate	Debate on the Characterisation
	Thoppil Bhasi : *Capita*l G. Sankara Pillai : *Bharata Vakyam*	5	Lecture Debate Discussion	Discussion on Thoppil Bhasi
	K.J. Baby : *Nadugadhika*	5	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				

Internal Examinations	Two internals of 120 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		72 hours		

Reference Materials :

- The Oxford India Anthology of Malayalam Dalit Writing(2011) • The Oxford India Anthology of Modern Malayalam Literature (2017).
- Mona Baker : Critical Readings in Translation Studies
- Silvia Kadiu : Reflexive Translation Studies : Silvia Kadiu
- Dr. N. Mukundan : Changamphuzha Krishnapillai
- Ulloor S Parameswara Aiyer : Kerala Sahithya Charithram (V Volumes, IV edition)

Teacher/s –in Charge: Femin Sunny

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	December	Femin Sunny
Module 2	January	Femin Sunny
Module 3	February-March	Femin Sunny

Course/ Lesson Plan 2021-2022

Semester I

Course category: Core Course I

Paper name: British Literature from Chaucer to 18th Century

Code: ENG 1 C01

Contact Hours: 90 **Credits: 5**

Course Outcome:

- Familiarize the students with various trends in British literature from the 14th century to the 18th century.
- Introduce them to various movements in British literature

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Section A: Poetry	Geoffrey Chaucer : "The General Prologue to Canterbury Tales" (first 100 lines)	6	Lecture	Evaluation through question-answer session
	William Shakespeare : Sonnet 18. "Shall I Compare thee to a Summer's Day" John Donne : "The Canonization"	6	Lecture Debate	Debate on the topic – Compare and Contrast Shakespeare and John Donne.
	Andrew Marvell : "To His Coy Mistress" John Dryden : "Mac Flecknoe"	6	Presentation on Literary Qualities in Mac Flecknoe	Reference reading and notes are evaluated.
	John Milton : "Paradise Lost" Book 1 (lines up to 270) Thomas Gray : "Elegy written in a Country Churchyard"	8	Lecture	Evaluation through Annotation questions
Section B: Drama	Shakespeare : Hamlet	8	Lecture Student seminar	Question-answer sessions Seminar evaluation

	Shakespeare : Hamlet & Webster : The Duchess of Malfi	6	Lecture Debate	Debate on the topic Elucidate the soliloquies in the Hamlet.
	Webster : The Duchess of Malfi	6	Lecture	Write-ups of students are to be evaluated.
			Student seminar	Seminar evaluation
	Sheridan : The Rivals	6	Lecture Student seminar	Class test of all the topics of Section II Seminar evaluation
Section C : Prose And Fiction	Swift : Gulliver's Travels	6	Lecture Debate Presentations	Question-answer sessions
	Henry Fielding : Joseph Andrews	6	Debate	Debate on the how far the term "picaresque" applied to Joseph Andrews.
	Francis Bacon : "Of Marriage", Joseph Addison : Sir Roger at Church	8	Discussion	Discussion in group on the topic, "Is being married better than remaining single?
	Daniel Defoe : Robinson Crusoe	6	Lecture	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	2	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point	Feedbacks are provided and marks are considered for CIE

			presentation, preferably.	
		90 hours		

Reference Materials:

- Carter, Ronald and John McRae. The Routledge History of Literature in English Britain and Ireland. Malcolm Bradbury, 2001.
- O' Neill, Michael. The Cambridge History of English Poetry. Cambridge University Press, 2010.

Teacher/s –in Charge:

- Keerthana P.K
- Module Division:

Module	Month	Teacher/s-in—charge
Module 1	June-July	Keerthana P.K
Module 2	August-September	Keerthana P.K
Module 3	October-November	Keerthana P.K

Course/ Lesson Plan 2021-2022

Semester I

Course category: Core Course II

Paper name: British Literature 19th century

Code: ENG1CO2

Contact Hours: 90 **Credits: 5**

Course Outcome:

- This course will train students to examine and interpret the long eighteenth century and its multiple revolutions through a transnational and cross-cultural perspective.
- Students will be trained to understand the continuities between the eighteenth century and high modernity.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	The Tiger, The Lamb Lines Composed a Few Miles above Tintern Abbey	6	Lecture	Evaluation through question-answer session
	Kubla Khan Ozymandias Ode to a Nightingale	6	Lecture Debate	Debate on the topic John Keats
	She Walks in Beauty Tithonus Fra Lippo Lippi	6	Presentation on Fra Lippo Lippi	Reference reading and notes are evaluated.
	A Musical Instrument Dover Beach The Blessed Damozel	8	Presentation and Lecture	Class test including all the poems
Module II	Oscar Wilde	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	The Importance of Being Earnest	6	Lecture Debate	Debate on the topic of Victorian tradtions and hypocrisy
	The Importance of Being Earnest	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	The Importance of Being Earnest	6	Lecture Student seminar	Class test of Module II Seminar evaluation

Module III	Charles Lamb : "Dream Children – A Reverie"	6	Lecture Debate Presentations	Question-answer sessions
	William Hazlitt : On Reading Old Books			
	Charles Dickens : A Tale of Two Cities	6	Lecture Debate	Debate on the Characterisation
	Emily Bronte : Wuthering Heights	8	Lecture Debate Discussion	Discussion on Heathcliff and Catherine
	Thomas Hardy : Tess of the D'Urbevilles	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Elizabeth Gaskell : *North and South*
- George Eliot : *The Lifted Veil* OXFORD WORLD'S CLASSICS

- Thomas Hardy : *Tess of the D'Urbervilles*
- Raymond Williams : Introduction *In the English Novel from Dickens to Lawrence*

Teacher/s –in Charge:

- Anju Rose Anto

Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Anju Rose Anto
Module 2	August-September	Anju Rose Anto
Module 3	October-November	Anju Rose Anto

Course/ Lesson Plan 2021-2022

Semester I

Course category: Core Course III

Paper name: History of English Language

Code: ENG1CO3

Contact Hours: 90 **Credits: 5**

Course Outcome:

- The course offers an overview of the History of English Language from its origin to the present.

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	Language families - The Indo-European family of languages; Germanic Family of languages and the origin of English	6	Lecture	Evaluation through question-answer session
	The early history of English language; Old English Period - Scandinavian invasions - Middle English Period: The Impact of the Norman Conquest on the English Language; - Middle English Literature.	6	Lecture Debate	Debate on the topic Origin of Language
	Modern English Period – Latin and Greek influence – Loan words - The impact of the Renaissance- Bible Translations	6	Presentation on Latin and Greek influence	Reference reading and notes are evaluated.

	Sound changes in English – The Great Vowel Shift - Changes in Grammar,	8	Presentation and Lecture	Class test including all the Topics
	vocabulary, phonology and morphology – Semantics – word formation			
Module II	Foreign influences on English in the Seventeenth, Eighteenth and the Nineteenth Centuries	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Colonialism and the English language	6	Lecture Debate	Debate on the topic of Colonialism and the English language
	Expansion of Vocabulary – Semantic change- Pidgins and Creoles.	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Contributions of major writers to the growth of English vocabulary	6	Lecture Student seminar	Class test of Module II Seminar evaluation
Module III	The discrepancy between spelling and pronunciation - Attempts to reform English spelling	6	Lecture Debate Presentations	Question-answer sessions
	Evolution of Standard English - Dialects of English: British and American – English in India	6	Lecture Debate	Debate on Dialects of English

	English in the postcolonial world – English as a global language — The rise of 'englishes' – impact of Science and Technology –	8	Lecture Debate Discussion	Discussion on impact of Science and Technology
	English in the digital age.	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- F. T. Wood : An Outline History of the English language
- C. L. Wrenn : The English Language
- A. C. Baugh : A History of the English Language
- David Crystal : English as a Global Language
- David Crystal: The English Language: A guided Tour of the Language
- Bill Ashcroft, et al : The Empire Writes Back
- Christian Mair :The Politics of English as a World Language

- Andreas Sedlatschek : Contemporary Indian English: Variation and Change
- Pingali Sailaja : Indian English
- Michael Hanrahan& Deborah L Madsen (Ed.): Teaching, Technology, Textuality: Approaches to New Media

Teacher/s –in Charge:

- Sr Alphonsa
- Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Sr Alphonsa
Module 2	August-September	Sr Alphonsa
Module 3	October-November	Sr Alphonsa

Course/ Lesson Plan 2021-2022

Semester I

Course category: Core Course IV

Paper name: Indian Literature in English

Code: ENG1 C04

Contact Hours: 90 **Credits: 5**

Course Outcome:

- Familiarize the students with the various trends and movements in Indian English literature from its inception to the present.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Section A: Poetry	Toru Dutt : "Our Casuarina Tree" Rabindranath Tagore : "The Child"	5	Lecture	Evaluation through question-answer session
	Nizzim Ezekiel : "In the Country Cottage" Jayantha Mahapatra : "Hunger" A.K. Ramanujan : "Obituary"	4	Lecture Debate	Debate on the topic: Compare and Contrast the writers Ezekiel and Mahapatra.

	R. Parthasarathy : "River, Once" Kamala Das : "The Old Playhouse" Gieve Patel : "The Ambiguous fate of Gieve Patel.	6	Presentation on Kamala Das as a Confessional Poet of India	Reference reading and notes are evaluated.
	Meena Alexander : "Blue Lotus" Arundhathi Subramaniam : "Home" MeenaKandasamy :"Dead Woman Walking"		Presentation and Lecture	Class test including all the annotation portion of Section A.
Section B: Fiction	Mulk Raj Anand : Coolie		Lecture Student seminar	Question-answer sessions Seminar evaluation
	R.K. Narayanan : The Guide	7	Lecture Debate	Debate on the topic of literary techniques of a frame narrative in "The Guide"

	Salman Rushdie : Midnight's Children	3	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	AmitavGhosh : The Hungry Tide		Lecture Student seminar	Class test of all the topics of Section -B Seminar evaluation
Section: C Drama	GirishKarnad : Yayati (English Translation by the author)	8	Lecture Debate Presentations	Question-answer sessions
	GirishKarnad : Yayati		Debate	Debate on the GirishKarnad : Yayati
	Mahesh Dattani : Tara	4	Discussion	Discussion on the Characteristics of Tara
	Mahesh Dattani : Tara	6	Lecture	Evaluation through question-answer session
Section-D Prose	JawaharLal Nehru : "What is Culture?"		Lecture Debate	Debate on Nehru's Writing Style
	AmartyaSen : "Reason and Identity" (From: The Argumentative Indian, Part IV)		Lecture Student Seminar	Seminar evaluation

	AmartyaSen : "Reason and Identity" Section 1-4)	5	Lecture Student Seminar	Seminar evaluation
	AmartyaSen : "Reason and Identity" (Section 58)		Lecture Discussion	Class test
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration		Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	2	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic		All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials:

- Agrawal K.A. Indian Writing in English: A Critical Study. Atlantic Publishers, 2003.
- Tiwari, Shubha. Indian Fiction in English Translation. Atlantic Publishers, 2005.

Teacher/s –in Charge:

- Keerthana P.K
- Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Keerthana P.K
Module 2	August-September	Keerthana P.K

Module 3	October-November	Keerthana P.K

Course/ Lesson Plan 2021-2022

Semester III

Course category: Core Course I

Paper name: Twentieth Century British Literature Post 1940

Code: ENG3CO9

Contact Hours: 90 **Credits: 5**

Course Outcome:

- This course will train students to examine and interpret the long twentieth century and its multiple revolutions through a transnational and cross-cultural perspective.
- Students will be trained to understand the perspectives on post modernity.

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	Dylan Thomas : "Fern Hill" Philip Larkin : "Church Going"	6	Lecture	Evaluation through question-answer session
	Thom Gunn : "On the Move" Ted Hughes : "View of a Pig", Seamus Heaney : "Punishment	6	Lecture Debate	Debate on the topic bog poetry
	Charles Tomlinson : "Swimming Chenango Lake" Geoffrey Hill : "In Memory of Jane Frazer	6	Presentation on Charles Tomlinson	Reference reading and notes are evaluated.

	Elizabeth Jennings : "One Flesh" Andrew Motion : "The Last Call"	8	Presentation and Lecture	Class test including all the poems
Module II	Samuel Beckett : *Waiting for Godot*	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Caryl Churchill : *Top Girls*	6	Lecture Debate	Debate on the topic of female characters
	Harold Pinter : *The Birthday Party*	6	Lecture	Write-ups of students are to be evaluated.
			Student seminar	Seminar evaluation
	Edward Bond : *Lear*	6	Lecture Student seminar	Class test of Module II Seminar evaluation
Module III	John Fowles : *The French Lieutenant's woman*	6	Lecture Debate Presentations	Question-answer sessions
	Kingsley Amis *: Lucky Jim*	6	Lecture Debate	Debate on the Characterisation
	Alan Sillitoe : *Loneliness of the Long Distance Runner*	8	Lecture Debate Discussion	Discussion on the character Smith
	Kazuo Ishiguro : Remains of the Day	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.

Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Book by Martin Esslin : The Theatre of the Absurd
- Michael Y. Bennett : Reassessing the Theatre of the Absurd: Camus, Beckett, Ionesco, Genet, and Pinter
- Michael Y. Bennett : The Cambridge Introduction to Theatre and Literature of the Absurd
- Perry Anderson : The Origins of Postmodernity
- Fredrick Jameson : Postmodernism, or, the Cultural Logic of Late Capitalism
- William Hutchings :Samuel Beckett's Waiting for Godot: A Reference Guide

Teacher/s –in Charge:

- Sr Alphonsa
- Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Sr Alphonsa
Module 2	August-September	Sr Alphonsa
Module 3	October-November	Sr Alphonsa

Course/ Lesson Plan 2021-2022

Semester III

Course category: Core Course II

Paper name: Literary Criticism and Theory: Part 2

Code: ENG3C10

Contact Hours: 90 **Credits: 5**

Course Outcome:

- Familiarize the students with Literary Criticism and Theory
  Introduce them to various theories and help them to have in-depth knowledge of the major theorists and key concepts.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Section A: 1.Structuralism 2. PostStructuralism/ Deconstruction 3.Psychoanalysis: An Overview	Major theorists, Key concepts. Structure, Sign, Signifier, Signified, Semiology, Semiotics, Langue and Parole, Mythemes, Structuralist Narratology.	6	Lecture	Evaluation through question-answer session
	Text for Detailed Study: Roland Barthes: "Structuralist Activity"		Lecture Debate	Debate on the topic – Major theorists of Structuralism Post-Structuralism.
	Major theorists, Key concepts. Text for Detailed Study: Jacques Derrida: "Structure, Sign and Play in the Discourse of Social Sciences"		Presentation on key concepts	Reference reading and notes are evaluated.

	Major theorists, Key concepts. Text for Detailed Study: Jacques Lacan: "The Mirror Stage as Formative of the Function of the I"	8	Lecture	Evaluation through quiz

Section B: 4. Feminism 5. Cultural Materialism/ New Historicism 6. Post colonialism: An Overview	Major theorist: : Virginia Woolf, Kate Millet, Elaine Showalter, Helene Cixous, Adrienne Rich. Key concepts.	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Text for Detailed Study: Elaine Showalter: "Towards a Feminist Poetics"	6	Lecture Debate	Debate on the topic of phases of feminism.
	Major theorists. & Louis Montrose: "Professing the Renaissance: The Poetics and Politics of Culture"	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Major theorists, Key concepts. Text for Detailed Study: Edward Said: "Jane Austen and Empire"	6	Lecture Student seminar	Class test of all the topics of Section-II Seminar evaluation
Section C: 7. Ecocriticism 8.Critiquing Theory: An Overview	Major theorists: Jonathan Bate, CheryllGlotfelty, Laurence Coupe, Patrick DMurphy, William Rueckert.	6	Lecture Debate Presentations	Question-answer sessions

	Key concepts: Anthropocentrism, Shallow Ecology vs Deep Ecology, The Crisis of Humanism, Nature/Culture, Green Studies, Environmental Imagination, Ecofeminism.	6	Debate	Debate on the key terms of Ecocriticism
	Text for Detailed Study: Cheryll Glotfelty: "Introduction: Literary Studies in an age of Environmental Crisis"	8	Discussion	Discussion on "Introduction: Literary Studies in an age of Environmental Crisis"
	Text for Detailed Study: Graham Good: "Presentism: Postmodernism, Poststructuralism, Postcolonialism"	6	Lecture	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	5	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	2	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE

		90 hours		

Reference Materials :

- Habib, M.A.R. Modern Literary Criticism and Theory. Blackwell Publishing,2008.
- Bennett, Andrews. An Introduction to Literature Criticism and Theory. Routledge Publishers, 2016.

Teacher/s –in Charge:

- Keerthana P.K
- Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Keerthana P.K
Module 2	August-September	Keerthana P.K
Module 3	October-November	Keerthana P.K

Course/ Lesson Plan 2021-2022

Semester III

Course category: Elective Course I

Paper name: EUROPEAN FICTION IN TRANSLATION Code: ENG3E02

Contact Hours: 90 Credits: 5

Course Outcome:

- This course will explore different trends in European fiction and its cultural impacts, through writings produced by people from different countries.

Modules	**Contents**	**Hours**	**Procedure/ Activity/ plans**	**Assessment**
Module I	Cervantes Don Quixote	6	Lecture	Evaluation through question-answer session
	Gustave Flaubert Madame Bovary	6	Lecture Debate	Debate on the topic morality

	Gustave Flaubert Madame Bovary	6	Presentation on Madame Bovary	Reference reading and notes are evaluated.
	Leo Tolstoy Anna Karenina	8	Presentation and Lecture	Class test including all the topics
Module II	Franz Kafka The Trial	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Kazantzakis Zorba, the Greek	6	Lecture Debate	Debate on the topic of contrast between Zorba and Boss
	Kazantzakis Zorba, the Greek	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	Gunter Grass The Tin Drum	6	Lecture Student seminar	Class test of Module II Seminar evaluation
Module III	Milan Kundera The Joke	6	Lecture Debate Presentations	Question-answer sessions
	Jose Saramago Blindness	6	Lecture Debate	Debate on the Characterisation
	Orhan Pamuk Snow	8	Lecture Debate Discussion	Discussion on Pamuk
	Italo Calvino If on a winter's night a traveller	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.

Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- Walter Cohen : A History of European Literature: The West and the World from Antiquity to the Present
- Dr. Usha Jain : European Classics in Translation
- John Lucas : The Literature o f Change: Studies in the Nineteenth Century Provincial Novel
- John Galsworthy : The Creation o f Character in Literature
- Jonathan Culler : The Uses of Madame Bovary
- Stirling Haig : The Madame Bovary Blues: The Pursuit o f Illusion in Nineteenth Century French Fiction
- Ruth Crego Benson : Women in Tolstoy.
- Laura J Gorfkle : Discovering the Comic in Don Quixote

Teacher/s –in Charge:

- Anju Rose Anto
- Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Anju Rose Anto
Module 2	August-September	Anju Rose Anto
Module 3	October-November	Anju Rose Anto

Course/ Lesson Plan

Semester III

Course category: Elective Course II

Paper name: Introduction to Linguistics Code: ENG 3 E04

Contact Hours: 90 **Credits: 5**

Course Outcome:

- The course is intended to familiarize learners with the nature and organization of language. The history of Linguistics and its key concepts are discussed.

Modules	Contents	Hours	Procedure/ Activity/ plans	Assessment
Module I	Unit 1 Origin of Language – Features of Language – language behavior and language system- – Language Families – Language Typology – Language Acquisition Introduction to Linguistics	6	Lecture	Evaluation through question-answer session
	Linguistics as a science - History of Linguistics: Ancient Greece and Rome	6	Lecture Debate	Debate on the topic History of Linguistics
	Ancient India – Medieval Arabic and Hebrew Traditions	6	Presentation on Arabic and Hebrew influence	Reference reading and notes are evaluated.
	Branches of Linguistics - Comparative Philology – Saussure's theories – Schools and	8	Presentation and Lecture	Class test including all the Topics

	movements – Historicism – Structuralism – Functionalism – Generativism .			
Module II	Sounds – Phonology and Phonetics - (The sound system, classification of sounds, phonological rules) – Articulatory Phonetics	8	Lecture Student seminar	Question-answer sessions Seminar evaluation
	Vocoids and Contoids – Allophones – Suprasegmental features – Auditory phonetics	6	Lecture Debate	Debate on the topic of suprasegmental features
	Morphology (Morphemes, Word formation, Morphological rules) – Morphophonemics – Semantics (Semantic properties, semantic fields, semantic change) - Syntax	6	Lecture Student seminar	Write-ups of students are to be evaluated. Seminar evaluation
	- Transformational Generative Grammar – Chomsky's contributions to Linguistics – Derivation – Constituent Structure – Immediate Constituents - Tagmemics.	6	Lecture Student seminar	Class test of Module II Seminar evaluation
Module III	Language and the brain – Psycholinguistics	6	Lecture Debate Presentations	Question-answer sessions

	Sociolinguistics – Ethnolinguistics Neurolinguistics –	6	Lecture Debate	Debate on sociolinguistics
	Ecolinguistics – Forensic Linguistics	8	Lecture Debate Discussion	Discussion on the features of Forensic Linguistics
	Computational Linguistics. Cognitive Science and Artificial Intelligence	6	Lecture Debate Discussion	Evaluation through question-answer session
Evaluation: (12 hrs)				
Internal Examinations	Two internals of 150 marks and 3 hours duration	6	Written Exam	Papers are evaluated and marks are taken for CIE. Feedbacks are given individually.
Assignments	Any topic	1	All students are required to prepare an assignment from any of the topics they're interested, but should avoid repetition	Assignments are corrected and feedbacks are given. CIE Internal mark is awarded on the basis of assignments too.
Seminars	Any topic	5	All students are required to present a topic with the help of power point presentation, preferably.	Feedbacks are provided and marks are considered for CIE
		90 hours		

Reference Materials :

- R H Robins :*A Short History of Linguistics*
- William O'Grady, Michael Dobrovsky& Mark Arnoff :*Contemporary Linguistics: An Introduction*
- Charles F. Hockett : A Course in Modern Linguistics • John Lyons : Language and Linguistics, An Introduction.
- Danny D Steinberg & Natalia V Sciarini :*An Introduction to Psycholinguistics*

- Malcolm Coulthard& Alison Johnson: *An Introduction to Forensic Linguistics*
- Peter Trudgill :*Sociolinguistics: An Introduction to Language and Society*
- Elizabeth Ahlsen :*Introduction to Neurolinguistics*
- Alvin Fill. : *Eco-linguistics*: *State of the Art 1998*
- PaninianLinguistics :https://web.stanford.edu/class/linguist289/encyclopaedia001.pdf
- Keith Allan :*The Routledge Handbook of Linguistics*
- E F K Koerner : "The Chomskyan Revolution," *Towards a History of American Linguistics*

Teacher/s –in Charge:

- Sr Alphonsa
- Module Division:

Module	Month	Teacher/s-in--charge
Module 1	June-July	Sr Alphonsa
Module 2	August-September	Sr Alphonsa
Module 3	October- November	Sr Alphonsa

Course: BSc. Computer Science (Complementary)

CSC1C01 – Computer Fundamentals

Semester: 1

Course Number: 1

Contact Hours: 2T+2L

Number of Credits: 2

Number of Contact Hours: 64

Course Evaluation: Internal – 15 Marks + External – 60 Marks

Aim of the Course:

To impart the students with fundamental principles and operations of various units of computer and to impart them with the basic skill in application packages.

Objectives of the Course:

· To learn the basics of computer hardware units and how they work together

· To acquire basic skill with office packages

Prerequisites: Background of the basic science at +2 level

Dept. of Computer Science

Course Outline

UNIT I [7T+6L]

Number systems- Non-positional number systems and positional number systems (Binary, Octal and Hexadecimal), Converting from one number system to another- decimal to a new base, converting to decimal from another bases, converting from base other than ten to base other than ten, short cut method for converting from binary to octal, octal to binary, binary to hexadecimal and hexadecimal to binary, Computer Codes (BCD, EBCDIC, ASCII) error detecting and correcting codes, parity bit, Hamming Code, computer arithmetic ,importance of binary, binary addition and subtraction.

UNIT II [6T+7L]

Boolean Algebra and Logic circuits- fundamental concepts of Boolean Algebra, postulates, Principle of duality, theorems of Boolean Algebra, Boolean functions, minimization, complement, canonicals forms, conversion between canonical forms. Logic Gates- AND, OR, NOT, NAND, NOR, XOR and XNOR, logic circuits, converting expression to logic circuit,

universal NAND and NOR gates, Exclusive OR and equivalence functions, Design of Combinational circuits (Half Adder, Subtractor and Full Adder)

UNIT III [6T+7L]

Basic Computer Organization-Input Unit, Output Unit, Storage Unit (Direct, Sequential and Random Access), CPU organization, Control Unit (micro programmed and hardwired control), primary storage, memory hierarchy, storage locations and addresses, storage capacity, bit, byte, nibble, RAM, ROM, PROM and EPROM, cache memory, registers. Secondary storage devices (Magnetic tape, Hard disk and CD drive)

UNIT IV [7T+6L]

I/O devices - Input Devices-identification and its use, keyboard, pointing devices (mouse, touch pad and track ball), Video digitizer, remote control, joystick, magnetic stripes, scanner, digital camera, microphone, sensor, and MIDI instruments, Output Devices identification and its use, monitor, printer (laser, inkjet, dot-matrix), plotter, speaker, control devices (lights, buzzers, robotic arms, and motors)

UNIT V [6T+6L]

Planning a Computer program, purpose of program planning, algorithm, flowchart - symbols, sample flowcharts, advantages and limitations.

Text Books:

1. Pradeep K. Sinha and Priti Sinha, Computer Fundamentals, BPB

References:

1. Peter Nortorn, Introduction to Computer, TMH
2. Rajaraman, V, Fundamental of Computers, Prentice Hall India
3. B. Ram, Computer Fundamentals

Lab List

Word Processing

· Paragraph formatting

· Newspaper style Document

· Table creation

· Mail merge

· Page formatting and printing

Spreadsheet

· Worksheet entries, including formula

Dept. of Computer Science

· Formatting cells

· Chart creation

· Functions

Presentation Software

· Creating presentation

· Animations

· Sound

· Inserting picture

Course Plan

Unit/hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Unit I (13 hours)	Number Systems, Converting from one number system to another, short cut method for converting from binary to octal, octal to binary, binary to hexadecimal and hexadecimal to binary, Computer Codes, Computer Arithmetic	● Lecture ● Problem-Solving	● Discussion ● Extra Problems as Assignments	Understanding the Basics of ● Number Systems ● Computer Codes ● Binary Arithmetic	● Evaluating Problem-Solutions ● Q and A
Unit II (13 hours)	Boolean Algebra and	● Lecture ● Problem-	● Discussion ● Simplificatio	Understanding ● Simplificatio	● Evaluating

Dept. of Computer Science

	Logic circuits- Logic Gates, universal gates, Exclusive OR and equivalence functions, Design of Combinational circuits.	Solving ● Illustrations	ns ● Designing Circuits	ns of Boolean Algebra ● Logic Gates ● Circuit Designing	Problem-Solutions ● Test
Unit III (13 hours)	Basic Computer Organization -Input Unit, Output Unit, Storage Unit, CPU organization, primary storage, memory hierarchy, storage locations and addresses, storage capacity, bit, byte, nibble, RAM, ROM, PROM and EPROM, cache memory, registers. Secondary storage devices	● Lecture ● Lab Sessions ● Illustrating Block Diagrams	● Discussion ● Drawing Block Diagrams	Understanding Basic Computer Organization	● MCQ ● Q and A
Unit IV (13 hours)	I/O devices - Input Devices- identification and its use, keyboard, pointing	● Lecture ● Seminar	● Discussion ● Identification of I/O devices	Understand the functions and working of various I/O devices	● Quiz

Dept. of Computer Science

	devices (mouse, touch pad and track ball), Video digitizer, remote control, joystick, magnetic stripes, scanner, digital camera, microphone, sensor, and MIDI instruments, Output Devices identification and its use, monitor, printer (laser, inkjet, dot-matrix), plotter, speaker, control devices (lights, buzzers, robotic arms, and motors)				
Unit V (12 hours)	Planning a Computer program, purpose of program planning, algorithm, flowchart - symbols, sample flowcharts, advantages	• Lecture • Lab Sessions • Illustrations	• Discussion • Writing Algorithms • Draw Flowcharts	Understand the Basics of Programming	• Evaluating Algorithms and Flowcharts • Test

Dept. of Computer Science

	and limitations.				

Faculty In-charge



Dr Jisha Jose Panackal

Dept. of Computer Science

CSC2C02 – Fundamentals of System Software, Networks and DBMS

Semester: 2

Course Number: 2

Contact Hours: 2T+2L

Number of Credits: 2

Number of Contact Hours: 64

Course Evaluation: Internal – 15 Marks + External – 60 Marks

Aim of the Course:

To impart the students with the basic concepts of system software, Computer Networks and Database.

Objectives of the Course:

· To learn the basic concepts of various system software

· To learn the basics of Computer Networks

· To learn the basics of Databases

Prerequisites: Background of the basic science at +2 level

Course Outline

UNIT I [6 T+6L]

System software - classification of programming languages (Machine, assembly & High level), Characteristics and Comparison, language processors (Assembler, Interpreter and Compiler), Operating Systems- Functions, types of OS (batch, multiprogramming, time sharing, real time and distributed)

UNIT II [7 T+6L]

Computer networks- goals of networking, network topologies, types of networks (LAN, MAN and WAN), network model, OSI model- 7 layers, Internet Layer- 5 layers, Communication Media-Guided (Twisted Pair, Coaxial Cable and Fiber Optic) and Unguided (microwave, satellite).

UNIT III [6 T+7L]

Database Management Systems-definition, structure of Database, data models (Record based Data model, Network model: - Basic Components, Record types, data types, links, relationships, Hierarchical model and Relational model)

Dept. of Computer Science

UNIT IV [6 T+7L]

Structured query language - Create, insert, select, update, delete, alter, drop commands

UNIT V [7 T+6L]

HTML-hypertext, hyper media, understanding basic HTML tools- HTML editor, web browser, General structure of HTML document, different types of elements-doc type, comment element, structural element, HTML tags and attributes: <html>, <body>, <head>, <title>, <h1>,... ,<h6>, <br>, <table>, <img>, <hr>, adding links, background image to the body, creating lists.

References:

1. P. K Sinha, Fundamentals of Computers
2. D. M Dhamdhere, Operating System: A concept based Approach
3. Behrouz A Forouzan, Data Communication & Networking, MC Graw Hill
4. Joel Sklar,Principles of Web Page Design, Vikas Publications

Lab List

HTML

1. Simple HTML document creation
2. HTML document with tables
3. HTML document with various lists
4. HTML document with links to different parts of the same
5. documents and to separate documents

MySQL

1. Table creation
2. Data insertion and deletion
3. Data retrieval
4. Alteration of tables

Dept. of Computer Science

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process)** **Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Unit I (12 hours)	System software, Classification of	● Lecture ● Illustrations	● Discussion ● Comparative Study	Understanding the Basics of	● MCQ ● Q and A

	programming languages Characteristics and Comparison, language processors, Operating Systems- Functions, types of OS			• Software • Computer Languages • Pre-processors • OS	
Unit II (13 hours)	Computer networks- goals of networking, network topologies, types of networks, network model, OSI model- 7 layers, Internet Layer- 5 layers, Communication Media.	• Lecture • Illustrations	• Discussion • Drawing various topologies, Layers of Network Models	Understanding • Computer Networks • Network Models	• Test • Q and A
Unit III (13 hours)	Database Management Systems- definition, structure of Database, data models	• Lecture • Illustrations	• Discussion • Comparative Study	Understanding DBMS	• Q and A • Test
Unit IV (13 hours)	Structured query language - Create, insert, select, update, delete, alter, drop	• PPT • Lab Sessions	• Discussion • Hands-on Experience	Understand SQL using MySQL	• Verification of Lab Exercises • Q and A

Dept. of Computer Science

	commands				
Unit V (13 hours)	HTML- hypertext, hyper media, understanding basic HTML tools- HTML editor, web browser, General structure of HTML document, different types of elements- doc type, comment element, structural element, HTML tags and attributes, adding links, background image to the body, creating lists.	• PPT • Lab Sessions	• Discussion • Hands-on Experience • Creative Learning	Understand the Basics of Web Designing using HTML	• Evaluating Web sites • MCQ

Faculty In-charge



Dr Jisha Jose Panackal

Dept. of Computer Science

CSC3C03 – Problem Solving Using C

Semester: 3

Course Number: 3

Contact Hours: 3T+2L

Number of Credits: 2

Number of Contact Hours: 80 Hrs.

Course Evaluation: Internal – Internal – 15 Marks + External – 60 Marks

Aim of the Course:

To equip the students with the basic concepts of problem solving using computers.

Objectives of the Course:

· To learn the concepts of programming.

· To learn the C language

Prerequisites:

· Background of the basic science at +2 level

Course Outline

UNIT I [9 T+7L]

Introduction to C- Structure of C program, Character Set, Keywords, Identifiers, Data Types, Qualifiers, Variables, Declarations, Symbolic Constants, Expressions, Statements, Different Types of Operators (Arithmetic, Logical, Relational & Equality, Unary and Conditional), Operator Precedence and Associativity, Library Functions, Comments, I/O functions-(Formatted scanf() &printf(), getchar (), putchar (), getche(), gets(), puts())

UNIT II [9 T+7L]

Control Statements- Selection Statements (if, if-else, else if ladder, switch), iteration (while, do while, for), jumping (goto, break, continue), Nested Control Statements

UNIT III [10 T+6L]

Structured Data types - Arrays (One dimensional and Two Dimensional), Character and String Functions, Structure (Definition, Processing-period Operator), Union

Dept. of Computer Science

UNIT IV [10 T+6L]

User defined Functions - Advantages, Definition, Accessing functions, formal and Actual Parameters, Recursion, Storage Classes- Automatic, External, Static and Register Variable, Argument Passing Mechanism

UNIT V [11T+6L]

Pointers and data files- Pointers, advantages, declaration, operations on pointers, pointers and one dimensional arrays, dynamic memory allocation. Data files (sequential), file handling functions (fopen(), fclose(), fputc(), fgetc(), fgets(), fputs(), fscanf(), fprintf()

Text Book:

1. E Balagurusamy, Programming in Ansi C, Tata McGraw Hill

References:

1. Byran Gotfried, Programming with C, Schaum Series
2. Kezningham & Ritchie,Programming in C
3. Yashvant Kanetkar, Let us C, BPB publications
4. Mullish Cooper, The spirit of C, Jasco books
5. Herbert Schildt, The Complete reference C, Tata McGraw Hill

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process)** **Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Unit I (16 hours)	Introduction to C- Structure of C program, Character Set, Keywords, Identifiers, Data Types, Qualifiers, Variables, Declarations, Symbolic Constants, Expressions, Statements,	• Lecture • Lab Sessions	• Discussion • Hands-on Learning	Understanding the Basics of • Programming using C • Tokens • Operators • I/O functions	• Evaluating Programs • Q and A

Dept. of Computer Science

	Different Types of Operators, Operator Precedence and Associativity, Library Functions, Comments, I/O functions				
Unit II (16 hours)	Control Statements- Selection Statements (if, if-else, else if ladder, switch), iteration (while, do while, for), jumping, Nested Control Statements	• Lecture • Illustrations • Program Logic Sharing	• Discussion • Hands-on Learning	Understanding • Control Statements • Program Implementations	• Program Test • MCQ
Unit III (16 hours)	Structured Data types - Arrays, Character and String Functions, Structure, Union	• Lecture • Lab Sessions	• Discussion • Hands-on Learning	Understanding Basic Data Structures	• Evaluating Programs • Q and A • Test
Unit IV (16 hours)	User defined Functions - Advantages, Definition, Accessing functions, formal and Actual	• Lecture • Lab Sessions	• Discussion • Hands-on Learning • Comparative Study	Understand the functions and working of various programs	• Evaluating Programs • Quiz

Dept. of Computer Science

	Parameters, Recursion, Storage Classes- Automatic, External, Static and Register Variable, Argument Passing Mechanism				
Unit V (16 hours)	Pointers and data files- Pointers, advantages, declaration, operations on pointers, pointers and one dimensional arrays, dynamic memory allocation. Data files, file handling functions	• Lecture • Lab Sessions • Illustrations	• Discussion • Writing Programs • Hands-on Learning	Understand the Basics of Dynamic Programming and use of Pointers	• Evaluating Programs • Q and A • Test

Faculty In-charge



Dr. Sr. Mini T V

Dept. of Computer Science

CSC4C04 – Data Structure Using C

Semester: 4

Course Number: 4

Contact Hours per Week: 5(3T+2L)

Number of Credits:2

Number of Contact Hours: 80 hrs

Course Evaluation: Internal – 15 Marks + External – 60 Marks

Objectives of the Course:

- To introduce the concept of data structures
- To make the students aware of various data structures
- To equip the students implement fundamental data structures

Prerequisites:

- Knowledge in C Programming Language

Course Outline:

Unit I [11 T+6L]

Primitive Data types and Abstract Data Types(ADT) - Introduction to data structures – definition - characteristics of data structures - categories of data structures – algorithm - space complexity and time complexity of an algorithm (concept only).

Unit II [7 T+6L]

Arrays and Singly Linked Lists - 1D, 2D and Multi-dimensional arrays – operations on arrays - Sparse Matrix Representation

Unit III [9 T+7L]

Lists- Linked List- Definition –Creation- Operations, Basics of Doubly Linked List, Circular Linked List.

Unit IV [11 T+7L]

Stack and Queues – Definition and Operations on stack - Implementation of Stack using arrays and linked lists - Applications of Stacks - Polynomial Addition Queues – Definition, Implementations of queue using arrays and linked lists – basics of Circular queue, Dequeue - Applications of queues.

Dept. of Computer Science

Unit V [10 T+7L]

Searching and Sorting: Searching: Linear search & Binary search. Sorting – Linear sort - Bubble sort - Selection sort - Insertion sort - Quick sort - Merge sort – Comparisons and implementations.

Text Books:

1. SeymourLipschutz,"Data Structures",TataMcGraw Hill Publishing Company Limited, Schaum"s Outlines, New Delhi.
2. YedidyanLangsam,MosheJ.Augenstein,and AaronM.Tenenbaum, "Data Structures Using C", Pearson Education., New Delhi.
3. Horowitz and Sahani, "FundamentalsofdataStructures",GalgotiaPublicationPvt.Ltd.,NewDelhi.

Reference Books:

1. Trembley, J.P. And Sorenson P.G., "An Introduction to Data Structures With Applications", Mcgraw- Hill International Student Edition, New York.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Addison- Wesley, (An Imprint of Pearson Education), Mexico City

Course Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Unit I (17 hours)	Primitive Data types and Abstract Data Types(ADT) - Introduction to data structures – definition - characteristics of data structures - categories of data structures – algorithm - space complexity and time	• Lecture • Lab Sessions	• Discussion • Hands-on Learning	Understanding the Basics of • Data Structures • Algorithms	• Q and A • Test

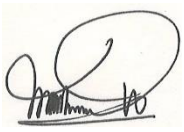
Dept of Computer Science

	complexity of an algorithm				
Unit II (13 hours)	Arrays and Singly Linked Lists - 1D, 2D and Multi-dimensional arrays – operations on arrays - Sparse Matrix Representation	• Lecture • Illustrations • Program Logic Sharing	• Discussion • Hands-on Learning	Understanding • Arrays • Matrices	• Program Test • MCQ
Unit III (16 hours)	Lists- Linked List- Definition –Creation- Operations, Basics of Doubly Linked List, Circular Linked List.	• Lecture • Lab Sessions	• Discussion • Hands-on Learning	Understanding Data Structures Using Linked Lists	• Evaluating Programs • Q and A • Test
Unit IV (18 hours)	Stack and Queues – Definition and Operations on stack - Implementation of Stack using arrays and linked lists - Applications of Stacks - Polynomial Addition Queues – Definition, Implementations of queue using arrays and linked lists – basics of Circular queue, Dequeue - Applications of queues.	• Lecture • Lab Sessions	• Discussion • Hands-on Learning • Comparative Study	Understand the functions of • Stacks • Queues And its implementations	• Evaluating Programs • Quiz
Unit V (17 hours)	Searching and Sorting:	• Lecture • Lab	• Discussion • Writing	Understand the Basics of	• Evaluating

Dept. of Computer Science

	Searching: Linear search & Binary search. Sorting – Linear sort - Bubble sort - Selection sort - Insertion sort - Quick sort - Merge sort – Comparisons and implementations.	Sessions • Illustrations	Programs • Hands-on Learning	• Searching • Sorting	Programs • Q and A • Test

Faculty In-charge



Dr. Sr. Mini T V

Dept. of Computer Science

Course: **MSc Computer Science (First Semester)**

Programme: CSS1C01 - Discrete Mathematical Structures

No. of lecture hours per week	4 Hrs
No.of credits for Theory	4

Aim of the course

To introduce discrete mathematics concepts necessary to understand basic foundation of Computer Science.

Course Outline

Unit I: Sets and Mathematical Logic: Set Theory - Types of sets, Set operations, Principles of Inclusion and Exclusion. Mathematical Logic - Propositional Calculus - Statement, Connectives, Conditional and Biconditional, Equivalence of Formula, Well Formed Formula, Tautologies, Duality Law, Functionally Complete Sets of Connectives, Normal Forms, Theory of Inference for the Statement Calculus, Predicate Calculus - Statement Functions, Variables and Quantifiers, Free and Bound Variables, Theory of Inference for the Predicate Calculus.

Unit II: Functions and Relations: Functions – Types of Functions, Composition of Functions and Inverse Functions. Relations - Relations and Their Properties, Functions as relations, Closure of Relations, Composition of relations, Equivalence Relations and Partitions. Partial Ordering, Hasse Diagram. The Pigeon Hole Principle.

Unit III: Lattices and Boolean Algebra - Lattices and Algebraic Systems, Principles of Duality, Basic Properties of Algebraic Systems Defined by Lattices, Distributive Lattices and Complemented Lattices. Boolean Lattices and Boolean Algebras. Boolean Functions and Boolean Expressions

.

Unit IV: Group Theory – Definition and Elementary Properties - Permutation Groups, Cyclic Groups – Subgroups - Cosets and Lagrange's Theorem, Semigroup and Monoid. Homeomorphism and Isomorphism. Rings, Integral Domains and Fields

.

Unit V: Graph Theory – Introduction, Directed Graph, Undirected Graph, Connected and Disconnected Graphs, Bipartite Graph, Complete Bipartite Graph, Isomorphic Graphs, Subgraph. Paths and Circuits. Shortest Paths in Weighted Graphs - Dijkstra's Algorithm. Eulerian Paths and Circuits, Hamiltonian Paths and Circuits. Trees - Spanning Trees and Cut-Sets, Minimum Spanning Trees - Kruskal's Algorithm, Prim's Algorithm.

References:

1. C Liu and D. Mohapatra, Elements of Discrete Mathematics - A Computer Oriented Approach, TMH, ISBN: 1259006395.
2. Alan Doerr and Kenneth Levassur, Applied Discrete Structure for Computer Science,

Dept of Computer Science

Galgotia Publications Pvt. Ltd, ISBN: 9780574217554.
3. J. K. Sharma, Discrete Mathematics, Macmillan Publishers India Limited, ISBN: 1403924759.
4. J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Application to Computer Science, McGraw-Hill Companies, ASIN: B001FPXR5Y.

Curriculum Plan

Unit/Hours (time required)	**Topics to be Taught (Input)**	**Procedure (process) student centric method of teaching**	**Activity**	**Learning outcome (outcome)**	**Assessment**
Unit1(18 Hour)	Sets and Mathematical Logic: Set Theory - Types of sets, Set operations, Principles of Inclusion and Exclusion. Mathematical Logic - Propositional Calculus - Statement, Connectives, Conditional and Biconditional, Equivalence of Formula, Well Formed Formula, Tautologies, Duality Law, Functionally Complete Sets of Connectives, Normal Forms, Theory of Inference for the Statement Calculus, Predicate Calculus - Statement Functions,	• Lecture using ICT tools	Peer group discussion on different types of sets	To Understand • Concept of different types of sets	• Assignment • MCQ evaluation

Dept of Computer Science

	Variables and Quantifiers, Free and Bound Variables, Theory of Inference for the Predicate Calculus.				
Unit 2 (20 Hours)	Functions and Relations: Functions – Types of Functions, Composition of Functions and Inverse Functions. Relations - Relations and Their Properties, Functions as relations, Closure of Relations, Composition of relations, Equivalence Relations and Partitions. Partial Ordering, Hasse Diagram. The Pigeon Hole Principle.	• Lecture using ICT Tools • Illustrations • Hands on sessions	• Seminar • Group stud	To Understand • Relations • Functions • Equivalence Relations • Partitions.	• Q&A exams.
Unit3 (18 Hours)	Lattices and Boolean Algebra - Lattices and Algebraic Systems, Principles of Duality, Basic Properties of Algebraic Systems Defined by Lattices, Distributive Lattices and Complemented Lattices. Boolean Lattices and	• Lecture using ICT tools • Illustrations	• Hands on sessions • Illustrations	To Understand Lattices and Boolean Algebra	• Q&A exams

Dept. of Computer Science

	Boolean Algebras. Boolean Functions and Boolean Expressions.				
Unit4 (14 Hours)	Group Theory – Definition and Elementary Properties - Permutation Groups, Cyclic Groups – Subgroups - Cosets and Lagrange's Theorem, Semigroup and Monoid. Homeomorphism and Isomorphism. Rings, Integral Domains and Fields.	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand Group Theory	• Q&A exams
Unit5(20 Hours)	Graph Theory – Introduction, Directed Graph, Undirected Graph, Connected and Disconnected Graphs, Bipartite Graph, Complete Bipartite Graph, Isomorphic Graphs, Subgraph. Paths and Circuits. Shortest Paths in Weighted Graphs - Dijkstra's Algorithm. Eulerian Paths and Circuits, Hamiltonian Paths and Circuits. Trees - Spanning Trees and	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand Graph Theory	• Assignments • Exams

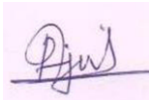
Dept. of Computer Science

	Cut-Sets, Minimum Spanning Trees - Kruskal's Algorithm, Prim's Algorithm.				

Course Outcomes:

CO:1	CO1: Summarize different types of Sets
CO:2	CO2: Describe Inclusion Exclusion Principle
CO:3	CO3: Discuss Functions and Relations.
CO:4	CO4: Describe Equivalence relations and partitions.
CO:5	CO5: Discuss Lattice and Boolean algebra.
CO:6	CO6: Describe Boolean expressions and functions
CO:7	CO7: Discuss Integral Domain and Rings
CO:8	CO8: Describes Kruskal's Algorithm, Prim's Algorithm.

Faculty in Charge:



Julie P.A

Programme: CSS1C02 –ADVANCED DATA STRUCTURES

Number of Lecture hours per week: 3Hrs Number of practical hours:4Hrs

Number of credits for theory:5 Number of credits for practical:1

Aim of the course

To introduce basic and advanced data structures dealing with algorithm development and problem solving.

Course Outline

Unit I: Data structure - definition - types & operations, characteristics of data structures - Abstract Data Type (ADT) – algorithms - concepts - definition - bjectives of algorithms - quality of an algorithm - space complexity and time complexity of an algorithm.

Unit II: Counting Techniques: Basic counting techniques - permutations and combinations, asymptotic behaviour of functions. Linear data structures - Arrays records - representation - data structure operations - traversing, inserting and deleting - sorting and searching - sorting algorithms - linear search & binary search - complexity. Linked lists -

Dept. of Computer Science

operations and implementations, - Stack - operations and its implementations (both array and linked list) - Applications - parsing arithmetic expressions, conversion and evaluating expressions. Recursion - characteristics of recursion, types of recursion applications of recursion in algorithms - comparison of recursive and non-recursive algorithms. Queue - operations and its implementations (both array and linked list) - circular queue - dequeue - priority queues, recursive lists, heterogeneous lists, deterministic skip lists, doubly linked lists and circular lists sparse matrix- representation.

Unit III: Non-linear Data Structures - trees - terminology - tree traversals algorithms Binary trees - threaded binary trees - binary search trees - traversals and operations on BST heap Tree - balanced trees - M-way trees - B and B+ trees, Red Black Tree, Digital Search Tree, Tries, Treaps, Huffman algorithm for extended binary tree - operations and their implementation. Graphs - representation of graphs – operations - traversals and their implementation.

Unit IV: Hashing - overview of hashing - hash tables - hash functions and their computations open addressing - linear probing - quadratic probing - double hashing algorithms and their implementations - rehashing - extendable hashing - separate chaining - hashing efficiency - heaps - overview of heaps - implementation and operations.

Unit V: Heap structures - Min-Max heaps - Deaps - leftist heaps - binomial heaps -Fibonacci heaps -binary heaps - skew heaps - pairing heaps - applications - amortized analysis an unrelated puzzle - Binomial queues - skew heaps - Fibonacci heaps - Splay trees.

References:

1. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, *Data Structures andAlgorithms*, Addison-Wesley, ISBN: 978-0201000238.
2. Horowitz E and Sahni S, *Fundamentals of Data Structures*, Computer Science Press, ISBN: 9780716780427.
3. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, *Fundamentals of Data Structures in C*, Silicon Press, ISBN: 0929306406.
4. Richard F. Gilberg and Behrouz A. Forouzan, *Data Structures: A Pseudocode Approach With C*, Thomson Brooks/Cole Publications, Course Technology, ISBN: 9780534390808.
5. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, *Data Structure using C*, Prentice- Hall, ISBN: 9780131997462.
6. Robert Kruse, Tondo C L and Bruce Leung, *Data Structures & Program Design in C*, Pearson India, 2nd Edition, ISBN: 9788177584233.
7. U. A. Deshpande and O. G. Kakde, *Data Structures & Algorithms*, ISTE Learning Materials Centre, New Delhi, ISBN: 9788188057054.
8. Thomas H Cormen, Charles E Leiserson, and Ronald L Rivest, *Introduction to Algorithms*, 3rd Edition, Prentice Hall of India Private Limited, New Delhi, ISBN: 978-0262033848.
9. Seymour Lipschutz, *Data Structures With C*, 1st Edition, Tata Mcgraw Hill Education Private Limited, ISBN: 0070701989.
10. Jean-Paul Tremblay, Paul G. Sorenson, P. G. Sorenson, *Introduction to Data Structures with Applications*, 2nd Edition, Mcgraw-Hill College, ISBN: 0070651574.

Dept. of Computer Science

Curriculum Plan

Unit/hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Unit I	Data structure - definition - types & operations, characteristics - Abstract Data Type – algorithms concepts – quality and complexity of an algorithm -	• Lecture using ICT tools • Problem Solving	Peer group discussion on different algorithm	To Understand • Concept of data structure • Criteria for choosing good algorithms	• Assignment • MCQ evaluation
Unit II	Counting Techniques: asymptotic behaviour of functions. Linear data structures - Arrays records - sorting algorithms - linear search & binary search Linked lists - Stack -s. Recursion - Queue - recursive lists, heterogeneous lists, deterministic skip lists, doubly linked lists and circular lists sparse matrix-representation.	• Lecture using ICT Tols • Illustrations • Hands on sessions	• Seminar • Group study	To Understand • Counting techniques • Linear data structures • Recursion • Linked list	• Lab tests • Q&A exams
Unit III	Non-linear Data Structures - trees - terminology - tree traversals	• Lecture using ICT tools • Illustrati	• Hands on sessions • Illustrations	To Understand • Non linear	• Lab tests • Q&A exams

Dept. of Computer Science

	algorithms Binary trees - threaded binary trees - binary search trees - traversals and operations on BST heap Tree - balanced trees - M-way trees - B and B+ trees, Red Black Tree, Digital Search Tree, Tries, Treaps, Huffman algorithm for extended binary tree - operations and their implementation. Graphs - representation of graphs – operations - traversals and their implementation	ons • Lab sessions		data structures • Huffman Algorithm	
Unit IV	Hashing - - linear probing - quadratic probing - double hashing - rehashing - extendable hashing - separate chaining - hashing efficiency - heaps -	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand • Hashing and its types	• Lab tests • Q&A exams
Unit V	Heap structures - Deaps - leftist heaps - binomial heaps - Fibonacci heaps -binary heaps - skew heaps - pairing heaps - Binomial queues - skew	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand • Heap data structure • Binomial queues • Splay	• Assignments

Dept. of Computer Science

	heaps - Fibonacci heaps - Splay trees.			trees	

Course Outcomes:

CO:1	Summarize different categories of data structures.
CO:2	CO2: Design algorithms to perform operations with linear and non – linear data structures.
CO:3	CO3: Describe how arrays, linked lists, stacks, queues, trees and graphs are represented in memory and used by algorithms.
CO:4	CO4: Describe common applications for arrays, linked lists, stack, queue, tree and graphs.
CO:5	CO5: Demonstrate different methods for traversing trees.
CO:6	CO6: Design and implement an appropriate hashing function for an application
CO:7	CO7: Discuss the computational efficiency of the principal algorithms for sorting, searching and hashing.
CO:8	CO8: Describes various types of trees and heap structures

Faculty in Charge:



Sindhu T

Programme: CSS1C03 – THEORY OF COMPUTATION

No. of lecture hours per week	4 Hrs
No.of credits for Theory	4

Aim of the course

To provide the students with an understanding of basic concepts in the theory of computation.

Course Outline

Unit I: Preliminaries - Introduction to formal proof and inductive proofs - The central concepts of Automata Theory - Alphabets, Strings, .Languages - Introduction to automata and grammar - Deterministic Finite Automata, Non-deterministic Finite Automata - Equivalence of Deterministic and Nondeterministic Finite Automata - Finite Automata with Epsilon Transitions - Equivalence of NFA with and without epsilon moves.

Dept. of Computer Science

Unit II: Regular Expressions, Finite Automata and Regular Expressions, Properties of Regular Languages - Pumping lemma and proof for existence of non-regular languages, Closure properties, homomorphism, substitution - Decision Properties - Equivalence and Myhill Nerode and DFA state minimization - Regular Grammar.

.

Unit III: Context Free Languages - Equivalence of CFG and PDA - Normal forms (CNF and GNF) - Closure properties of CFL's - DCFL's and their properties - Decision procedures - CYK algorithm - Pumping lemma and proof for existence of non-context - free languages - Context sensitive languages: Equivalence of LBA and Context Sensitive Grammar (CSG).

.

Unit IV: Turing machines - TM computations - Equivalence of standard TM with multitape and non deterministic TM's - Turing acceptable, Turing decidable and Turing enumerable language classes - Equivalence of type 0 grammars with TM's - Church thesis -Chomsky hierarchy - Closure properties of recursive and recursively enumerable languages.

.

Unit V: Computability and Decidability - halting problem - reductions – post correspondence problem. Computational complexity - Time and space bounded simulations
- Classes P and NP - NP completeness - Cook's theorem.

References:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages of Computation, 3rd Edition, Prentice Hall, ISBN: 0321455363.
2. Linz P, An Introduction to Formal Languages and Automata, Narosa Publishing House Pvt. Ltd., New Delhi, ISBN: 9788173197819.
3. Michael Sipser, Introduction to Theory of Computation, Cengage Learning India Private Limited, Indian Edition, ISBN: 8131505138.
4. H.R. Lewis and C.H. Papadimitriou, Elements of Theory of Computation, 2nd Edition, Prentice Hall, ISBN: 0132624788.
5. J. E. Savage, Models of Computation, Exploring the Power of Computing, Addison Wesley, 1998, Available at http://cs.brown.edu/~jes/book/.
6. Martin J.C, Introduction to Languages and Theory of Computation, Tata McGraw Hill, 3rd Edition, ISBN: 9780070660489.

Dept. of Computer Science

Curriculum Plan

Unit/Hours (time required)	Topics to be Taught (Input)	Procedure (process) student centric method of	Activity	Learning outcome (outcome)	Assessment

		teaching			
Unit1(18 Hour)	Preliminaries - Introduction to formal proof and inductive proofs - The central concepts of Automata Theory - Alphabets, Strings, .Languages - Introduction to automata and grammar - Deterministic Finite Automata, Non-deterministic Finite Automata - Equivalence of Deterministic and Nondeterministic Finite Automata - Finite Automata with Epsilon Transitions - Equivalence of NFA with and without epsilon moves.	• Lecture using ICT tools	Peer group discussion on different types of sets	To Understand • Concept of DFA and NFA	• Assignment • MCQ evaluation
Unit 2 (20 Hours)	Regular Expressions, Finite Automata and Regular Expressions, Properties of Regular Languages - Pumping lemma and proof for existence of non-regular languages, Closure properties, homomorphism, substitution - Decision Properties - Equivalence and Myhill Nerode and DFA state minimization - Regular Grammar.	• Lecture using ICT Tools • Illustrations • Hands on sessions	• Seminar • Group stud	To Understand • Regular languages • Pumping Lemma • Regular Grammer .	• Q&A exams.

Dept. of Computer Science

Unit3 (18 Hours)	Context Free Languages - Equivalence of CFG and PDA - Normal forms (CNF and GNF) - Closure properties of CFL's - DCFL's and their properties - Decision procedures - CYK algorithm - Pumping lemma and proof for existence of non-context - free languages - Context sensitive languages: Equivalence of LBA and Context Sensitive Grammar (CSG).	• Lecture using ICT tools • Illustrations	• Hands on sessions • Illustrations	To Understand CFL and CFG	• Q&A exams
Unit4 (14 Hours)	Turing machines - TM computations - Equivalence of standard TM with multi tape and non deterministic TM's - Turing acceptable, Turing decidable and Turing enumerable language classes - Equivalence of type 0 grammars with TM's - Church thesis - Chomsky hierarchy - Closure properties of recursive and recursively enumerable languages.	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand Turing machines	• Q&A exams

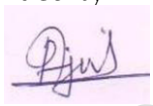
Dept. of Computer Science

Unit5(20 Hours)	Computability and Decidability - halting problem - reductions - post correspondence problem. Computational complexity - Time and space bounded simulations - Classes P and NP - NP completeness - Cook's theorem.	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand Computability and decidability	• Assignments • Exams

Course Outcomes:

CO:1	CO1:Concepts of Automata Theory
CO:2	CO2: Describe Finite Automata
CO:3	CO3: Discuss Regular Expressions.
CO:4	CO4: Describe Context free languages
CO:5	CO5: Discuss Push down Automata
CO:6	CO6: Describe Turing Machine
CO:7	CO7: Discuss Computability and decidability
CO:8	CO8: Describes NP completeness.

Faculty in Charge:



Julie P.A

Dept. of Computer Science

Programme: CSS1C04 – THE ART OF PROGRAMMING METHODOLOGY

Number of Lecture hours per week: 2Hrs
Number of practical hours: 4Hrs
Number of credits for theory:4
Number of credits for practical:1

Aim of the course

- To learn the art of designing algorithms and flowcharts.
- To introduce the concept of algorithmic approach for solving real-life problems.
- To develop competencies for the design and coding of computer programs.
- To learn designing programs with advanced features of C.

Course Outline

Unit I: Part A: Problem Solving - Flow Chart for Structured Programming – Program Charts System Charts - Variables, data names, programming statements - Flow Chart Symbols - Terminal Symbols - I/O - Comments - Connectors - Process - Decision – Loops - Flow Charts of Fundamental Algorithms (mentioned in Part B). **Part B:** Algorithm Design - Problem Solving Aspect - Top down Design - Formal Conventions Writing Algorithms - Fundamental Algorithms (Discuss the Design of Algorithms only). **Part C:** Program, Characteristics of a good program - Modular Approach - Programming style - Documentation and Program Maintenance - Compilers and Interpreters - Running and Debugging Programs - Syntax Errors - Run-Time Errors - Logical Errors - Concept of Structured Programming.

Unit II: Introduction to C Programming - overview and importance of C - C Program Structure and Simple programs - Creation and Compilation of C Programs under Linux and Windows Platforms. Elements of C Language and Program constructs - structure of C program - character set, tokens, keywords, identifier - Data types, constants, symbolic constants, variables, declaration, data input and output, assignment statements. Operators in C - arithmetic operators, relational operators, logical operators, assignment operators,increment and decrement operators, conditional operators, special operators, precedence of operators - arithmetic expressions - evaluation of expressions, type conversion in expressions - precedence and associativity - mathematical functions - I/O operations.

Unit III: Decision making - if statement, if else statement, nesting of if else and else if ladder, switch statement, break statement, continue statement, goto statement, return statement. looping - while, do-while, and for loops, nesting of loops, skipping & breaking loops. Arrays - single dimension arrays - accessing array elements - initializing an array, two dimensional & multi-dimensional arrays - memory representation - strings - processing of strings - string manipulation functions.

Unit IV: The Concept of modularization - defining function - types of functions – User defined functions - function prototype and definition - arguments - passing parameters – call by reference - call by value - returning - nesting of functions and recursion - passing arrays & strings to function - returning multiple values - recursion - scope and life time of variables storage class specifiers - automatic, extern, static storage, register storage. Structures & Union definition, giving values to members, structure initialization, comparison of structure variables, arrays of structures, arrays within structures, structures within arrays, structures and functions, Unions, bit-fields.

Unit V: Pointer - pointer operator - pointer expression - declaration of pointer – initializing pointer - de-referencing - pointer to pointer, constant pointer, array of pointers, pointer to

Dept. of Computer Science

function. Files - file handling - defining & opening a file - closing a file - Input/output operations on files - error handling, random access to files, command line arguments - dynamic memory allocation - linked lists (concepts only) - preprocessor directives: macro substitution directives - simple macros - macros with arguments - nesting of macros, compiler control directives.

References:

1. Martin M. Lipschutz and Seymour Lipschutz, *Schaum's Outline of Theory and Problems of Data Processing*, ISBN: 9780070379831 (Unit I Part A).
2. Anil Bikas Chaudhuri, *The Art Of Programming Through Flowcharts & Algorithms*, Laxmi Publications, New Delhi (Unit I Part A).
3. Jean Paul Trembley and Pual G Sorenson, *An Introduction to Data Structures with Applications*, Tata McGraw Hill (Unit I Part B).
4. R G Dromey, *How to Solve by Computer*, Pearson Education, 5th Edition, ISBN: 0134340019 (Unit I Part B).
5. J.B Dixit, *Computer Fundamentals and Programming in C*, Firewall Media, ISBN: 8170088828. (Unit I Part C).
6. Dennie Van Tassel, Program Style, *Design, Efficiency, Debugging, and Testing*, PHI, ISBN: 0137299478 (Unit I Part C).
7. E Balagruswamy, *Programming in ANSI C*, TMH, 5th Edition, ISBN: 0070681821.
8. Kamthane, *Programming in C*, 2nd Edition, Pearson India, ISBN: 8131760316.
9. Brian W. Kernighan and Dennis M. Ritchie, *C Programming Language*, PHI, ISBN: 0131103628.
10. Kanetkar, *Let Us C*, BPB Publications, 8th Edition, ISBN: 1934015253.

Curriculum Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Unit I	**Part A**: Problem Solving - Flow Chart for Structured Programming – **Part B:** Algorithm Design - Problem Solving Aspect - Top down Design - Formal Conventions Writing Algorithms – **Part C:** Program, Modular Approach - Compilers and	• Lecture using ICT tools • Problem Solving	Peer group discussion on different algorithm	To Understand • Concept Flowchar and algorithms • Modular approach • Errors in programing	• Assignment • Q & A Tests

Dept. of Computer Science

	Interpreters - Syntax Errors - Run-Time Errors - Logical Errors - Concept of Structured Programming.				
Unit II	Introduction to C ProgrammingOperators in C - evaluation of expressions, type conversion in expressions - precedence and associativity - mathematical functions - I/O operations.	• Lecture using ICT Tols • Illustrations • Hands on sessions	• Seminar • Group study	To Understand • Basics of C programming	• Lab tests • Q&A exams
Unit III	Decision making - if statement, if else statement, nesting of if else and else if ladder, switch statement, break statement, continue statement, goto statement, return statement. looping - while, do-while, and for loops, nesting of loops, skipping & breaking loops. Arrays - single dimension arrays - accessing array elements - initializing an array, two dimensional & multi-dimensional arrays - memory representation - strings - processing of strings -	• Lecture using ICT tools • Illustrations • Lab sessions	• Hands on sessions • Illustrations • Hands on sessions	To Understand • Decision making • Looping • Arrays	• Lab tests • Q&A exams

Dept. of Computer Science

Unit IV	The Concept of modularization - defining function - types of functions – arguments - passing parameters – call by reference - call by value - recursion - storage class specifiers - Structures & Union	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand • Modularisation • Argument passing • Storage class	• Lab tests • Q&A exams
Unit V	Pointer - Files - file handling - error handling, command line arguments - dynamic memory allocation - preprocessor directives:	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand • Pointers in C • File handling • Dynamic memory allocation	• Assignments • Lab tests • Q and A tests

Course Outcomes:

CO:1	Improve ability to develop effective algorithms.
CO:2	Understand the fundamental principles of problem-solving using computers.
CO:3	Demonstrate the applications of the programming constructs including decision making, looping, arrays and strings
CO:4	Conceptualize modular programming basics using functions, structures and Unions
CO:5	Understand features like pointers and macros and to become familiar with programming with files
CO:6	Design, develop, implement, test and document well-structured and reliable computer programs

Faculty in Charge:



Sindhu T

Dept. of Computer Science

Programme: CSS1C05 – COMPUTER ORGANIZATION & ARCHITECTURE

Number of Lecture hours per week: 4Hrs

Number of credits for theory:4

Objectives: To familiarize with the digital fundamentals, computer organization, computer architecture and assembly language programming.

Course Outline

Unit I: Number systems and Conversions, Boolean Algebra - Truth Tables - Logic gates and Map simplification - flip-flops - design of combinational and sequential circuits - examples of digital circuits - adders, multiplexers, decoders, counters, shift registers – register transfer language and micro operations - data representation - data types, sign and magnitude, complements, fixed-point representation, floating-point representation, other binary codes, error detection codes.

Unit II: Basic computer organization - machine instructions - classification, function, addresses, size, addressing modes - instruction cycle - instruction sequencing. Fundamental concepts - registers, register transfers, performing arithmetic or logic operations, memory read and write, execution of a complete instruction, branch instruction, single bus, two bus, three bus organization, a complete processor - Control unit - hardwired control, micro programmed control, micro instructions-types.

Unit III: Arithmetic & Logic Unit - addition of positive numbers - fast adders – signed addition and subtraction - addition/subtraction logic unit - multiplication of positive numbers - array multiplier, sequential multiplier - signed number multiplication - multiplication using Booth's algorithm - fast multiplication - bit pair recording of multiplication, division-restoring and non-restoring algorithms, floating point numbers and operations.

Unit IV: Main Memory - memory hierarchy - main memory - RAM, ROM - memory cells - cell organization - working - performance considerations - cache memory - virtual memory - memory management requirements - secondary storage - memory interleaving. Input / Output Organization - Accessing I/O ,d&Vices - programmed I/O, interrupt I/O - interrupts - interrupt processing - hardware interrupts - programmable interrupt controller - vectored interrupts - interrupt nesting - daisy chaining - direct memory access (DMA) - DMA operations & DMA Controller, Introduction to I/O interfaces, I/O channels, IO Processors.

Unit V: Architecture - General 8-bit microprocessor and its architecture - 8085 - Functional block diagram - architecture functions of different sections - architecture of 8086 CPU. Instruction Sets - Instruction format - addressing modes - instruction set of 8085 CPU - Instruction cycle - timing diagrams - different machine cycles - fetch and execute operations - estimation of execution time - estimation of execution time. Intel 8051 Micro controller - Architecture - basic instructions - basic assembly language programs peripherals: interrupts, timers, parallel port, serial port.

Dept. of Computer Science

References:

1. V Carl Hamacher, Zvonko Vranesic and Safwat Zaky, *Computer Organization*, Mc-Graw Hill International Edition, 5th Edition, ISBN: 9780071122184.
2. Morris Mano, *Digital Logic and Computer Design*, Prentice Hall of India, ISBN: 0876924178.
3. M Morris Mano, *Computer System Architecture*, Prentice Hall, 3rd Edition. ISBN: 0131755633.
4. William Stallings, *Computer Organization and Architecture*, 9th Edition, Prentice Hall, ISBN: 013293633X.
5. Andrew S Tanenbaum, *Structured Computer Organization*, Prentice Hall, 6th Edition,ISBN: 0132916525.
6. Floyd Thomas L, *Digital Fundamentals*, Pearson Education, 10th Edition, Prentice Hall, ISBN: 0132359235.
7. Albert Paul Malvino, Donald P Leach, *Digital Principles and Applications*, McGraw Hill, 4th Edition, ISBN: 0070398836.
8. Thomas C Bartee, *Digital Computer Fundamentals*, McGraw Hill, 6th Edition, ASIN:B004H0SL5K.
9. Ramesh. S. Gaonkar, *Microprocessor Architecture*, Programming, and Applications with the 8085, 6th Edition, Wiley Eastern Ltd, New Delhi, ISBN: 9788187972884.
10. Mohamed Rafiquzzaman, *Introduction to Microprocessors and Microcomputer Based System Design*, 2nd Edition, CRC Press, ISBN: 9780849344756.
11. Muhammad Ali Mazidi, Janice Mazidi, Rolin Mckinlay, Janice M. Mazidi, Janice Gillispie Mazidi and Rolin D., *The 8051 Microcontroller and Embedded Systems*, Pearson Education Asia, 5th Indian Reprint, ISBN: 013119402X.

Curriculum Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Unit I	Number systems Boolean Algebra flip-flops - design of combinational and sequential circuits - adders, multiplexers, decoders, counters, shift registers – register transfer language and micro operations -	• Lecture using ICT tools • Problem Solvin • Demonstrations	• Peer group discussion on NS • Seminar	To Understand • Number systems • Boolean Algibra • Circuits,Registers	• Assignment • MCQ evaluation

Dept. of Computer Science

	data representation- binary codes, error detection codes.				
Unit II	Basic computer organization - machine instructions - classification, function, addresses, size, addressing modes - instruction cycle - instruction sequencing. Fundamental concepts - registers, performing arithmetic or logic operations, memory read and write, execution of a complete instruction, branch instruction, bus organization, a complete processor - Control unit -, micro instructions-types.	• Lecture using ICT Tols • Illustrations • Problem solving	• Seminar • Group study	To Understand • Working of machine instructions • Arithemetic and logic operations	• Q&A exams • Assignments
Unit III	Arithmetic & Logic Unit - addition of positive numbers - - array multiplier, sequential multiplier - signed number multiplication -	• Lecture using ICT tools • Illustrations • Problem solving	• Illustrations • Drawing sessions	To Understand • ALU-addition multiplication ,division	• Assignments • Q&A exams

Dept. of Computer Science

	division-				
Unit IV	Main Memory - memory hierarchy - main memory - RAM, ROM - memory cells - cell organization - working - performance considerations - cache memory - virtual memory- memory interleaving. Input / Output Organization - Accessing I/O devices - interrupts - interrupt processing Introduction to I/O interfaces, I/O channels, IO Processors.	• Lecture using ICT tools • Illustrations •	• Illustrations • Drawing sessions	To understand • Memory hierarchy • Cache and virtual memory • How i/o devices accessed	• Assignments • Q&A exams
Unit V	Architecture - General 8-bit microprocessor and its architecture - 8085 - Intel 8051 Micro controller - interrupts, timers, parallel port, serial port	• Lecture using ICT tools • Illustrations •	• Seminar • Group study	To understand • Microprocessor-8085-8086 • Microcontroller-8051	• Assignments

Dept. of Computer Science

Course Outcomes:

CO:1	Identify, understand and apply different number systems and codes.
CO:2	Understand the digital representation of data in a computer system.
CO:3	Understand the general concepts in digital logic design and their use in sequential and combinational circuit design.
CO:4	Describe fundamental organization of a computer system

CO:5	Explain addressing modes, instruction formats and program control statements.
CO:6	Understand computer arithmetic formulae and solve problems
CO:7	Distinguish the organization of various parts of a system memory hierarchy.
CO:8	Identify and compare different methods for computer I/O

Faculty in Charge:



Sindhu T

Dept. of Computer Science

Course: **MSc Computer Science (Second Semester)**

Programme: **CSS2C06 – DESIGN AND ANALYSIS OF ALGORITHMS**

No. of lecture hours per week	4 Hrs
No.of credits for Theory	4

Aim of the course

- To introduce the concept of algorithmic approach for solving real-life problems.
- To teach basic principles and techniques of computational complexity.
- To familiarize with parallel algorithms and related techniques.

Course Outline

Unit I: Algorithm Design: Introduction, Steps in developing algorithm, Methods of specifying an algorithm, Decisions prior to designing: based on the capabilities of the device, based on the nature of solutions, based on the most suitable data structures. Model of Computation: RAM model and PRAM model. Important Problem Types (Introductory concepts): Sorting, Searching, String processing, Graph problems, Combinatorial problems, Geometric problems and Numerical problems.

Unit II: Basic Technique for Design of Efficient Algorithm: Brute Force approach (String matching), Divide-and-Conquer approach (Merge sort), Branch-and-Bound technique (Knapsack problem). Greedy approach (Kruskal's algorithm and Prim's Algorithm), Dynamic Programming (Longest Common Subsequence), Backtracking (Sum of subsets problem).

Unit III: Algorithm Analysis: Importance of algorithm analysis, Time and Space Complexity. Growth of Functions: Asymptotic notations, Cost estimation based on key operations- Big Oh, Big Omega, Little Oh, Little Omega and Theta notations, Big Oh Ratio Theorem, Big Theta Ratio Theorem, Big Omega Ratio Theorem. Analyzing Algorithm Control Structures, Solving Recurrences: Iteration Method, Substitution Method, The Recursion Tree Method, Master's Theorem, Problem solving using Master's Theorem Case 1, Case 2 and Case 3. Analysis of Strasser's algorithm for matrix multiplication, Analysis of Merge sort.

Unit IV: Complexity - Complexity Classes: P, NP, NP Hard and NP Complete problems. NP Completeness reductions for Travelling Salesman Problem and Hamiltonian Cycle. P versus NP problem.

Unit V: Analysing Parallel Algorithms: Time Complexity, Cost, Number of Processors, Space Complexity, Speed up, Efficiency, Scalability, Amdahl's Law. Parallel merging and sorting, Euler tour technique, Parallel prefix computation, Determinist c symmetry breaking.

References:

1. Thomas H Cormen, Charles E Leiserson, and Ronald L Rivest, Introduction to Algorithms, 3rd Edition, Prentice Hall of India Private Limited, New Delhi, ISBN: 9780262033848 (Unit I, II, III and IV).
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, 1st Edition. Addison Wesley, ISBN: 0534915728 (Unit I, II, III and IV).
3. Pallaw, V K, Design and Analysis of Algorithms, Asian Books Private Ltd, 2012, ISBN: 8184121687 (Unit I, II, III and IV).
4. Sanjay Razdan, Fundamentals of Parallel Computing, Narosa Publishing House, 2014, ISBN: 9788184873481 (Unit V).
5. Pandey H M, Design and Analysis of Algorithms, University Science Press, 2013, ISBN: 9788131803349 (Unit I, II, III and IV).
6. Upadhyay N, Design and Analysis of Algorithms, SK Kataria & Sons, 2008 (Unit I, II, III and IV).
7. U. Manber, Introduction to Algorithms: A Creative Approach, Addison Wesley, ISBN: 9780201003277 (Unit I, II, III and IV).
8. Gilles Brassard and Paul Bratley, Fundamentals of Algorithmics, Prentice-Hall of India, ISBN: 0133350681 (Unit I, II, III and IV).
9. Goodman S E and Hedetniemi, Introduction to the Design and Analysis of Algorithms, Mcgraw Hill, ISBN: 0070237530 (Unit I, II, III and IV).
10. Horowitz E and Sahni S, Fundamentals of Computer Algorithms, Galgotia Publications Pvt. Ltd, ISBN: 8175152575 (Unit I, II, III and IV).
11. Oded Goldreich, P, NP and NP - Completeness, Cambridge University Press, 2011. ISBN: 0521122546 (Unit V).
12. Donald Knuth, The Art of Computer Programming, Fundamental Algorithms, Volume 1, Addison Wesley, 1997, ISBN: 8177587544 (Unit I).
13. Sanjeev Arora and Boaz Borak, Computational Complexity - A Modern Approach, Cambridge University Press; 2009, ISBN: 0521424267 (Unit III).
14. Daniel Hills W and Bruce M Boghosian, Parallel Scientific Computation, Science, 13 August 1993, Vol. 261 (5123), pp.856-863 (Unit V).

Curriculum Plan

Unit/Hours (time required)	Topics to be Taught (Input)	Procedure (process) student centric	Activity	Learning outcome (outcome)	Assessment

Dept. of Computer Science

		method of teaching			
Unit1(18 Hour)	Algorithm Design: Introduction, Steps in developing algorithm, Methods of specifying an algorithm, Decisions prior to designing: based on the capabilities of the device, based on the nature of solutions, based on the most suitable data structures. Model of Computation: RAM model and PRAM model. Important Problem Types (Introductory concepts): Sorting, Searching, String processing, Graph problems, Combinatorial problems, Geometric problems and Numerical problems. .	• Lecture using ICT tools	Peer group discussion on different types of sets	To Understand • Concept of Algorithm designs	• Assignment • MCQ evaluation
Unit 2 (20 Hours)	Basic Technique for Design of Efficient	• Lecture using ICT Tools • Illustrations	• Seminar • Grou	To Understand • Basic	• Q&A exams.

Dept. of Computer Science

	Algorithm: Brute Force approach (String matching), Divide-and-Conquer approach (Merge sort), Branch-and-Bound technique (Knapsack problem). Greedy approach (Kruskal's algorithm and Prim's Algorithm), Dynamic Programming (Longest Common Subsequence), Backtracking (Sum of subsets problem).	• Hands on sessions	p stud	techniq ue for design of efficien t algorith m .	
Unit3 (18 Hours)	Algorithm Analysis: Importance of algorithm analysis, Time and Space Complexity. Growth of Functions: Asymptotic notations, Cost estimation based on key operations- Big Oh, Big Omega, Little Oh, Little Omega and Theta notations, Big Oh Ratio Theorem, Big	• Lecture using ICT tools • Illustrations	• Hand s on sessio ns • Illustr ations	To Understand Time and Space complexity	• Q&A exams

Dept. of Computer Science

	Theta Ratio Theorem, Big Omega Ratio Theorem. Analyzing Algorithm Control Structures, Solving Recurrences: Iteration Method, Substitution Method, The Recursion Tree Method, Master's Theorem, Problem solving using Master's Theorem Case 1, Case 2 and Case 3. Analysis of Strasser's algorithm for matrix multiplication, Analysis of Merge sort.				
Unit4 (14 Hours)	Complexity - Complexity Classes: P, NP, NP Hard and NP Complete problems. NP Completeness reductions for Travelling Salesman Problem and Hamiltonian Cycle. P versus NP problem.	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand P,NP ,NP Hard	• Q&A exams

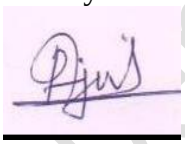
Dept. of Computer Science

Unit5(20 Hours)	Analysing Parallel Algorithms: Time Complexity, Cost, Number of Processors, Space Complexity, Speed up, Efficiency, Scalability, Amdahl's Law. Parallel merging and sorting, Euler tour technique, Parallel prefix computation, Deterministi c symmetry breaking.	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand Parallel prefix computation	• Assignments • Exams

Course Outcomes:

CO:1	CO1:Concepts of Algorithm Design
CO:2	CO2: Describe Basic Technique for Design of Efficient Algorithm
CO:3	CO3: Discuss Algorithm Analysis
CO:4	CO4: Describe Recursion Tree method and Masters method
CO:5	CO5: Learn Strassen's matrix multiplication
CO:6	CO6: Describe Complexity
CO:7	CO7: Knowledge about Parallel Algorithms
CO:8	CO8: Understand Parallel prefix computation.

Faculty in Charge:



Julie P.A

Dept. of Computer Science

Programme:CSS2C07 – OPERATING SYSTEM CONCEPTS COURSE

Number of Lecture hours per week: 3Hrs	Number of practical hours: 3Hrs
Number of credits for theory:4	Number of credits for practical:1

Aim of the Course

- Introduce the underlying principles of an operating system.
- Exposure of multi programming, virtual memory and resource management concepts.
- Case study of public and commercially available operating systems

Course Outline

Unit I: Operating System Overview - Objectives and functions - Evolution of Operating System- Major Achievements - Process Description and Control - Process, Creation & Termination of Processes, Five State Model, Suspended Process, Process Description,Process Control - Modes of Execution, Process Creation, Process and Mode Switching. Threads - Processes Vs Threads, Multithreading, Thread States, Types of Threads, MultiCore and Multithreading. Case Study - Unix SVR4 Process Management, Linux Process and Thread Management.

Unit II: Concurrency - Principles, Race Condition, Operating System Concerns, Process Interaction, Completion for Resources, Cooperation by Sharing. Mutual Exclusion - Requirements, Hardware Support, Semaphores, Producer Consumer Problem, Monitors,Message Passing, Readers/Writers Problem. Deadlock - Principles, Prevention, Avoidance, Detection, Recovery, Dining Philosophers Problem. Case Study: Unix Concurrency Mechanisms.

Unit III: Memory Management, Address binding, Logical Vs Physical address space, Dynamic Loading, Dynamic Linking and Shared Libraries, Overlays, Swapping, Contiguous Memory allocation, Paging, Segmentation, Virtual memory, Demand paging, Page replacement, Thrashing. Case Study: Windows Memory Management.

Unit IV: Uniprocessor Scheduling - types, scheduling algorithms - criteria, nonpreemptive,preemptive. Comparative study of scheduling algorithms - FCFS, SJF, Priority, RR, Multilevel, Feedback Queue. Multiprocessor Scheduling - Classification, Granularity,Design Issues, Process Scheduling, Thread Scheduling. Real Time Scheduling - Background, Characteristics of Real Time OS, Scheduling, Deadline Scheduling, Rate Monotonic Scheduling, Priority Inversion. Case study: Linux Scheduling .

Unit V: Client/Server Computing - Definition, Applications, Classes, Three-Tier Client/Server Architecture, Middleware. Service-Oriented Architecture- Distributed Message Passing - Remote Procedure Calls - Clusters. Mobile Operating Systems - Characteristics - Comparative Study of the Features of iOS and Android.

Reference

1. William Stallings, *Operating System- Internals and Design Principles*, 7th Edition, Pearson, ISBN: 9780273751502.

Dept. of Computer Science

2. Abraham Silberschatz, Peter B. Galvin and, Greg Gagne, *Operating System Concepts*, 9th Edition, John Wiley & SonsTISBN: 9781118063330.
3. Ann Mclver McHoes and Ida M. Flynn, *Understanding Operating Systems*, 6th Edition, Cengage Learning, 2010, ISBN: 9781439079201.
4. Mukesh Singhal and Niranjan G. Shivaratri, *Advanced Concepts in Operating Systems - Distributed, Database, and Multiprocessor Operating Systems*, Tata McGraw-Hill Education Private Limited, ISBN: 9780070575721.
5. Current Literature (for Mobile Operating Systems).

Curriculum Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Unit I(18 Hrs)	OS Overview - Evolution of OS Process, Five State Model, Case Study - Unix SVR4 Process Management, Linux Process and Thread Management.	• Lecture using ICT tools • Problem Solving	• Peer group discussion • Seminar	To Understand • Process and thread • Process models • Process management	• Assignment • MCQ evaluation
Unit II (18 Hrs)	Concurrency - Mutual Exclusion - Semaphores, Producer Consumer Problem, Readers/Writers Problem. Deadlock - Dining Philosophers Problem. .	• Lecture using ICT Tols • Illustrations • Lab sessions	• Seminar • Group study • Hands on sessions	To Understand • Concurrency • ME and semaphores • IPC problems and dead lock	• Lab tests • Q&A exams
Unit III	Memory Management, Address binding,	• Lecture using	• Hands on	To Understand	• Lab tests • Q&A exams

Dept. of Computer Science

	Logical Vs Physical address space, Dynamic Loading, Contiguous Memory allocation, Paging, Segmentation, Virtual memory, Demand paging, Page replacement, Thrashing.	ICT tools • Illustrations • Lab sessions	sessions • Illustrations	• Memory management • Memory allocation	
Unit IV(18 Hrs)	Uniprocessor Scheduling - Multiprocessor Scheduling - Granularity, Thread Scheduling. Real Time OS, Scheduling, Deadline Scheduling, Rate Monotonic Scheduling,	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand • Scheduling • Thread scheduling	• Lab tests • Q&A exams
Unit V(18 Hrs)	Client/Server Computing - Definition, Applications, Classes, Three-Tier Client/Server Architecture, Middleware. Service-Oriented Architecture-Distributed Message Passing - Remote Procedure Calls - Clusters. Mobile Operating Systems -	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand • Cs computing • Middle ware • Android and iOS	• Assignments

Dept. of Computer Science

	Characteristics - Comparative Study of the Features of iOS and Android.				

Course Outcomes:

CO:1	Explain the basics of database management system, concepts of relational data model, entity- relationship model, relational database design, relational algebra and calculus
CO:2	Apply the normalization techniques to improve the database design
CO:3	Describe various database manipulation commands in SQL.
CO:4	Understand Transaction Processing & Locking using the concept of Concurrency control.
CO:5	Conceptualize advanced features of Object-Oriented Database Management Systems and Distributed databases

Faculty in Charge:



Sindhu T

Programme: **CSS2C08 – COMPUTER NETWORKS**

No. of lecture hours per week	4 Hrs
No.of credits for Theory	4

Aim of the course

- To provide the student with a top down approach of networking starting from the application layer.
- To introduce computer networking in the back drop of Internet protocol stack.

Course Outline

Unit I:Introduction to Computer networks - introduction - topology - categories of networks Internetwork - Internet - network modes- layered model - OSI and TCP/IP Models Transmission media - Wired and unwired media. Computer networks and Internet – the network edge - the network core - network access - delay and loss - protocol layers and services - history of computer networking and Internet.

Dept. of Computer Science

Unit II: Application layer protocols – principles – the web and HTTP – FTP – Email in Internet – DNS. Socket programming – building a Web server - content distribution.

Unit III: Transport layer services – introduction – relationship between Transport and Network layer – UDP – reliable data transfer – TCP - congestion control - Network layer services – routing – IP - routing in Internet - router - IPV6 - multicast routing – mobility.
.
Unit IV: Link layer services - error detection and correction - multiple access protocols – LAN address – ARP – Ethernet – hubs – bridges – switches - wireless links – PPP - ATM.
.
Unit V: Security in Networks – Principles of Cryptography – Authentication – Integrity –Key Distribution and Certification – Firewalls – Attacks and Counter Measures.

References:

1. J. F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach Featuring Internet, 6th Edition, Perason Education, ISBN: 0132856204.
2. Behrouz Forouzan, Data Communications and Networking, 4th Edition, McGraw-Hill Reprint, ISBN: 0073250325.
3. Peterson L.L. and Davie B .S., Computer Networks, A Systems Approach, 5th Edition, Morgan Kaufmann, ISBN: 9780123850591.
4. Keshav, An Engineering Approach to Computer Networking, Pearson Education Asia, ISBN: 97898123598652000.
5. Andrew S. Tanenbaum, Computer Networks, 5th Edition, PHI, ISBN: 9788131787571.
6. Herbert Scheldt, Java Complete Reference, 7th Edition, McGraw-Hill Osborne Media, ISBN: 9780072263855.

6. Martin J.C, Introduction to Languages and Theory of Computation, Tata McGraw Hill, 3rd Edition, ISBN: 9780070660489.

Curriculum Plan

Unit/Hours (time required)	**Topics to be Taught (Input)**	**Procedure (process) student centric method of teaching**	**Activity**	**Learning outcome (outcome)**	**Assessment**

Dept. of Computer Science

Unit1(18 Hour)	Introduction to Computer networks - introduction - topology - categories of networks Internetwork - Internet - network modes- layered model - OSI and TCP/IP Models Transmission media - Wired and unwired media. Computer networks and Internet - the network edge - the network core - network access - delay and loss - protocol layers and services - history of computer networking and Internet.	• Lecture using ICT tools	Peer group discussion on different types of sets	To Understand • Concept of OSI and TCP/IPs	• Assignment • MCQ evaluation
Unit 2 (20 Hours)	Application layer protocols – principles – the web and HTTP – FTP – Email in Internet – DNS. Socket programming – building a Web server - content distribution.	• Lecture using ICT Tools • Illustrations • Hands on sessions	• Seminar • Group stud	To Understand • Application layer protocols .	• Q&A exams.

Dept. of Computer Science

Unit3 (18 Hours)	Transport layer services – introduction – relationship between Transport and Network layer – UDP – reliable data transfer – TCP - congestion control - Network layer services – routing – IP - routing in Internet - router - IPV6 - multicast routing – mobility.	• Lecture using ICT tools • Illustrations	• Hands on sessions • Illustrations	To Understand Transport layer protocols	• Q&A exams
Unit4 (14 Hours)	Link layer services - error detection and correction - multiple access protocols – LAN address – ARP – Ethernet – hubs – bridges – switches - wireless links – PPP - ATM.	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand Link Layer services	• Q&A exams

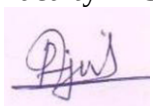
Dept of Computer Science

Unit5(20 Hours)	Security in Networks – Principles of Cryptography – Authentication – Integrity – Key Distribution and Certification – Firewalls – Attacks and Counter Measures.	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand Principles of security	• Assignments • Exams

Course Outcomes:

CO:1	CO1:Concepts of Computer networks
CO:2	CO2: Learn about Network Topologies
CO:3	CO3: Discuss Application layer protocols
CO:4	CO4: Describe Transport layer Protocols
CO:5	CO5: Understand Link layer services
CO:6	CO6: Describe Ethernet ,Hub,switches
CO:7	CO7: Discuss Security in Networks
CO:8	CO8: Understand Principles of Cryptography

Faculty in Charge:




Julie P.A , Sindhu T

Dept. of Computer Science

Programme: CSS2C09 – COMPUTATIONAL INTELLIGENCE

Number of Lecture hours per week: 4Hrs
Number of credits for theory:4

Aim of the course

- To introduce concepts of Artificial Intelligence and Machine Learning.

Course Outline

Unit I: Introduction - Artificial Intelligence - problems, scope and applications, problem space and search - production system- characteristics - the predicate calculus, inference rules,structures and strategies for state space search, strategies for space search, using state space to represent reasoning with the predicate calculus.

Unit II: Heuristics Search: control and implementation of state space search, generate and test, hill climbing, Best-first search, problem reduction, constraint satisfaction, means- ends analysis, heuristic in games, complexity issues.

Unit III: Knowledge representation issues, representation and mappings, representing simple facts in logic, representing instances and ISA relationships, computable functions and predicates, resolution, natural deduction, knowledge representation using rules, logic programming, forward versus backward reasoning, symbolic reasoning under uncertaintynon- monotonic reasoning, depth first search, breadth first search.

Unit IV: Game playing - the mini-max search procedure, adding alpha-beta cut-offs,additional refinement, iterative deepening, planning system and its components,understanding, understanding as constrained satisfaction. Slot and filler structures: semantic nets, frames, conceptual dependency, scripts. Definition and characteristics of expert system, representing and using domain knowledge, expert system shells. Knowledge engineering, knowledge acquisition, expert system life cycle & expert system tools, MYCIN & DENDRAL examples of expert system.

Unit V: Machine learning - rote learning, learning by taking advice, learning in problem solving, learning from examples, explanation based learning, analogy, formal learning theory,connectionist models - hopfield networks, learning in neural networks, back propagation, the genetic algorithm, classifier systems and genetic programming, artificial life and society based learning.

References:

1. Elaine Rich, Kevin Knight and Shivshankar B. Nair, *Artificial Intelligence*, 3rd Edition, Tata - McGraw Hill, New Delhi, ISBN: 0070087709.
2. V S Janakiraman, K Sarukesi and P Gopalakrishnan, *Foundations of Artificial Intelligence and Expert System*, Macmillan India Limited, ISBN: 0333926250.
3. Stuart Russell and Peter Norvg, *Artificial Intelligence: A Modern Approach*, 3rd Edition, Prentice Hall, ISBN: 0136042597.'
4. G. F. Luger and W.A Stubblefield, *Artificial Intelligence - Structures and Strategies for Complex Problem Solving*, Addison-Wesley, 6th Edition, ISBN: 9780321545893.
5. P. H. Winston, *Artificial Intelligence*, Addison-Wesley, 3rd Edition, ISBN: 0201533774.
6. Nils J. Nilsson, Artificial Intelligence, A New Synthesis, 1st Edition, Morgan Kaufmann Publishers, Inc, ISBN: 1558604677.

Dept. of Computer Science

Curriculum Plan

Unit/hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Unit I(18 Hrs)	Introduction - Artificial Intelligence - problems, scope and applications, problem space and search - production system- the predicate calculus,	• Lecture using ICT tools • Problem Solving	• Peer group discussion • Problem solving	To Understand • Concept AI • Production system	• Assignment • MCQ evaluation
Unit II(24 Hrs)	Heuristics Search: state space search, generate and test, hill climbing, Best-first search, problem reduction, constraint satisfaction, means- ends analysis, heuristic in games,	• Lecture using ICT Tols • Illustrations	• Seminar • Group study	To Understand • Various heruristic searches • Heuristic in games	• Lab tests • Q&A exams
Unit III(20 Hrs)	Knowledge representation representing instances and ISA relationships, resolution, natural deduction, knowledge representation using rules, logic programming, forward versus backward reasoning, symbolic reasoning under	• Lecture using ICT tools • Illustrations •	• Illustrations • Problem solving	To Understand • Knowledge representation • Logic programming	• Lab tests • Q&A exams

Dept of Computer Science

	uncertainty				
Unit IV(18Hrs)	Game playing - the mini-max search procedure, adding alpha-beta cut-offs, planning system understanding, Slot and filler structures: semantic nets, frames, conceptual dependency, scripts. Definition and characteristics of expert system,	• Lecture using ICT tools • Illustrations •	• Illustrations • Seminar	To understand • Game playing • Knowledge representation	• Lab tests • Q&A exams
Unit V(10 Hrs)	Machine learning - learning, connectionist models -, learning in neural networks, back propagation, the genetic algorithm, classifier systems and genetic programming, artificial life and society based learning	• Lecture using ICT tools • Illustrations	• Seminar • Group study • Seminar	To understand • Machine learning • Genetic Algorithm	• Assignments • Q & A tests

Course Outcomes:

CO:1	Apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems
CO:2	Conceptualize various knowledge representation techniques.
CO:3	Analyze the problem-solving methods and algorithms related to searching, reasoning, game playing and machine learning
CO:4	Understand the functioning of expert systems and its importance .
CO:5	Demonstrate the implementation various AI algorithms to solve real life problems

Faculty in Charge:



Sindhu T

Dept. of Computer Science

Programme: **CSS2C10 – PRINCIPLES OF SOFTWARE ENGINEERING**

No. of lecture hours per week	4 Hrs
No.of credits for Theory	4

Aim of the course

To develop familiarity with software engineering principles and practices.
To have an understanding about the process of product/literature survey, techniques of problem definition, and methods of report writing.

Course Outline

Unit I:Introduction – problem domain - software engineering challenges – approaches –software process and development models – agile models – SDLC - software process.

Unit II: Software requirements analysis & specification - feasibility study - types of feasibility – software requirements - problem analysis – requirement specification –functional specification – metrics. Software design – outcome – cohesion and coupling –layered arrangement of modules – approaches to software design - structured analysis – DFD – extending DFD technique for applying to real-time systems – structured design – detailed design - object oriented modelling – use case model – class diagram – interaction diagram -activity diagram - data diagram – state chart diagram - ER diagram.

Unit III: User Interface (UI) design – characteristics – basic concepts – types –fundamentals of component-based GUI Development – UI design methodology – process planning – cost estimation – project scheduling – configuration management – risk management - software coding – review – documentation – software testing - software testing basics - steps involved in test plan - software testing strategies.

Unit IV: Managing project – time management – setting aims and objectives – techniques for generating ideas – literature survey – types of information sources – writing literature survey.

Unit V: Project story preparation – key deliverables – communicating with experts – forms of communication – presenting ideas – common problems faced by a research scholar – report writing.

References:

1. Pankaj Jalote, An Integrated Approach to Software Engineering, 3rd Edition, Narosa Publishing House, ISBN: 9788173197024.
2. Rajib Mall, Fundamentals of Software Engineering, 3rd Edition, PHI Learning Pvt Ltd, ISBN: 9788120338197.
3. Rohit Khurana, Software Engineering: Principles and Practices, 2nd Edition, Vikas Publishing House Pvt Ltd, ISBN: 8125939466.

Dept. of Computer Science

4. Andy Hunt, Your Research Hunt, How to Manage it, Routledge, ISBN: 0415344085.
5. Michael Jay Polonsky, David S. Waller, Designing and Managing a Research Project: A Business Student's Guide, Sage, ISBN: 1412977754.
6. Richard Bullock, Maureen Daly Goggin and Francine Weinberg, The Norton Field Guide to Writing (with Readings and Handbook), 3rd Edition, W. W. Norton & Company, ISBN: 0393919595.
7. Kavadia Garg, Agrawal and Agrawal, An introduction to Research Methodology, Rbsa Publishers ISBN: 8176111651.

Curriculum Plan

Unit/Hours (time required)	**Topics to be Taught (Input)**	**Procedure (process) student centric method of teaching**	**Activity**	**Learning outcome (outcome)**	**Assessment**
Unit1(18 Hour)	Introduction – problem domain - software engineering challenges – approaches – software process and development models – agile models – SDLC - software process.	• Lecture using ICT tools	Peer group discussion on different types of sets	To Understand • Concept of SDLC	• Assignment • MCQ evaluation
Unit 2 (20 Hours)	Software requirements analysis & specification - feasibility study - types of feasibility – software requirements - problem analysis – requirement specification – functional specification – metrics. Software design – outcome – cohesion and	• Lecture using ICT Tools • Illustrations • Hands on sessions	• Seminar • Group stud	To Understand • SRS • DFD • ER Diagram • Activity Diagram.	• Q&A exams.

Dept. of Computer Science

	coupling – layered arrangement of modules – approaches to software design - structured analysis – DFD – extending DFD technique for applying to real-time systems – structured design – detailed design - object oriented modelling – use case model – class diagram – interaction diagram - activity diagram - data diagram – state chart diagram - ER diagram.				
Unit3 (18 Hours)	User Interface (UI) design – characteristics – basic concepts – types – fundamentals of component-based GUI Development – UI design methodology – process planning – cost estimation – project scheduling – configuration management – risk	• Lecture using ICT tools • Illustrations	• Hands on sessions • Illustrations	To Understand User Interface	• Q&A exams

Dept of Computer Science

	management - software coding – review – documentation – software testing - software testing basics - steps involved in test plan - software testing strategies.				
Unit4 (14 Hours)	Managing project – time management – setting aims and objectives – techniques for generating ideas – literature survey – types of information sources – writing literature survey.	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand Project management	• Q&A exams
Unit5(20 Hours)	Project story preparation – key deliverables – communicating with experts – forms of communication – presenting ideas – common problems faced by a research scholar – report writing.	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand Report writing	• Assignments • Exams

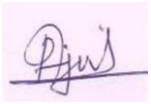
Dept. of Computer Science

Course Outcomes:

CO:1	CO1:Concepts of Software Engineering
CO:2	CO2: Describe Software processes
CO:3	CO3: Knowledge About process models

CO:4	CO4: Describe object oriented modelling
CO:5	CO5: Understand User interface Design
CO:6	CO6: Describe Software testing
CO:7	CO7: Discuss Project management
CO:8	CO8: Describes Report Writing

Faculty in Charge:



Julie P.A

Dept of Computer Science

Course : MSc Computer Science (Third Semester)

Programme: CSS3C11 – ADVANCED DATABASE MANAGEMENT SYSTEM

Number of Lecture hours per week: 3Hrs	Number of practical hours: 3Hrs
Number of credits for theory:4	Number of credits for practical:1

Aim of the Course

Number of Lecture hours per week: 3Hrs

- To understand the relational model, and know how to translate requirements captured in an Entity-Relationship diagram into a relational schema
- To reason about dependencies in a relational schema.
- To understand normal form schemas, and the decomposition process by which normal forms are obtained.
- To familiarize with advanced SQL' statements
- To understand advanced features of database technologies.

Course Outline

Unit I: Introduction - purpose of database systems, views of data - data abstraction, instances and schemas, data independence, data models - hierarchical data model, network data model, relational data model, ER d&tg9,mg9lei. Database languages - DDL, DML, transaction anagement, storage management, database administrator, database users, overall system structure. Relational data model - relational model concepts, keys, integrity constraints - domain constraints, key constraints, entity integrity constraints, referential integrity constraints. ER data model - basic concepts, constraints, keys, design issues, entity relationship diagram, weak entity sets, extended ER features, design of an ER database schema, reduction of an ER schema to tables. Relational algebra and calculus – relational algebra - selection and projection, set

operations, renaming, joins, division. Relational calculus - tuple relational calculus, domain relational calculus. Expressive power of algebra and calculus.

Unit II: Relational database design - anomalies in a database - functional dependency -lossless join and dependency- preserving decomposition - normalization - normal forms -first, second and third normal form - Boyce Codd normal form - multivalued, dependency - fourth normal form - join dependency - project join normal form - domain key normal form.

Unit III: Relational database query languages - basics of QBE and SQL. Data definition in SQL data types, creation, insertion, viewing, updation, deletion of tables, mo difying the structure of the tables, renaming, dropping of tables. Data constraints - I/O constraints, primary key, foreign key, unique key constraints, ALTER TABLE command database manipulation in SQL - computations done on table data - SELECT command, logical operators, range searching, pattern matching, grouping data from tables in SQL, GROUP BY, HAVING clauses. Joins - joining multiple tables, joining a table to it. DELETE - UPDATE. Views - creation, renaming the column of a view, destroys view. Program with SQL - data types Using SET and SELECT commands, procedural flow, IF, IF /ELSE, WHILE, GOTO, global variables. Security - locks, types of locks, levels of locks. Cursors - working with cursors, error handling, developing stored procedures, CREATE, A LTER and
DROP, passing and returning data to stored procedures, using stored procedures within queries, building user defined functions, creating and calling a scalar function, implementing triggers, creating triggers, multiple trigger interaction (Use MySQL as the RDBMS).

Unit IV: Transaction management, concurrency control and query processing- concept,definition and states of transactions, ACID properties - concurrency control, serializability - conflict serializability, view serializability, recoverability-recoverable schedules, noncascading schedules, strict schedules. Concurrency control schemes - locking- two phase locking, deadlock, granularity, timestamp ordering protocol. Basics of query processing.

Unit V: Object Oriented Database Management Systems (OODBMS) - concepts, need for OODBMS, composite objects, issues in OODBMSs, advantages and disadvantages of OODBMS. Distributed databases - motivation - distributed database concepts, types of distribution, architecture of distributed databases, the design of distributed databases, distributed transactions, commit protocols for distributed databases.

Reference

1. Elmasri and Navathe, *Fundamentals of Database Systems*, 5th Edition, Pearson, ISBN: 9788131758984.
2. Abraham Silbersehatz, Henry F. Korth and S.Sudarshan, *Database System Concepts*, 6th Edition, Tata McGraw-Hill, ISBN: 0071325220.
3. CJ Date, *An Introduction to Database Systems*, 8th Edition, Addison Wesley, ISBN: 0321197844.
4. Ramakrishnan and Gehrke, *Database Management Systems*, 3rd Edition, McGraw - Hill Education, ISBN: 9339213114.
5. Alexis Leon and Mathews Leon, *Database Management Systems*, 1st Edition, Vikas Publishers, ISBN: 8182092221.

Dept. of Computer Science

6. Vikram Vaswani, *MySQL The complete Reference*, 1st Edition, Tata Mcgraw Hill Education Private Limited, ISBN: 0070586845.
7. Joel Murach, *Murach's Mysql*, Mike Murach & Associates Inc, ISBN: 9350237695.
8. Paul DuBois, *MySQL Cookbook*, 2nd Edition, O'Reilly Media, ISBN: 184042809.

Curriculum Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Unit I(15 Hrs)	Introduction to DBMS-views of data - data models - Database languages - database users, Relational data model - ER data model - Relational algebra and calculus – relational algebra -	• Lecture using ICT tools • Problem Solving	• Peer group discussion • Seminar	To Understand • DBMS vies • DBMS users • DBMS Languages • DBMS models	• Assignment • MCQ evaluation
Unit II(18 Hrs)	Relational database design - anomalies in a database - functional dependency - lossless join and dependency-preserving decomposition -normalization-	• Lecture using ICT Tols • Illustrations • Lab sessions	• Seminar • Group study • Hands on sessions	To Understand • Anomalies • Dependency preserving • Normalisation	• Lab tests • Q&A exams
Unit III(22 Hrs)	Relational database query languages – SQL query processing	• Lecture using ICT tools • Illustrations • Lab	• Hands on sessions • Illustrations	To Understand • SQL query processing	• Lab tests • Q&A exams

Dept. of Computer Science

		sessions			
Unit IV(20 Hrs)	Transaction management, - ACID properties -, serializability schedules, Concurrency control schemes - locking- deadlock, granularity, timestamp ordering protocol.	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand • Transactin in DBMS • Concurrency and serialisability • Deadlock	• Lab tests • Q&A exams
Unit V(15 Hrs)	Object Oriented Database Management Systems Distributed databases - distributed transactions, commit protocols for distributed databases.	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand • OODBMS • Distributed Databses	• Assignments

Course Outcomes:

CO:1	Explain the basics of database management system, concepts of relational data model, entity- relationship model, relational database design, relational algebra and calculus
CO:2	Apply the normalization techniques to improve the database design
CO:3	Describe various database manipulation commands in SQL.
CO:4	Understand Transaction Processing & Locking using the concept of Concurrency control.
CO:5	Conceptualize advanced features of Object-Oriented Database Management Systems and Distributed databases

Faculty in Charge:



Sindhu T

Dept. of Computer Science

Programme: **CSS3C12 – Object Oriented Programming Concepts**

No. of lecture hours per week	4 Hrs
No.of credits for Theory	4

Aim of the course

To learn object oriented concepts and programming concepts and methodologies and to learn its implementation using Java.

.

Course Outline

Unit I:Introduction to OOPS - basic principles of object orientation (objects , attributes and methods, encapsulation and information hiding, state retention, object identity, messages, class hierarchy, inheritance, polymorphism, genericity) - introduction to Java - history, versioning, the Java Virtual Machine, byte code, features of Java, language components - primitive data types, comments, keywords, literals, variables scope & declarations, control structures - FOR, IF, WHILE, DO WHILE, SWITCH, BREAK, CONTINUE statements - operators - casts and conversions - arrays.

Unit II: Object - oriented programming – classes - class fundamentals - declaring objects -new operator – methods – parameter passing – constructors - parameterized constructors -this keyword – finalize method. Overloading methods and constructors, access controls, static and final, nested and inner classes. Inheritance - extends, member access and inheritance, super keyword, polymorphism, method overriding, dynamic method dispatch, abstract classes, packages and interfaces.

Unit III: Exceptions, threads & IO in Java - The file and standard streams, stream classes and interfaces, using byte streams and character streams, threads - threads vs. processes, creating threads, runnable interface, thread class, inter thread communication, synchronization. Exceptions - basic of Java exception handling, hierarchy, developing user defined exception classes.

Unit IV: Applets, AWT & Swing - applet class, types of applet, skeleton, applet tag, passing parameters, event handling, delegation event model, event classes, listeners, AWT classes and window fundamentals, frames, working with fonts, graphics and colors, AWT controls, layouts and menus, dialogue boxes. Swings - Japplets, icon, labels, buttons, textbox, combo box, tables and panes.

Unit V: Database and sockets - JDBC - introduction, architecture, drivers, connections, statements, resultset and meta data (Use MySQL as the RDBMS). Sockets: introduction to networking, InetAddress, url, socket, server sockets, datagrams. Introduction to Unified Modelling Language (UML), UML diagrams, class diagrams, object interaction diagrams, state and activity diagrams, component diagrams, deployment diagrams. Introduction to analysis - object oriented system analysis, design and implementations.

Dept. of Computer Science

.**References:**

1.Herbert Scheldt, Java Complete Reference, 8th Edition, Tata Mcgraw Hill Education Private Limited, ISBN: 1259002462.
2. E Balaguruswamy, Programming in Java: A Primer, 4th Edition, Tata Mcgraw Hill Education Private Limited, ISBN: 007014169X.
3. Kathy Sierra, Head First Java, 2nd Edition, Shroff Publishers and Distributors Pvt Ltd, ISBN: 8173666024.
4. David Flanagan, Jim Farley, William Crawford and Kris Magnusson, Java Enterprise in a Nutshell: A Desktop Quick Reference, 3rd Edition, O'Reilly Media, ISBN: 0596101422.
5. Grady Booch, James Rumbaugh and Ivar Jacobson, The Unified Modeling Language User Guide, 2nd Edition, Pearson, ISBN: 8131715825.

Curriculum Plan

Unit/Hours (time required)	**Topics to be Taught (Input)**	**Procedure (process) student centric method of teaching**	**Activity**	**Learning outcome (outcome)**	**Assessment**
Unit1(18 Hour)	Introduction to OOPS - basic principles of object orientation (objects , attributes and methods, encapsulation and information hiding, state retention, object identity, messages, class hierarchy, inheritance, polymorphism, genericity) - introduction to Java - history, versioning, the Java Virtual Machine, byte	• Lecture using ICT tools	Peer group discussion on different types of sets	To Understand • Concept of OOPS	• Assignment • MCQ evaluation

Dept. of Computer Science

	code, features of Java, language components - primitive data types, comments, keywords, literals, variables scope & declarations, control structures - FOR, IF, WHILE, DO WHILE, SWITCH, BREAK, CONTINUE statements - operators - casts and conversions - arrays.				
Unit 2 (20 Hours)	Object - oriented programming – classes - class fundamentals - declaring objects- new operator – methods – parameter passing – constructors - parameterized constructors - this keyword – finalize method. Overloading methods and constructors, access controls, static and final, nested and inner classes. Inheritance - extends, member access and inheritance, super	• Lecture using ICT Tools • Illustrations • Hands on sessions	• Seminar • Group stud	To Understand • Objest • Classes • methods • Interfaces.	• Q&A exams.

Dept of Computer Science

	keyword, polymorphism, method overriding, dynamic method dispatch, abstract classes, packages and interfaces.				
Unit3 (18 Hours)	Exceptions, threads & IO in Java - The file and standard streams, stream classes and interfaces, using byte streams and character streams, threads - threads vs. processes, creating threads, runnable interface, thread class, inter thread communication, synchronization. Exceptions - basic of Java exception handling, hierarchy, developing user defined exception classes.	• Lecture using ICT tools • Illustrations	• Hands on sessions • Illustrations	To Understand Exception Handling	• Q&A exams
Unit4 (14 Hours)	Applets, AWT & Swing - applet class, types of applet, skeleton, applet tag, passing parameters, event handling,	• Lecture using ICT tools • Illustrations • Hands on	• Hands on sessions • Illustrations	To understand AApplet,AWT,Swing	• Q&A exams

Dept. of Computer Science

	delegation event model, event classes, listeners, AWT classes and window fundamentals, frames, working with fonts, graphics and colors, AWT controls, layouts and menus, dialogue boxes. Swings - Japplets, icon, labels, buttons, textbox, combo box, tables and panes.	Session			
Unit5(20 Hours)	Database and sockets - JDBC - introduction, architecture, drivers, connections, statements, resultset and meta data (Use MySQL as the RDBMS). Sockets: introduction to networking, InetAddress, url, socket, server sockets, datagrams. Introduction to Unified Modelling Language (UML), UML diagrams, class diagrams, object interaction	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand JDBC	• Assignments • Exams

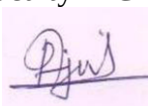
Dept. of Computer Science

	diagrams, state and activity diagrams, component diagrams, deployment diagrams. Introduction to analysis - object oriented system analysis, design and implementations.				

Course Outcomes:

CO:1	CO1: Understand the Concepts of OOPS
CO:2	CO2: Describe Features of Java
CO:3	CO3: Discuss Byte code , JVM
CO:4	CO4: Describe object, class
CO:5	CO5: Discuss Exception Handling and Threads
CO:6	CO6: Describe Applet, AWT ,Swing
CO:7	CO7: Discuss Database and Sockets
CO:8	CO8: Knowledge about UML Diagrams

Faculty in Charge:



Julie P.A

Dept. of Computer Science

Programme: CSS3C13 Principles of Compilers

Number of Lecture hours per week: 3Hrs	Number of practical hours: 3Hrs
Number of credits for theory:4	Number of credits for practical:1

Aim of the Course

To introduce the fundamental concepts and various phases of compiler design.

Course Outline

Unit I: Introduction to compiling - definition of compiler, translator, interpreter, analysis of the source program, the phases of a compiler, compiler construction tools- applications of compiler technology – programming language basics - lexical analysis – role of lexical analyser – input buffering - specification of tokens – recognition of tokens using finite automata - regular expressions and finite automata - from NFA to DFA - Regular Expression to an NFA - Design of a lexical analyser generator.

Unit II: Syntax analysis – role of parser – error handling and recovery – definitions of parsing, top-down parsing and bottom-up parsing - context free grammars – derivations -parse tree – ambiguity – associativity and precedence of operators - writing a grammar – topdown parsing – recursive descent parsing - FIRST and FOLLOW – LL (1) Grammars –recursive predictive parsing - bottom up parsing – reductions – handle pruning – shift reduce parsing - operator precedence parsing, simple LR parsing.

Unit III: Intermediate code generation – DAG – three address code – addresses and instructions – quadruples – triples – Static Simple Assignment form – types and declarations – type expressions - type equivalences – declarations – type checking – rules – type conversion – function and operator overloading – type inference and polymorphic functions – control flow – boolean expressions – short circuit code – flow-control statements – control-flow translation for boolean expressions – BREAK CONTINUE and GOTO statements.

Unit IV: Run time environments – storage optimization – static Vs dynamic allocation –stack allocation of space - activation trees and records – calling sequences – access to non local data on the stack – data access without nested procedures – issues with nested procedures – heap management – the memory manager – the memory hierarchy – locality in programs – reducing fragmentation - manual deallocation requests.

Unit V: Code generation – issues in the design of a code generator – the target language – a simple target machine model – the program and instruction costs – address in the target code – static allocation – stack allocation – run-time address for names – basic blocks and flow graphs – representation of flow graphs. Code optimization - the principal sources of optimization – data flow analysis – abstraction – data flow analysis schema – data flow schemas on basic blocks – reaching definitions – live variable analysis – available expressions. Region based analysis – regions – region hierarchies for reducible flow graphs – overview of a region based analysis.

Reference

1. V Aho A, Ravi Sethi, D Ullman J, *Compilers Principles*, Techniques and Tools, 2nd Edition, Pearson Education Singapore Pte Ltd, ISBN: 8131721019.
2. K. V. N. Sunitha, *Compiler Construction*, Pearson, ISBN:9789332500297.
3. W Appel and Andrew, *Modern Compiler Implementation in C*, 1st Edition,Cambridge University Press, ISBN: 817596071X.
4. Allen I Holub, *Compiler Design in C*, 1st Edition, PHI Learning Pvt Ltd, ISBN: 812030778X.
5. Tremblay and Sorenson, *The Theory and Practice of Compiler Writing*, 1st Edition, BSP Books Pvt Ltd, ISBN: 8178000776.

Dept. of Computer Science

6. Torben Ægidius Mogensen, *Basics of Compiler Design*, Department of Computer Science, University of Copenhagen (Online Edition).

Curriculum Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Unit I(18 Hrs)	Introduction to compiling - definition of compiler, translator, interpreter, the phases of a compiler, finite automata - regular expressions and finite automata - from NFA to DFA - Regular Expression to an NFA - Design of a lexical analyser generator.	• Lecture using ICT tools • Problem Solving	• Peer group discussion • Seminar	To Understand • Compiler and interpreter • Phases of compiler • Lexical Analysis	• Assignment • MCQ evaluation
Unit II(20 Hrs)	Syntax analysis – role of parser – – ambiguity – associativity and precedence of operators topdown parsing – recursive descent parsing - FIRST and FOLLOW – LL (1) bottom up parsing – LR parsing.	• Lecture using ICT Tols • Illustrations	• Seminar • Group study • Problem solving	To Understand • Syntax analysis • Abiguity • Top down-bottom up parser.	• Assignments • Q&A exams
Unit III(20Hrs)	Intermediate code generation – DAG – three address code –	• Lecture using ICT tools • Illustratio	• Illustrations • Prob	To Understand • ICG- • Three	• MCQ tests • Q&A exams

Dept of Computer Science

	– type expressions - type equivalences – type boolean expressions – short circuit code – flow-control statements – control-flow translation for boolean expressions – BREAK CONTINUE and GOTO statements.	ns	lem solvi ng	address code • Flow control expressi ons	
Unit IV(17 Hrs)	Run time environments – storage optimization – static Vs dynamic allocation – – heap management – the memory manager – the memory hierarchy – locality in programs – reducing fragmentation - manual deallocation requests.	• Lecture using ICT tools • Illustratio ns	• Illus trati ons • Dra wing	To understand • Storage optimis ation • Memor y hierarch y	• Assignments • Q&A exams
Unit V(15 Hrs)	Code generation Code Region based analysis – regions – region hierarchies for reducible flow graphs –	• Lecture using ICT tools • Illustratio ns • Hands on Session	• Sem inar • Gro up stud y	To understand • CG • Region based analysis	• Assignment s • Q & A tests

Dept. of Computer Science

Course Outcomes:

CO:1	Understand the major phases of compilation, identify tokens of a typical high -level programming language, define regular expressions for tokens, design and implement a lexical analyzer
CO:2	Develop the parsers and experiment the knowledge of different parsers design without automated tools

CO:3	Construct the intermediate code representations and generation.
CO:4	Explain the role of different types of runtime environments and memory organization for implementation of typical programming languages
CO:5	Apply the optimization techniques to have a better code for code generation

Faculty in Charge:



Sindhu T

Programme: CSS3E01a – COMPUTER GRAPHICS

No. of lecture hours per week	4 Hrs
No.of credits for Theory	4

Aim of the course

- To understand the fundamentals of the modern computer graphics.
- To pipeline the mathematics of affine transformations in three dimensions.
- To understand the common data structures to represent and manipulate geometry,
- colour and light representation and manipulation in graphics systems.
- To have an exposure to programming in Open GL.

Course Outline

Unit I:Introduction – Application of computer graphics, Video Display Devices- refresh CRT, raster and random scan display, color CRT, flat panel, LCD, LED, DVST. Raster -Scan Systems-video controller, display processor, Random-Scan Systems.

Unit II: 2D Graphics: Line drawing algorithms – DDA, Bresenham's – Midpoint Circle drawing algorithm –Filling-Scan line polygon fill algorithm, boundary fill algorithm, floodfill algorithm, 2D Transformations-translation, rotation, scaling, shearing and reflection, composite transformations. 2D Viewing –the viewing pipeline, viewing coordinate reference frame, window-to- viewport coordinate transformation. Clipping-point clipping, Cohen Sutherland line clipping, Sutherland Hodgeman polygon clipping, text clipping.

Unit III: 3D Graphics: 3D Transformations- translation, rotation, scaling, shearing and reflection,3D Viewing-viewing pipeline, viewing coordinates, projections- parallel & perspective projections.

Dept of Computer Science

Unit IV: 3D object representation - wireframe model, curve representation, surfaces, spline representation, bezier curves, cubic spline. Visible surface detection methods- classification, back-face detection, Z-buffer algorithm.

Unit V: Discrete Techniques and OpenGL programming - Texture mapping, Bit and Pixel operations, Compositing, Sampling and Aliasing Techniques. Introduction to OpenGL, Features in OpenGL, OpenGL operations, Abstractions in OpenGL - GL, GLU & GLUT, a few examples of OpenGL programs.

References:

1.Donald Hearn and M. Pauline Baker, Computer Graphics, 2nd Edition, Prentice Hall, ISBN: 0135309247.
2. Donald D. Hearn, M. Pauline Baker and Warren Carithers, Computer Graphics with Open GL, 4th Edition, Prentice Hall, ISBN: 9780136053583
3. Hill, Computer Graphics using OpenGL, 3rd Edition, Prentice Hall of India Private Ltd. New Delhi, ISBN: 8120338294.
4. Mason Woo, Jackie Neider, Tom Davis, Dave Shreiner, Dave Shriner and Tom David, Open GL Programming Guide, 6th Edition, Person, ISBN: 9780201604580.
5. The Official Guide to Learning OpenGL, Version 1.1, Available at http://www.glprogramming.com/red/.
6. Shreiner and Angel, Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL, 6th Edition, Pearson Education, ISBN: 0132545233.

Curriculum Plan

Unit/Hours (time required)	**Topics to be Taught (Input)**	**Procedure (process) student centric method of teaching**	**Activity**	**Learning outcome (outcome)**	**Assessment**
Unit1(18 Hour)	Introduction – Application of computer graphics, Video Display Devices- refresh CRT, raster and random scan display, color CRT, flat panel, LCD, LED, DVST. Raster - Scan Systems-	• Lecture using ICT tools	Peer group discussion on different types of sets	To Understand • Application of computer Graphics	• Assignment • MCQ evaluation

Dept. of Computer Science

	video controller, display processor, Random-Scan Systems.				
Unit 2 (20 Hours)	2D Graphics: Line drawing algorithms – DDA, Bresenham's – Midpoint Circle drawing algorithm – Filling-Scan line polygon fill algorithm, boundary fill algorithm, floodfill algorithm, 2D Transformations-translation, rotation, scaling, shearing and reflection, composite transformations. 2D Viewing –the viewing pipeline, viewing coordinate reference frame, window-to-viewport coordinate transformation. Clipping-point clipping, Cohen Sutherland line clipping, Sutherland Hodgeman polygon clipping, text clipping.	• Lecture using ICT Tools • Illustrations • Hands on sessions	• Seminar • Group stud	To Understand • line drawing algorithm • circle drawing • Transformation • Clipping.	• Q&A exams.

Dept. of Computer Science

Unit3 (18 Hours)	3D Graphics: 3D Transformations-translation, rotation, scaling, shearing and reflection,3D Viewing-viewing pipeline, viewing coordinates, projections-parallel & perspective projections.	• Lecture using ICT tools • Illustrations	• Hands on sessions • Illustrations	To Understand Transformations	• Q&A exams
Unit4 (14 Hours)	3D object representation - wireframe model, curve representation, surfaces, spline representation, bezier curves, cubic spline. Visible surface detection methods-classification, back-face detection, Z-buffer algorithm.	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand 3D object representation	• Q&A exams
Unit5(20 Hours)	Discrete Techniques and OpenGL programming - Texture mapping, Bit and Pixel operations, Compositing, Sampling and Aliasing Techniques. Introduction to OpenGL, Features in	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand OpenGL	• Assignments • Exams

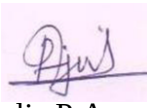
Dept. of Computer Science

	OpenGL, OpenGL operations, Abstractions in OpenGL - GL, GLU & GLUT, a few examples of OpenGL programs.				

Course Outcomes:

CO:1	CO1: Understand the Applications of computer Graphics
CO:2	CO2: Differentiate LED , LCD ,DVST
CO:3	CO3: Understand 2D Graphics
CO:4	CO4: Gain knowledge of line and circle drawing algorithm
CO:5	CO5: Understand different methods of clipping
CO:6	CO6: Understand Texture mapping
CO:7	CO7: Familiar about Texture mapping
CO:8	CO8: Understand OpenGL Programming

Faculty in Charge:



Julie P.A

Dept. of Computer Science

Programme: CSS3E02f – DATA WAREHOUSING AND DATA MINING

No. of lecture hours per week	4 Hrs
No.of credits for Theory	4

Aim of the course

To provide the fundamentals on information retrieval and data mining techniques To focus on practical algorithms of textual document indexing, relevance ranking, web usage mining, text analytics, as well as their performance evaluations. To give an exposure to the fundamentals of Data Analytics.

Course Outline

Unit I: Data warehouse - definition - operational database systems Vs data warehouses - multidimensional model - from- tables and spreadsheets to Data Cubes - schemas for multidimensional databases - measures - concept hierarchies - OLAP operations in the multidimensional data model - data warehouse architecture.

Unit II: Data mining - introduction - definition - data mining functionalities - major issues in data mining - data pre-processing - data cleaning - data integration and transformation -data reduction - data discretization and concept hierarchy generation. Association rule mining - efficient and scalable frequent item set mining methods - mining various kinds of association rules - association mining to correlation analysis - constraint- based association mining.

Unit III: Classification and prediction - issues regarding classification and prediction - classification by decision tree introduction - Bayesian classification - rule based classification - classification by back propagation - support vector machines - associative classification - lazy learners - other classification methods - prediction - accuracy and error measures - evaluating the accuracy of a classifier or predictor - ensemble methods - model section.

Unit IV: Cluster analysis - types of data in cluster analysis - a categorization of major clustering methods - partitioning methods - hierarchical methods - density-based methods -grid-based methods - model-based clustering methods - clustering high dimensional data -constraint-based cluster analysis - outlier analysis.

Unit V: Graph mining - mining object, spatial, multimedia, text and web data -multidimensional analysis and descriptive mining of complex data objects - spatial data mining - multimedia data mining - text mining - mining the World Wide Web.

References:

1Jain Pei, Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, 3rd Edition, Elsevier, ISBN: 9380931913.
2. Alex Berson and Stephen J. Smith, Data Warehousing, Data Mining & OLAP, Computing Mcgraw-Hill, ISBN: 0070062722.
3. K.P. Soman, Shyam Diwakar and V. Ajay, Insight into Data mining Theory and Practice, 1st Edition, Prentice Hall of India, ISBNy.8120328973.
4. G. K. Gupta, Introduction to Data Mining with Case Studies, 3rd Edition, PHI Learning Pvt. Ltd, ISBN: 8120350022.
5. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, 1st Edition, Pearson India, ISBN: 9332518653.

Curriculum Plan

Unit/Hours (time required)	Topics to be Taught (Input)	Procedure (process) student	Activity	Learning outcome (outcome)	Assessment

Dept of Computer Science

		centric method of teaching			
Unit1(18 Hour)	Data warehouse - definition - operational database systems Vs data warehouses - multidimensional model - from-tables and spreadsheets to Data Cubes - schemas for multidimensional databases - measures - concept hierarchies - OLAP operations in the multidimensional data model - data warehouse architecture.	• Lecture using ICT tools	Peer group discussion on different types of sets	To Understand • Concept of Data ware house	• Assignment • MCQ evaluation
Unit 2 (20 Hours)	Data mining - introduction - definition - data mining functionalities - major issues in data mining - data pre-processing - data cleaning - data integration and transformation - data reduction - data discretization and concept hierarchy generation. Association rule	• Lecture using ICT Tools • Illustrations • Hands on sessions	• Seminar • Group stud	To Understand • Datamining functionalities • Data integration and transformation .	• Q&A exams.

Dept. of Computer Science

	mining - efficient and scalable frequent item set mining methods - mining various kinds of association rules - association mining to correlation analysis - constraint- based association mining.				
Unit3 (18 Hours)	Classification and prediction - issues regarding classification and prediction - classification by decision tree introduction - Bayesian classification - rule based classification - classification by back propagation - support vector machines - associative classification - lazy learners - other classification methods - prediction - accuracy and error measures - evaluating the accuracy of a classifier or predictor - ensemble methods - model section.	• Lecture using ICT tools • Illustrations	• Hands on sessions • Illustrations	To Understand Classification and prediction	• Q&A exams

Dept. of Computer Science

Unit4 (14 Hours)	Cluster analysis - types of data in cluster analysis - a categorization of major clustering methods - partitioning methods - hierarchical methods - density-based methods - grid-based methods - model-based clustering methods - clustering high dimensional data - constraint-based cluster analysis - outlier analysis.	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand Cluster analysis	• Q&A exams
Unit5(20 Hours)	Graph mining - mining object, spatial, multimedia, text and web data - multidimensional analysis and descriptive mining of complex data objects - spatial data mining - multimedia data mining - text mining - mining the World Wide Web.	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand Graph mining	• Assignments • Exams

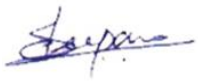
Dept. of Computer Science

Course Outcomes:

CO:1	CO1: Understand Data Warehouse
CO:2	CO2: Familiar about OLAP
CO:3	CO3: Understand Data mining functionalities

CO:4	CO4: Gain knowledge of Classification
CO:5	CO5: Understand Prediction
CO:6	CO6: Understand Clustering
CO:7	CO7: Familiar about Graph mining
CO:8	CO8: Understand OpenGL Programming

Faculty in Charge:



Deepa M

Dept. of Computer Science

Course: **MSc Computer Science (Fourth Semester)**

Programma:CSS4E03c-SYSTEM SECURITY

Number of Lecture hours per week: 5Hrs
Number of credits for theory: 3

Aim of the course

To provide an understanding of the differences between various forms of computer security, where they arise, and appropriate tools to achieve them.

Course Outline

Unit I: Notion of different types of securities - information security - computer security -security goals, relation between security, confidentiality, integrity, availability and authorization, vulnerabilities - principles of adequate protection. Notions of operating security, database security, program security, network security attacks - threats,vulnerabilities and controls. The kind of problems - interception, interruption, modification,fabrication. Computer criminals - amateurs, crackers, career criminals. Methods of defence- control, hardware controls, software controls, effectiveness of controls.

Unit II: Program security - secure programs - fixing faults, unexpected behaviour, types of flaws. Non-malicious program errors - buffer overflows, incomplete mediation. Viruses and other malicious code - kinds of malicious code, how viruses attach, how viruses gain control,prevention, control example - the brain virus, the internet worm, web bugs. Targeted malicious code - trapdoors, Salami attack. Controls against program threats - development controls, peer reviews, hazard analysis**.**

Unit III: Operating system security - protected objects and methods of protection -
memory address protection - fence, relocation, base/bounds registers, tagged architecture,segmentation, paging. Control of access to general objects - directory, access control

list. File protection mechanism - basics forms of protection, single permissions. Authentication - authentication basics, password, authentication process challenge - response, biometrics.Trusted operating systems - security policies for operating systems, models of security -requirement of security systems, multilevel security, access security, limitations of security systems. Trusted operating system design - elements, security features, assurance, system flaws and assurance methods.

Unit IV: Database Security - security requirements - integrity of database, confidentiality and availability, reliability and integrity, sensitive data, interface, multilevel database,proposals for multilevel security.

Unit V: Administrating security - security planning - contents of a security planning, team members, commitment to a security plan, business continuity plans. Risk analysis -the nature of risk, steps of risk analysis. Arguments for and against risk analysis, organizational security policies - purpose and goals of organizational security. Audience, characteristics of a good security policy. Nature of security policies - data sensitivity policy, government agency IT security policy. Physical security - natural disaster, human vandals, interception of sensitive information.

References:

1. C. P. Pfleeger and S. L. Pfleeger, Security in Computing, 4th Edition, Pearson India, ISBN: 9788131727256.
2. Matt Bishop, Computer Security: Art & Science, 1st Edition, Pearson, ISBN: 0201440997.
3. William Stallings, Cryptography and Network Security: Principles and Practice, 6th Edition, Pearson India, ISBN: 9332518777.
4. Michael E. Whitman and Herbert J. Mattord, Principles of Information Security, 4th Edition, Ceneage Learning India Pvt Ltd, ISBN: 8131516458.

Curriculum Plan

Unit/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Unit I	Notion of different types of securities - information security - computer security -security goals, relation between security, confidentiality, inte	• Lecture using ICT tools.	Peer group discussion on different types of securities.	To Understand • Concept of different types of securities.	• Assignment • MCQ evaluation

Dept. of Computer Science

	grity, availability and authorization, vulnerabilities - principles of adequate protection. Notions of operating security, database security, program security, network security attacks - threats, vulnerabilities and controls. The kind of problems - interception, interruption, modification, fabrication. Computer criminals - amateurs, crackers, career criminals. Methods of defence - control, hardware controls, software controls, effectiveness of controls.				
Unit II	**s.**Program security - secure programs - fixing faults, unexpected behaviour, types of flaws. Non-malicious program errors - buffer overflows, incomplete mediation. Viruses and other malicious code - kinds of malicious code, how viruses attach, how viruses gain	• Lecture using ICT Tools • Illustrations • Hands on sessions	• Seminar • Group study	To Understand • Flaws • Viruses • Buffer overflows • Program threats and Controls.	• Q&A exams.

Dept. of Computer Science

	control,prevention, control example - the brain virus, the internet worm, web bugs. Targeted malicious code - trapdoors, Salami attack. Controls against program threats - development controls, peer reviews, hazard analysis.				
Unit III	Operating system security - protected objects and methods of protection - memory address protection - fence, relocation, base/bounds registers, tagged architecture,segmentation, paging. Control of access to general objects - directory, access control list. File protection mechanism - basics forms of protection, single permissions. Authentication - authentication basics, password, authentication process challenge - response, biometrics.Trusted operating systems - security policies for operating systems, models of security - requirement of	• Lecture using ICT tools • Illustrations	• Hands on sessions • Illustrations	To Understand • Memory address protection • Trusted OS	• Q&A exams

Dept. of Computer Science

	security systems, multilevel security, access security, limitations of security systems. Trusted operating system design - elements, security features, assurance, system flaws and assurance methods.				
Unit IV	Database Security - security requirements - integrity of database, confidentiality and availability, reliability and integrity, sensitive data, interface, multilevel database,proposals for multilevel security.	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand • Database securities	• Lab tests • Q&A exams
Unit V	Administrating security - security planning - contents of a security planning, team members, commitment to a security plan, business continuity plans. Risk analysis - the nature of risk, steps of risk analysis. Arguments for and against risk analysis, organizational security policies - purpose and goals	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand • Security plan • Good security policy • IT security policy	• Assignments

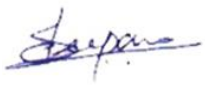
Dept. of Computer Science

	of organizational security. Audience, characteristics of a good security policy. Nature of security policies - data sensitivity policy, government agency IT security policy. Physical security - natural disaster, human vandals, interception of sensitive information.				

Course Outcomes:

CO:1	CO1: Summarize different types of securities.
CO:2	CO2: Describe information security.
CO:3	CO3: Discuss biometric based authentication.
CO:4	CO4: Describe COA triad.
CO:5	CO5: Discuss program security in system security.
CO:6	CO6: Trusted OS design.
CO:7	CO7: Discuss threats of virus and other malicious codes.Explain the working and controlling mechanism of viruses.
CO:8	CO8: Describes various types of system security challenges.

Faculty in Charge:



Deepa M

Dept. of Computer Science

Programme: CSS3E01a – CSS4E04a Digital Image Processing

Number of Lecture hours per week	**5**Hrs
Number of credits for theory	**4**

Aim of the course

To be familiar with processing of the images, recognition of the pattern and their applications.

Course Outline

Unit I: Introduction - digital image representation - fundamental steps in image processing- elements of digital image processing systems - digital image fundamentals - elements of visual perception - a simple image model - sampling and quantization - basic relationship between pixels - image geometry.

Unit II: Image transforms - introduction to Fourier transform - discrete Fourier transform(DFT) - properties DFT- other separable image transforms - Walsh, Hadamard and Discrete Cosine transforms. Hotelling transform.

Unit III: Image enhancement - basic grey level transformation - histogram equalization -image subtraction - image averaging - spatial filtering - smoothing, sharpening filters Laplacian filters. Enhancement in the frequency domain - frequency domain filters smoothing, sharpening filters - homomorphic filtering.

Unit IV:Image restoration - model of Image degradation/restoration process - noise models inverse filtering - least mean square filtering - constrained least mean square filtering. Edge detection - thresholding - region based segmentation - boundary representation.

Unit V: Image compression - fundamental concepts of image compression – compression models - information theoretic perspective. Lossless compression - Huffman coding -arithmetic coding - bit plane coding - run length coding. Lossy compression – transform coding - image compression standards.

References:

1. Richard E Woods and Rafael C Gonzalez, Digital Image Processing, 3rd Edition, Pearson Education Singapore Pte Ltd, ISBN: 8131726959.
2. B. Chanda and D.D. Majumder, Digital Image Processing and Analysis, 2nd Edition, PHI Learning Pvt Ltd, ISBN: 8120343255.
3. A.K. Jain, Fundamentals of Digital Image Processing, 2nd Edition, PHI Learning Pvt Ltd, ISBN: 8120309294.
4. W.K. Pratt, Digital Image Processing: PIKS Scientific Inside, 4th Edition, John Wiley, ISBN: 0471767778.

Dept. of Computer Science

5. Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing Analysis and Machine Vision, 3rd Edition, Ceneage Learning India Pvt Ltd, ISBN: 8131518833.

Curriculum Plan

Unit/hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Unit I	Introduction - digital image representation - fundamental steps in image processing - elements of digital image processing systems - digital image fundamentals - elements of visual perception - a simple image model - sampling and quantization - basic relationship between pixels - image geometry.	• Lecture using ICT tools.	Peer group discussion on digital image processing systems.	To Understand • Concept of digital image processing systems.	• Assignment • MCQ evaluation
Unit II	Image transforms - introduction to Fourier transform - discrete Fourier transform(DFT) - properties DFT- other separable image transforms - Walsh, Hadamard and Discrete Cosine transforms. Hotelling transform.	• Lecture using ICT Tools • Illustrations • Hands on sessions	• Seminar • Group study	To Understand • DFT • Cosine transformation. • Hotelling transform	• Q&A exams.
Unit III	Image enhancement - basic grey level transformation - histogram	• Lecture using ICT tools • Illustratio	• Hands on sessions	To Understand • Grey level	• Q&A

Dept. of Computer Science

	equalization - image subtraction - image averaging - spatial filtering - smoothing, sharpening filters Laplacian filters. Enhancement in the frequency domain - frequency domain filters smoothing, sharpening filters - homomorphic filtering.	ns	Illustrations	transformation • Filters	exams
Unit IV	Image restoration - model of Image degradation/restoration process - noise models inverse filtering - least mean square filtering - constrained least mean square filtering. Edge detection - thresholding - region based segmentation - boundary representation.	• Lecture using ICT tools • Illustrations • Hands on Session	• Hands on sessions • Illustrations	To understand • Edge detection	• Lab tests • Q&A exams
Unit V	Image compression - fundamental concepts of image compression - compression models - information theoretic perspective. Lossless compression - Huffman coding - arithmetic coding - bit plane coding -	• Lecture using ICT tools • Illustrations • Hands on Session	• Seminar • Group study	To understand • Image compression • Huffman Coding • Compression standards	• Assignments

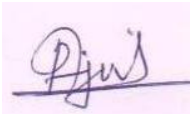
Dept. of Computer Science

	run length coding. Lossy compression - transform coding - image compression standards.				

Course Outcomes:

CO:1	CO1: Understand about digital image processing.
CO:2	CO2: Describe Fourier transformation.
CO:3	CO3: Discuss compression methods like Lossless and Lossy compression.
CO:4	CO4: Learn about edge preserving.
CO:5	CO5: Discuss Huffman coding.
CO:6	CO6: Know about Image restoration.
CO:7	CO7: Discuss various filters used for Image processing.
CO:8	CO8: Understand elements of digital image perception.

Faculty in Charge:



Julie P A

Dept. of Computer Science

BCM1B01 BUSINESS MANAGEMENT

Number of Lecture Hours per week : 6

Number of Credits : 4

Internal : 20, External :80

Examination Hours :2.5

Objectives:

- To understand the management concepts and to learn concepts in real life businesses

Module I

Concepts of Management – Characteristics of management – Schools of management thought - Management and administration – Management by objectives – Management by participation – Management by exception – Management by motivation - Functions of management – Planning– Organizing - Departmentation – Delegation (25 Hours, 20 marks)

Module II

Functions of Management:– Motivation: – concept and importance – Contributions of McGregor, Maslow and Herzberg – Leadership – Concept and styles – Leadership traits - Communication – process and barriers – Control – concept - steps – tools – Coordination – Concept, Principles, Techniques. (20 Hours, 15 marks)

Module III

Business Ethics:– Ethics and Morality – Theories of ethics: Teleological theory – Deontological theory –Virtue theory – Types of ethics – Meaning and scope of business ethics - Characteristics – Objectives of Business Ethics - Factors influencing business ethics – Arguments for and against business ethics – Different views of business ethics - The Separatist View, The Unitarian View, The Integration View, Ethical issues in global business. (20 Hours, 20 marks)

Module IV

Corporate Social Responsibility (CSR): Meaning and definition - History of CSR activities – Concept of Corporate citizenship - Need and importance of CSR – Stakeholders of CSR – Steps in the implementation of CSR activities – CSR and business ethics - CSR and corporate governance – CSR initiatives in India. (18 hours, 15 marks)

Module V

Emerging concepts in management – Kaizen – TQM – TPM – MIS – ISO – Change management – Stress management – Fish bone (ISHIKAWA) Diagram – Holacracy - Rank & Yank - 20% time - Gamification - Flexi-working - Business ecosystem – Logistic management. (13 Hours, 10 marks)

Specific Outcomes:

1. Understand the concept of Management
2. Understand the importance of Management in a global perspective
3. Understand the differences between management and leadership in real life situations
4. Analyze the concept of corporate social responsibility towards stakeholders
5. Understand about the most modern techniques of management practiced in developed countries

OBJECTIVES

- To understand the concept of Managerial functions and realize the importance of Leadership and Management.
- To transform the business concept of an Individual firm from an indigenous perspective to a global perspective and realise the importance of business ethics in real life situation.
- To realise the growing importance of corporate social responsibility in the present era and examine how this concept help the business to fulfil its responsibilities towards society.

- To transform the limited idea about management to a more comprehensive and holistic concept and understand about the most sophisticated concepts and techniques in Management in various countries

Lesson plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**
Module I (25 hours)	Concepts of Management, management and administration, MBO,management by participation, management by motivation	● Lecture ● Discussion ● Participative Learning	● Seminars and Assignments on the topic Management By Objectives (MBO) ● Discussion on Business News	● To understand the concepts of Management ● To evaluate different schools of Management Thoughts ● To identify various functions of Management	● Business Quiz

Module II (20 hours)	Functions of management, Concepts of Motivation, Communication process and barriers Leadership - Concepts and Styles, Control - Tools	• Lecture • Discussion • Participative Learning	• Powerpoint Presentation on Motivation Theories • Group discussion on various communication gadgets available and its importance in business • Leadership games	• To evaluate various motivation theories • Identify communication channels and study communication process and barriers in business • To understand leadership qualities and skills	• Evaluation through test papers
Module III (20 hours)	Business ethics and morality , theories of ethics,factors influencing business ethics, different views of business ethics	• Lecture • Discussion • Participative Learning	• Interaction with local business entrepreneurs	• To understand factors influencing business ethics • To identify different views of business ethics	• Essay writing

Module IV (18 hours)	Corporate social responsibility, Concepts of Corporate citizenships, Steps in implementation of CSR activities, CSR and Corporate Governance	• Lecture • Discussion • Participative Learning	• Group discussion on Corporate Social Responsibility • Debate on relevance of CSR in present scenario	• To study relevance of corporate social responsibility • To identify various steps in implementing CSR	• Evaluation through Viva
Module V (13 hours)	Emerging concepts in Management, Change Management, Stress management, Business Ecosystem, Logistics Management	• Lecture • Discussion • Participative Learning	• Powerpoint presentation on various areas of Stress Management • Collage on Business Ecosystem	• To study the emerging concepts of Business management • To identify various concepts of stress management and logistics management	• Assessment through Descriptive test

BCM1C01 MANAGERIAL ECONOMICS

Number of Lecture Hours per week: 5

Number of Credits: 4

Internal: 20, External: 80

Examination Hours : 2.5

Objectives:

- To understand the concept of macro and micro economics and its role in managerial decision making.

Module I

Managerial Economics:- – Definition and characteristics – Nature and Scope - Economics Vs Managerial Economics - Decision making and forward planning – Relationship of managerial economics with other disciplines - Basic economic tools in management economics – The role of managerial economist. (10 Hours,10 marks)

Module II

Theory of consumer behaviour: - Cardinal analysis - Law of diminishing marginal utility – consumer surplus; Ordinal approach – indifference curve analysis – consumer equilibrium – income consumption curve and price consumption curve – Hicksian decomposition of price effect in to substitution effect and income effect – Demand curve for normal, inferior and giften goods – concept of elasticity of demand – measurement of various elasticities – Elasticity of supply. (20 Hours,20 marks)

Module III

Market structure:-

a. Perfect competition: – profit maximization and equilibrium of firm and industry – short run and long term supply curves – price and output determination.

b. Monopoly: – Price determination under monopoly – equilibrium of firm – comparison between perfect competition and monopoly – price discrimination.

c. Monopolistic competition: price and output determination – product differentiation – comparison with perfect competition – excess capacity under monopolistic competition.

d. Oligopoly: indeterminate pricing and output – classical models of oligopoly – price leadership - collusive oligopoly – kinked demand curve. (20 Hours,20 marks)

Module IV

An overview of Indian economy - Indian economy since 1991 - Basic characteristics of Indian economy - Factors that led to the opening up of Indian economy - Indian economy under WTO regime - Issues in Indian economy: Problems of growth, unemployment, poverty, inequality in income distribution, inflation – The role of parallel economy – The role of Government in a market economy. (15 Hours,15 marks)

Module V

Structure and direction of India‘s foreign trade and India‘s trade regulation and promotion - Exchange rate policy – Intellectual Property Rights - Foreign capital and MNCs in India, Trade reforms - An overview of Kerala economy - Trade and commerce in Kerala - Industrial development of the state - the role of small scale industries in Kerala economy. (15 Hours, 15 marks)

Specific Outcomes:

1. Understand Macro & Micro economics & its role in managerial decision making.
2. Understand the concept of law of diminishing marginal utility theory.
3. Understand the structure and importance of different types of markets.
4. Understand the role played by government in regulating Indian economy
5. Understand a conceptual knowledge regarding India’s foreign trade and the application of this knowledge in securing business opportunities.

OBJECTIVES

- To understand the concept of marginal utility theory and its role in managerial decision making.
- To understand the structure of different markets and its influence on business decisions and to integrate this knowledge with business applications.

- To realise the concept of Indian economy in Business and the role played by the government in regulating the Indian economy.
- To gain conceptual knowledge regarding India's foreign trade and the application of this knowledge in benefitting the opportunities available to businesses.

Lesson Plan

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (10 Hours)	Managerial Economics - Definition and nature, The role of managerial economists, Basic economic tools in Managerial Economics	• Lecture • Discussion • Participative Learning	• Powerpoint presentation on Definition and nature of Managerial Economics • Group Discussion on Role of managerial Economists	• To understand nature of managerial economics • To evaluate the role of managerial economists	• Evaluation through Case Study
Module II (10 Hours)	Basic Concepts of Demand and Cost, Law of Variable Proportions, Economies	• Lecture • Discussion • Participative Learning	• Group Discussion on Economies and Diseconomies of scale • Presentation on Law of Variable	• To study various concepts of demand and cost • To understand law of variable proportions • To analyze	• Evaluation through test papers

	and Diseconomies of scale, Cost Minimization, Profit Maximization		Proportions	economies and diseconomies of scale	
Module III (20 Hours)	Theory of Consumer Behaviour, Law of Diminishing Marginal Utility, Concept of Elasticity of Demand	• Lecture • Discussion • Participative Learning	• Consumer Behaviour Survey on various products • Powerpoint presentation on elasticity of Demand	• To evaluate theories of Consumer Behaviour • To study Law of Diminishing Marginal Utility	• Assessment through Test paper
Module IV (20 Hours)	Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly	• Lecture • Discussion • Participative Learning	• Peer Group Discussion on different types of Market Structure • Powerpoint presentation on difference between perfect competition and monopolistic competition	• To evaluate various structure of Market	• Assessment through Essay Writing
Module V (15 Hours)	Tourism and Environment,	• Lecture • Discussion	• Presentation on influence of	• To evaluate scope of eco tourism	• Evaluation through

	Meaning and principles of Sustainable Tourism Development, Environment impact assessment, Eco tourism	• Participative Learning	tourism in Kerala Economy • Exhibition on Taste of Kerala	• To study meaning and principles of sustainable tourism development	test papers

BCM2B02 FINANCIAL ACCOUNTING

Number of Lecture Hours per week: 6

Number of Credits: 4

Internal: 20, External: 80

Examination Hours : 2.5

Objectives:

- To develop skill in the preparation of accounts from Incomplete Records system

Module I

Single Entry System of Accounting: Definition – Objectives - Advantages- Limitations- Distinction between Double entry and Single entry- Types of Single entry- Determination of Profit or Loss under single entry- Statement of Affairs/ Capital comparison method- Distinction between Balance Sheet and Statement of Affairs- Distinction between Profit and loss account and Statement of Profit and Loss- Conversion method- Practical Problems. (16 Hours, 15 marks)

Module II

Company Accounts- Issue of Shares:Introduction- Books of accounts maintained by companies- Share Capital- Phases of capital- Difference between Reserve capital and Capital Reserve- Shares and types of shares- Equity and Redeemable Preference shares - Convertible Cumulative Preference Shares (CCP shares) Sweat Equity shares- Employees Stock Option Scheme (Theory only)- Private Placement of shares- Issue of shares- Procedures- Minimum Subscription- Shares issued for consideration- Shares issued for consideration other than cash- Issue of shares at par and premium (issue at discount, not to be taught)- Treatment of Fraction shares- Application, Allotment and Calls on Shares- Share capital allotment- Calls in arrears and calls in advance- Interest on calls in arrears and calls in advance- Difference between calls in arrears and calls in advance- Oversubscription and under subscription- Pro-rata allotment- Forfeiture and reissue of shares- Annulment of forfeiture- Surrender of shares- Distinction between forfeiture and surrender- Journal entries- Practical problems. (30 Hours,25 marks)

Module III

Accounting for issue of Debentures:Definition – Types of debentures- Issue of Debentures- For cash, for consideration other than cash and issued as collateral security- Fraction debentures- Distinction between share and debenture- Terms of issue of debentures- Interest on debentures- Journal entries- Practical problems. (10 Hours,10 marks)

`

Module IV

Convergence to International Financial Reporting Standards: Meaning of Accounting Standards- need and importance of global accounting standards- Role of IASB in developing IFRS – components of IFRS (IAS,IFRS,IFRIC and SIC)- process of setting IFRS –Conceptual Framework and its contents – Definition of elements in financial statements- Criteria or principles of recognition, measurement, presentation and disclosure- convergence to IFRS- Emergence of Ind AS – Standard setting process in India – Role of NFRA –Entities required to adopt Ind AS- Role of FASB in developing US GAAP- Difference between Ind AS and IFRS. (18 Hours, 15 marks)

Module V

Ind. AS / IFRS compiled Financial Statements of Companies (Ind AS1): Preparation of final accounts under new format (SOPL, SOCE and SOFP – excluding SOCF) - Treatment of adjustment items such as Corporate Dividend Tax- Transfer to Reserve- Provision for taxation- TDS on Interest income, implied adjustment of interest on loans and other usual adjustment items such as depreciation, Closing stock, provisions, outstanding, prepaid, accrued, and received in advance - Practical problems. (22 Hours, 15 marks)

(Theory and problems may be in the ratio of 30% and 70% respectively)

Specific Outcomes:

1. Students learn to prepare accounts even from incomplete information.
2. The learner learns to prepare Company accounts
3. Understands the concept of debentures and learns to account for debentures.
4. Understand the application of IFRS in Companies
5. Critically learns 'AS' and IFRS.

OBJECTIVES

- To Understand preparation of company accounts and the various concepts. .
- To learn accounting for debt instruments like debentures.
- To know application of 'IFRS' and its compliance by various business entities
- To study the differences between 'AS' and 'Ind AS' and its corporate application.

Lesson Plan

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (16 Hours)	Preparation of financial statements of sole trader, single entry meaning and methods of profit determination, depreciation accounting	● Lecture ● Discussion ● Participative Learning	● Problem solving ● Participative learning	● To study how to prepare financial statement of sole trader ● To understand the details of single entry ● To understand depreciation accounting	● Assessment through test papers
Module II (30Hours)	Issue of shares and debentures,forfeiture of shares,preparation of financial statements of joint stock company	● Lecture ● Discussion ● Participative Learning	● Assignments on forfeiture of shares ● Seminars on issue of shares and debentures ● problem solving	● To study issue of shares and debentures ● To understand forfeiture of shares ● To study financial statement of joint stock company	Evaluation through test papers

Module III (10 Hours)	Meaning and concepts of banking, non banking asset, preparation of profit and loss account and balance sheet of banking company	• Lecture • Discussion • Participative Learning	• Group discussion on meaning and concepts of banking • Problem solving	• To understand meaning and concepts of banking • To study non banking asset • To study how to prepare profit and loss account and balance sheet	Assessment through test papers
Module IV (18 Hours)	Insurance accounts, types of insurance,final accounts of insurance	• Lecture • Discussion • Participative Learning	• PPT presentation on types of insurance • Problem solving	• To identify insurance accounts and type of insurance • To study the preparation of final accounts	• evaluation through test papers and MCQ

Module V (22 Hours)	Objectives and uses of financial statements,development of accounting standards in India ,requirements of IFRS,international organisations engaged in accounting harmonizations, Ind AS, difference between Ind AS and IFRS	• Lecture • Discussion • Participative Learning	• PPT presentation on difference between Ind AS and IFRS • Peer group discussion on requirement of IFRS	• To evaluate objective and uses of financial statements • To identify the development of accounting standards in India • To study requirements of IFRS • To identify international organisations engaged in accounting harmonizations • Study difference between Ind AS and IFRS	evaluation through descriptive exam

BCM2C02 MARKETING MANAGEMENT

Number of Lecture Hours per week: 5

Number of Credits: 4

Internal: 20, External: 80

Examination Hours : 2.5

Objectives:

- To understand the core marketing concepts, consumer buying behaviour and the potential challenges and strategies adopted by various business organisations.

Module I

Marketing Management: The value of marketing–Core marketing concepts–The new marketing realities–Philosophy of marketing - Creating long term loyalty relationships – Marketing management tasks –Analyzing consumer markets-Factors influencing consumer behaviour-Buying decision process - market segmentation; bases for segmenting consumer markets – market targeting - marketing of services - rural marketing in India; potential, challenges and strategies. (20 Hours,20marks)

Module II

Creating and Capturing Value: The fundamentals of product management; product levels; customer value hierarchy– Classification of product–Managing brands and brand equity-Product and Services differentiation-Product and brand relationships - Product Life Cycle Marketing Strategies - New product development-Packaging, labeling, Warranties and Guarantees.

Pricing to capture value; setting the price; methods of pricing; pricing strategies; pricing for rural markets. (20 Hours,20 marks)

Module III

Delivering Value: Distribution -marketing channels and value networks-role of marketing channels-channel design and management decision-channel integration and system-conflict, cooperation and competition-Managing retailing, wholesaling and logistics-Direct and online marketing (10 Hours,10 marks)

Module IV

Communicating Value: Integrated Marketing Communications; role of marketing communication; developing effective communication; marketing communication mix - managing advertising; deciding on media and measuring effectiveness ; communicating to rural audience- Sales Promotion-Personal selling; principles of

personal selling-Events and experiences-Public relation-Interactive marketing-word of mouth marketing. (15 Hours,15 marks)

Module V

`E-commerce and E-marketing: Concept and nature; Reason for growth of e-marketing - E-commerce marketing practices; types of E-commerce; E-commerce business models; E-commerce marketing strategies - M-commerce marketing practices- Electronic Payment System-Security issues in E commerce. (15 Hours,15 marks)

Specific Outcomes:

1. The learner understands the core marketing concepts and consumer buying behaviour
2. The Scholar learns the concept of creating and capturing value.
3. Understand the concept of marketing channels in the competitive environment.
4. Learns to enrich the firm's competitive strength.
5. Understand and develop an idea about the latest trends in e-commerce and e-marketing.

OBJECTIVES

- To understand the concept of creating and capturing value in order to gain a competitive advantage.
- To understand the concept of marketing channels and the importance of adopting various techniques of marketing to withstand competition.
- To realise the importance of communicating value and the technique of reaching the minds of the customers.
- To understand about the latest trends in e-commerce and e-marketing.

Lesson Plan

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (20 Hours)	Value of marketing,philosophy of marketing,marketing management tasks,factors influencing buying behaviour,market segmentation, market targeting,marketing of service	● Lecture ● Discussion ● Participative Learning	● PPT on market segmentation ● Seminar presentation on consumer behaviour of various products ● Survey of various marketing strategies adopted by service providers	● To study :- 1. Value of marketing and philosophy 2. Marketing management tasks 3. Market segmentation ● To evaluate;- 1. Factors influencing buying behaviour 2. Marketing of services	evaluation through case study

Module II (20Hours)	Fundamentals of product management, Classification of products,brand and brand equity, product life cycle ,pricing strategies	● Lecture ● Discussion ● Participative Learning	● Assignment on classification of products ● Seminar on product life cycle	● To study fundamentals of product management ● To evaluate;- 1. Brand and brand equity 2. Product life cycle 3. Pricing strategies	Assessment through descriptive eam
Module III (10 Hours)	Marketing channels,managing retailing,wholesaling and logistics direct and online marketing	● Lecture ● Discussion ● Participative Learning	● Seminars on marketing channels ● Debates on direct and online marketing ● Marketing games	To evaluate:- 1 Marketing channels 2. Management of wholesaling and logistics 3.Direct and online marketing	evaluation through essay writing
Module IV (15 Hours)	Marketing communication, sales promotion, marketing	● Lecture ● Discussion ● Participative Learning	● Peergroup discussion on marketing communication mix	To identify;_ ● Marketing communication mix ● Decision on	evaluation through essay writing

	communication mix, personal selling, interactive marketing		• Presentation on personal selling and interactive marketing	media and effectiveness • Principles of personal selling	
Module V (15 Hours)	E commerce, e commerce marketing strategies,e commerce marketing practices, m-commerce marketing practices	• Lecture • Discussion • Participative Learning	PPT presentation on e commerce marketing strategies	Evaluate:- E commerce marketing strategies M commerce marketing practices	evaluation trough test paper

BCM3A11 BASIC NUMERICAL METHODS

Number of Lecture Hours per week: 5

Number of Credits: 4

Internal: 20, External: 80

Examination Hours : 2.5

Objectives:

- Understand the basic concepts of theory of equations and quadratic formula

Module I

Numerical expressions and Equations: Simultaneous linear equations (up to three variables), Quadratic equations in one variable-factorization and quadratic formula (10 Hours, 10 marks)

Module II

Matrices: introduction - type of matrices – trace and transpose and determinants - matrix operations – adjoint and inverse –rank- solving equations by matrices: Cramer‘s Rule (not more than three variables). (15 Hours, 15 marks)

Module III

Sequence, Series and Progression : Concepts and differences - Arithmetic progression- nth term and sum of n terms of an AP - Insertion of Arithmetic means in AP - Geometric progression- _nth term and sum of n terms of an GP - Insertion of Geometric Mean in GP - Harmonic progression. (20 Hours, 15 marks)

Module IV

Interest and Time value: Concept of interest-Types of interest: Simple interest and compound interest – nominal, real and effective rate of interest - Future value and Present Value; Annuity and Perpetuity - Computing future and present values of annuity (regular and immediate) - multi and growing period perpetuity - Compound annual growth rate - computation of Equated Monthly Instalments (EMI). (15 Hours, 15 marks)

Module V

Descriptive Statistics: Measures of Central Tendency – Mean: Arithmetic mean, Geometric mean and Harmonic Mean- Median, Mode and other position values - Measures of Dispersion: mean deviation, quartile deviation, standard deviation and coefficient of variation - Measures of Skewness and Kurtosis. (20 Hours, 25 marks)

Specific outcomes :

1. The learner learns the concepts of equations and quadratic formulas.
2. Facilitates the scholar to use matrices for large volume data processing.
3. This helps to solve problems involving arithmetic and geometric progressions.
4. Able to choose the right mode of interest and EMI for debt repayment
5. Develop the skill of using descriptive statistical tools.

OBJECTIVES

- To learn matrices, types, use and its application on various business situations.
- To impart knowledge on progressions and its applications.
- To learn various types of interest, growth rate and calculation of EMI on debt repayment.
- To realize the concepts of descriptive statistics and its applications.

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**
Module I (10 Hours)	Sets and sets operation,matrices,venn diagram,matrix multiplication .solving system of simultaneous	● Lecture ● Discussion ● Participative Learning	● Presentation on fundamental ideas about matrices and their operational rules ● Problem	Study;- ● Sets and sets operations ● Venn diagram ● matrices Solving;- ● Matrix multiplication ● Simultaneous	Assessment through test papers

	linear equations		solving	linear equation	
Module II (15 Hours)	Theory of equation meaning and type	● Lecture ● Discussion ● Participative Learning	● Assignment on simple linear and simultaneous equations ● Problem solving	Study theory of equation and types	evaluation through test papers
Module III (20 Hours)	Arithmetic progression, geometric progression, mathematics of finance,simple and compound interest	● Lecture ● Discussion ● Participative Learning	● Problem solving	● Study arithmetic progression and geometric progression ● Calculate simple and compound interest	evaluation through test papers
Module IV (15 Hours)	Meaning and definition of statistics , types of enquiries ,presentation of data by diagrammatic and graphical	● Lecture ● Discussion ● Participative Learning	● Presentation on type of enquiries ● Presentation of data on diagrammatic and graphical method	Evaluate;- ● Meaning and definition of statistics ● Types of enquiries Study;- ● Presentation of data by	Assessment through test papers

	method, formation of frequency distribution		● Problem solving	diagrammatic and graphical method ● Formation of frequency distribution	
Module V (20 Hours)	Measures of central tendency, skewness and kurtosis, lorenz curve, time series,index numbers	● Lecture ● Discussion ● Participative Learning	● Assignment on central tendency ● Problem solving	Study;- ● Measures of central tendency ● Analysis of time series ● Trend and seasonal variations ● Index number	Test papers

BCM3A12 PROFESSIONAL BUSINESS SKILLS

Number of Lecture Hours per week: 5

Number of Credits 4

Internal: 20, External: 80

Examination 2.5 Hours

Objectives:

- To know professional and soft skills for business, business communication and documentation

Module I

Professionalism: Meaning -Definition – Characteristics - Traits and Qualities of a good professional - Professionalism in business - Professional Skills: important soft

skills for business success- Professionalism in Communication: Verbal Communication: Professional Presentation - Different Presentation Postures- Written Communication: Email - Significance of Email in business – Email etiquette: format - rules – dos and don‘ts - Technical Documentation: Standards – Types (15 Hours, 15 marks)

Module II

E-Learning :Introduction of electronic learning - benefits and drawbacks of e-Learning - Online education - Digital age learners - Knowledge resources on internet - E-books, Audio, Video and other means for e-learning- Introduction to e-content development and tools - Online libraries – MOOCs - The e-Learning as a service Industry - major technologies used in e-earning- different approaches for e-Learning delivery - E-learning in India (12 Hours, 12 marks)

Module III

Business Data Analysis : Features of New Generation Computers – Concept of data analysis – Business Data Analysis – Data Analyst – Types of analysts - organisation and source of data, importance of data quality, dealing with missing or incomplete data- Social Networking Analysis – Big Data Analysis - Role of Data Scientist in Business & Society - Role of Artificial Intelligence and Intelligent Agents in e-business - Ethical and Legal considerations in Business Analytics (18 Hours, 18 marks)

Module IV

Socio - Cyber Informatics: IT and society - Digital Divide – Digital natives-Cyber space- New opportunities and threats - Cyber ethics - Cyber-crimes -Types - Cyber Laws –Organisations related with cyber laws-Cyber addictions - Information overload - Health issues - e-waste and Green Computing –Recent E-governance initiatives in India (15 Hours, 15 marks)

Module V

Digital Marketing : Introduction to Digital marketing Environment –meaning & Concept – Need for digital marketing – Advantages and disadvantages of digital marketing -Trends in digital marketing- Types of digital marketing – Business models in digital marketing Business to Business (B2B), Business to Customer

(B2C), Customer to Customer (C2C), Business to Employees (B2E), Business to Government (B2G) - Online advertising - types of online advertising - Top e-commerce websites around the world and its scenario in India. PPC (Pay per Click) advertising – Search engine Analytics – search engine ads – social media channels and ads (20 Hours, 20 marks)

Specific outcomes:

1. Facilitates easy business communication
2. Improved knowledge of E-learning resources and its delivery broadens vision and insight of management.
3. Knowledge of artificial intelligence and data analysis helps to diversify and grow business cutting across obstacles
4. Knowledge of existing national and international cyber laws makes communication and business easier.
5. Digital marketing and its application of social media channels and advertisements enhances changes and horizons of business.

OBJECTIVES

- To measure the applications e –learning resources and its delivery in India.
- To learn data analysis, networking, artificial intelligence, ethical and legal considerations.
- To realize IT and society, cyber ethics, cyber crimes, cyber laws and E-governance initiatives.
- To introduce digital marketing, types of digital marketing, social media and advertisements.

Lesson Plan

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (15 Hours)	● Professionalism in Communication ● Email in Business ● Technical Documentation	● Lecture ● Discussion ● Participative Learning	● Seminars and Assignments on professionalism in Communication ● Online Group discussion on significance of Email in business	● To evaluate professionalism in Business ● To analyse significance of Email in business ● To evaluate Professionalism in Communication	Assessment through Essay writing Competition

Module II (12 Hours)	• E-Learning - Benefits and Drawbacks • Online Education • Introduction to E-Content and Tools • Online Libraries • Major Technologies used in E-Learning	• Lecture • Discussion • Participative Learning	• Online Discussion On Inflibnet • Seminar on Benefits and Drawbacks of E-Learning	• To study Knowledge Resource on Internet • To evaluate different means of e-learning	Assessment through test papers
Module III (18 Hours)	• Concept of data analysis • Social networking Analysis • Role of Data Scientist	• Lecture • Discussion • Participative Learning	• Seminars and Assignments on Organisation and Source of data	• To study features of New generation Computers • To evaluate role of data scientists in Business and Society	Evaluation through Testpapers

	in Business and Society ● Role of Artificial Intelligence and Agents in business				
Module IV (15 Hours)	● Social cyber Informatics ● Cyber Crimes ● E- waste and Green Computing ● Recent E-Governance initiative in India	● Lecture ● Discussion ● Participative Learning	● OnlineGroup discussion in Cyber Crimes ● Online collage on E-waste and Green Computing	● To study cyber laws ● To evaluate e-waste and green computing	Assessment through test papers
Module V (20 Hours)	● Digital Marketing ● Social	● Lecture ● Discussion ● Participative Learning	● Experience sharing by student Entrepreneur	● To study various Business models	Evaluation through Test

	media ads and channels ● Business models in marketing		s on Digital marketing ● Debate on advantages and disadvantages of Digital marketing	● To evaluate advantages and disadvantages of Digital marketing ● To evaluate online advertisements	papers

BCM3BO3 BUSINESS REGULATIONS

Number of Lecture Hours per week: 5

Number of Credits: 4

Internal: 20, External: 80

Examination Hours : 2.5

Objectives:

- To impart basic knowledge of various business law in force

Module I

Business Laws : Introduction - Nature of Business Law - Meaning and definition - Indian Contract Act, 1872: Contract - Definition - Essentials of valid contracts - Classification of contracts - Offer and acceptance - Consideration - Capacity to contract - Free consent -Coercion - Undue influence - Misrepresentation - Fraud - Mistake - Void agreements -Discharge of contract - Breach of contract and remedies - Contingent contracts -Quasi contracts. (20 Hours, 30 marks)

Module II

Special Contracts: Contract of Indemnity: Meaning - Nature - Right of indemnity holder and indemnifier - Contract of Guarantee: Meaning - Nature - Rights and liabilities of surety - Discharge of surety from liability - Contract of Bailment and

Pledge: Rights and duties of bailor and bailee, pledger and pledgee - Contract of Agency - Creation of agency - Delegation of authority - Duties and liabilities of principal and agent -Termination of agency. (20 Hours. 18 marks)

Module III

Sale of Goods Act 1930: Contract for sale of goods -Essentials of a contract of sale -Conditions and Warranties - Caveat emptor - Sale by non owners - Rules as to delivery of goods - Unpaid seller and his rights. (10 Hours, 12 marks)

Module IV

The Consumer Protection Act 1986: Objects and scope - Definition of consumer and consumer dispute - Complaint - Goods - Service - Unfair trade practices - Restrictive trade practices - Rights of consumers - Consumer Protection Council - Consumer Disputes Redressal Agencies. (7 Hours, 10 marks)

Module V

The limited liability partnership Act 2008 – Salient features – Distinction with partnership and company – LLP agreement – partners and designated partners – incorporation document – Extent and limitation of liability of LLP and partners. (7 Hours, 10 marks)

Specific outcomes:

1. Helps to establish and run business as directed by the government.
2. Knowledge of Indian Contract Act 1872 helps to enter into valid contracts in life and business.
3. Learning of Sale of Goods Act helps to do business keeping all legal formalities.
4. Understanding of the privileges and rights of consumers helps to do legally standing business admitting the status of the customers; increases business and relationships in the long run.
5. Able to create LLP business with sound legal knowledge

OBJECTIVES

- To understand in detail of Indian Contract Act and its application on business situations.
- To Learn Sale of Goods Act 1930 and its application.
- To study Consumer Protection Act and grievance handling mechanism.
- To understand Limited Liability Partnership and its application of partnership business. Syllabus Module I: Business Laws : I

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**
Module I (20 Hours)	• Contract Act 1872	• Lecture • Discussion • Participative Learning	• Seminars and assignments on Capacity to contract	• To study essentials of a valid Contract • To study capacity to contract	Evaluation through test papers
Module II (20 Hours)	• Contract of Indemnity • Contract of Guarantee • Contract of Agency	• Lecture • Discussion • Participative Learning	• Assignments and Seminars on Contract of Guarantee and Indemnity	• To study Contract of Indemnity and Guarantee • To study Bailment and Pledge • To study Bailment and Pledge	Evaluation through test papers

	• Bailment and Pledge				
Module III (10 Hours)	• Sale of Goods Act 1930 • Contract for Sales Goods Act	• Lecture • Discussion • Participative Learning	• Assignment on Essentials of Contract for sales	• To study sale of Goods Act 1930	Evaluation through test papers
Module IV (7 Hours)	• Consumer Protection Act	• Lecture • Discussion • Participative Learning	• Peer group discussion on Unfair trade practices	• To study consumer protection act • To evaluate Rights of Consumer	Assessment through MCQ
Module V (7 Hours)	• LLP Act 2008	• Lecture • Discussion • Participative Learning	• Seminars on LLP	• To study LLP Agreement • To evaluate difference between partnership and Company	Evaluation through Test papers

BCM3BO4 CORPORATE ACCOUNTING

Number of Lecture Hours per week: 6

Number of Credits: 4

Internal: 20, External: 80

Examination Hours : 2.5

Objectives:

- To learn to account for redemption of pref. shares, bonus shares, right shares and buy back of shares.

Module I

a. Redemption of Debentures:

Meaning- Writing off of Discount on issue and loss on issue of debenture- Methods of redemption- Annual drawings out of profit and capital (New regulation to be taught)- Debenture redemption reserve- Lump sum payment- Sinking funds and Insurance Policy (Theory only)- Purchase of own debentures- For cancellation, Investment and Reissue- Ex-interest and Cum-interest- Redemption by conversion- Journal Entries.

b. Redemption of Preference Shares:

Provisions for redemption- Sources used for redemption- Capital redemption reserve- Journal entries

c. Bonus Shares:

Cash Bonus- Capital bonus- provisions for the issue of bonus shares- Sources of bonus issue- Advantages of bonus issue- Journal entries.

d. Buyback of shares:

Meaning- Provisions for issue- Sources of buyback- Advantages of buyback- Book building - Journal entries.

e) Right Issue: Right of pre-emption – Calculation of value of right (30 Hours, 25 marks)

Module II

Banking Companies:

Meaning of banking- Slip system of ledger posting- Important terms used- Revenue recognition in banks- Rebate on bills discounted with problems- Interest on doubtful debts with problems- Non-Performing Assets- Classification- Provisions for NPA(problems) - Final accounts of banking companies in the new form- Practical Problems. (18 Hours, 15 marks)

Module III

Accounts of Life Insurance:

Meaning of life insurance- Features- Types of life insurance- Important terms used- Adjusting entries- Calculation of Life fund with problems- Determination of profit of life business and net bonus payable- Problems- Preparation of final accounts of life business in the new form- Practical Problems. (18 Hours, 15 marks)

Module IV`

Consolidated Financial Statements (Ind AS 110): Group Companies and Group Structures– need for consolidation – Calculation of pre-acquisition Calculation of profit- Post-acquisition profit- Calculation of Non-Controlling Interest – Calculation of Cost of Control (Goodwill) or Capital Reserve- Preparation of Consolidated Balance Sheet without adjustments (simple problems) (20 Hours, 15 marks)

Module V

Important Disclosure based accounting standards: Earnings per share(Basic and Diluted) Ind AS 33 – Segment Reporting Ind AS 108- Events after Reporting Period (Adjusting and Non adjusting) Ind AS 10- Related party transactions Ind AS 24 - Changes in accounting policies, accounting estimates and errors Ind AS 8- Interim Financial Reporting Ind AS 34.

(10 Hours, 10 marks)

(Theory and problems may be in the ratio of 30% and 70% respectively)

Specific course outcomes:

1. Becomes competent to prepare accounts related with redemption of preference shares, bonus shares, right issue of shares and buy back of shares.
2. Realizes the concept of preparation of final accounts of banking companies.
3. Develop the skill of preparation of final accounts of life insurance companies.
4. Able to prepare the final accounts of group companies.
5. Understand the concept of disclosure based accounting standard and interim reporting.

OBJECTIVES

- Construct the financial practices of banking companies and preparation of final accounts.
- Develop accounting practices of life insurance companies and drafting final accounts.
- Demonstrate the preparation of consolidated financial statements of group companies.
- Develop important disclosure based accounting standards and interim financial reporting.

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**

Module I (30 Hours)	• Redemption of Debentures • Different methods of Redemption • Redemption of Preference Shares • Bonus Share, Buyback of shares, Right issue	• Lecture • Discussion • Participative Learning	• Seminar on methods of redemption of debentures • Assignment on exercise questions	• To study redemption of debentures • To study redemption of preference shares • To evaluate bonus and right issue	Evaluation through test papers
Module II (18 Hours)	• Accounting of Banking Companies • Preparation of financial statements of banking company	• Lecture • Discussion • Participative Learning	• Assignment on exercise questions	• To study preparation of final accounts of banking companies	

Module III (18 Hours)	• Accounts of Life Insurance • Preparation of Final accounts of Life Insurance	• Lecture • Discussion • Participative Learning	• Group discussion on different types of Life Insurance • Assignment on exercise questions	• To study various type of Life Insurance • To evaluate the methods to determine profit of life business	Evaluation through test papers
Module IV (20 Hours)	• Consolidated financial statements	• Lecture • Discussion • Participative Learning	• Seminar on various consolidated financial statements • Assignment on exercise questions	• To study the preparation of various consolidated financial statements	Assessment through problem solving tests
Module V (10 Hours)	• Indian accounting standards	• Lecture • Discussion • Participative Learning	• Seminars on Indian Accounting standards	• To evaluate Indian Accounting Standards	Assessment through test papers

BCM3C03 HUMAN RESOURCE MANAGEMENT

Number of Lecture Hours per week: 5
Number of Credits: 4
Internal: 20, External: 80
Examination Hours: 2.5

Objectives:

- To impart understandings on human resource management

Module I

Introduction to Human Resource Management—Importance--scope and objectives of HRM. Evolution of the concept of HRM- Approaches to HRM- Personnel management Vs Human Resource Management-HRM and competitive advantage-Traditional Vs Strategic human resource management. E-HRM - Operational E-HRM- Relational E-HRM- Transformational E- HRM (20 Hours, 20 marks)

Module II

Human resource planning, Recruitment and selection—Job analysis---process of job analysis-job description- job specification-- methods of job analysis-- Conventional Vs strategic planning—job evaluation—Recruitment--source of recruitment-methods. (18 Hours, 18 marks)

Module III

Placement, Induction and Internal mobility of human resource. Training of employees—need for training-objectives- approaches --methods-training environment- areas of training- Training evaluation. (12 Hours, 12 marks)

Module IV

Performance appraisal and career planning. Need and importance- objectives process- methods and problems of performance appraisal- . Concept of career planning –features- methods –uses career development. (12 Hours, 15 marks)

Module V

Compensation management and grievance redressal. Compensation planning objectives- Wage systems- factors influencing wage system-. Grievance redressal

procedure- discipline- approaches punishment- essentials of a good discipline system. Labour participation in management. (18 Hours, 15 marks)

Specific course outcomes:

1. Knowledge of human resource management helps to run business effectively.
2. Understand the necessary skills required for the employment in an organization.
3. Familiarity with the induction and organizational training practices helps to have effective trained work force in the organisation..
4. Understand the concept of career planning and performance appraisal.
5. Insight on compensation and grievance management practices helps to take effective and appropriate decisions on time.

OBJECTIVES

- To equip the students with basic knowledge and skills required for the acquisition, development and retention of human resources.
- Develop the organizational practices of induction and organizational training practices.
- Analyze the concept of performance appraisal and career planning.
- Understand the compensation management and grievance redressal practices in the organization

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**

Module I (20 Hours)	• Introduction to human resource management • Human resource management and personnel management • Resource management	• Lecture • Discussion • Participative Learning	• Seminar on traditional v/s strategic management	• To study scope and objectives of management • To evaluate traditional HRM v/s strategic HRM • To study resource management	• Evaluation through test papers
Module II (18 Hours)	• Human resource planning ,job analysis • Recruitment .source of recruitment	• Lecture • Discussion • Participative Learning	• Seminar on human resource planning • Assignment on source of recruitment	• To evaluate human resource planning • To analyse source of recruitment	Evaluation through test paper
Module III (12 Hours)	• Placement • Induction • Training	• Lecture • Discussion • Participative Learning	• Online discussion on training method	• To study placement and induction method • To evaluate	Evaluation through testpaper

				training method	
Module IV (12 Hours)	• Performance appraisal and career planning • Career planning concepts and methods	• Lecture • Discussion • Participative Learning	• Online discussion on career development	• To evaluate performance appraisal and career planning	Assessment through case study
Module V (18 Hours)	• Compensation management an grievance redressal • Factors influencing wage system, grievance redressal procedure	• Lecture • Discussion • Participative Learning	• Seminar on grievence redressel proceduresOnline discussion on various methods of compensation management • Seminar on factors influencing wage system	• To evaluate the compensation management and grievance redressalTo study about grievances redressal management • To evaluate factors of wage system	Evaluation through case study Evaluation through test papers

BCM4A13 ENTREPRENEURSHIP DEVELOPMENT

Number of Lecture Hours per week: 5

Number of Credits : 4

Internal: 20, External: 80

Examination Hours: 2.5

Objectives:

- To understand the basic concepts of entrepreneurship

Module I

Concepts of entrepreneur: Entrepreneur- Définitions - Characteristics of entrepreneur-Classification of entrepreneur-Entrepreneurial traits -Entrepreneurial functions - role of entrepreneurs in the economic development - Factor affecting entrepreneurial growth – Entrepreneurship – Meaning – definition - Entrepreneur vs Intrapreneur - Women Entrepreneurs - Recent development – Problems - Entrepreneurial Development Programmes - Objectives of EDP - Methods of training - Phases of EDP. (15 Hours, 15 marks)

Module II

Institutional support and incentives to entrepreneurs- Functions of Department of Industries and Commerce (DIC) - Activities of Small Industrial Development Corporation (SIDCO)-Functions of National Small Industries Corporation(NSIC)-

Functions of Small Industries Development Bank of India (SIDBI) - Khadi Village Industry Commission (KVIC)-Small Industries Service Institute (SISI)- Functions and services of Kerala Industrial Technical Consultancy Organisation (KITCO)-Activities of Science and Technology Entrepreneurship Development Project (STEDP)-Strategies of National entrepreneurship Development Board (NEDB) - Objectives of National Institute for entrepreneurship and small business development (NIESBUD) - Techno park-Functions of techno park Incentives-Importance- Classification of incentives – Subsidy - Types of Subsidy (17 Hours, 15 marks)

Module III

Micro Small and Medium Enterprises- Features- Objectives- Importance- Role of SME in the economic development- MSME Act 2006- Salient features- Credit Guarantee Fund Trust Scheme for MSMEs - Industrial estates-Classification-Benefits- Green channel- Bridge capital- Seed capital assistance-Margin money schemes –Single Window System- Sickness- Causes –Remedies- Registration of SSI (15 Hours, 15 marks)

Module IV

Setting up of Industrial unit-(Only Basic study) Environment for Entrepreneurship – Criteria for selecting particular project- Generating project ideas-Market and demand analysis-Feasibility study- Scope of technical feasibility- Financial feasibility- Social cost benefit analysis-Government regulations for project clearance-Import of capital goods- approval of foreign collaboration-Pollution control clearances- Setting up of micro small and medium enterprises-Location decision- Significance. (18 Hours, 20 marks)

Module V

Project Report - Meaning-Definition - Purpose of project reports-Requirements of good report - Methods of reporting - General principles of a good reporting system - Performa of a project report - Sample project report. (The preparation of sample project report shall be treated as an assignment of this course). (15 Hours, 15 marks)

Specific Outcomes:

1. It motivates the learner to become an entrepreneur
2. Knowledge of supports available helps to reap the benefits of easily
3. It is intended to trigger the mind set of youth to establish and run MSMEs in life
4. Knowledge of establishing industrial units helps to start with business units easily.
5. The learner can draft and finalise project report without external helps and supports.

OBJECTIVES

- To learn the governmental support for entrepreneurs
- To study the importance of MSMEs and supports available.
- To give a glimpse of establishment and running of a business unit
- To give an idea of preparing a project report.

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**
Module I (1515Hours)	● Concepts of entrepreneur,classification of entrepreneurs,wo	● Lecture ● Discussion ● Participative Learning	● Experience shared by student entrepreneur ● Online discussion about women entrepreneurs	● To study the concepts of entrepreneur ● To evaluate women entrepreneurship ● To evaluate	Assessment through case studyEvaluation through test papers

	men entrepreneur,factors affecting entrepreneurial growth,entrepreneurial development growthConcept of Entrepreneur ● Role of entrepreneur in economic development ● Women Entrepreneurship		hip Webinar on entrepreneurship ● Online interactive session with local women entrepreneurs	entrepreneurial development programmeTo study about various concepts of Entrepreneurship ● To encourage them to get into entrepreneurship	
Module II (15 Hours)	● Institutional support and incentive to entrepren	● Lecture ● Discussion ● Participative Learning	● Assignment on institutional support and incentive to entrepreneurs Seminars and	● To evaluate institutional support and incentive to entrepreneurs ● To identify various	● Assessment through essay writingAsse

	eurs,importance - classification of entrepreneurship Institutional support and incentives to Entrepreneurs ● Activities of SIDCO, NSIC,SIDBI, KVIC, SISI, KITCO, STEDP		Assignments On various activities of different institutions	subsidiesTo study about different incentive schemes and subsidy available for entrepreneurs	ssment through test papers
Module III (15 Hours)	MSME features and objectives.role of SME in economic development, ● Msme act2006,registration of SSI	● Lecture ● Discussion ● Participative Learning	● Assignment on role of MSME in economic development Discussion on role of SME in economic development	● To study msme features and objectives ● To evaluate MSME act 2006 To evaluate MSME ACT ● To study MSME	● Assessment through test papers Evaluation through test papers

	Micro small and medium Enterprises ● MSME Act 2006 ● Seed capital assistance			features and objectives ● To identify registration of SSI	
Module IV (18 Hours)	Setting up of industrial unit,generation of project ideas market , demeand , feasibility studySetting up of industrial unit, generating project ideas, feasibility study,sickness , causes , remedies	● Lecture ● Discussion ● Participative Learning	● Seminar On pollution control clearance ● Debate on government regulation for project clearance ● Industrial visitPresentation on project ideas	● To study setting up of industrial unit ● To evaluate government regulation for project clearanceTo evaluate setting up of industrial unit ● Feasibility study	● Evaluation through test papers Assessment through essay writing
Module V (15 hours)	Project report, Methods of reporting.proforma of a project report	● Lecture ● Discussion ● Participative Learning	● Presentation on the preparation of project report	● To develop the skill on project report preparation ● To study the	● Evaluation through test paper

				proforma of project report	
Module V (15 Hours)	Project report, General principles of a good reporting system	• Lecture • Discussion • Participative Learning	• Assignment on preparation of project report	• To acquire the skill of preparing project report	Assessment through test paper

BCM4A14 BANKING AND INSURANCE

Number of Lecture Hours per week: 5
Number of Credits: 4
Internal: 20, External: 80
Examination Hours: 2.5

Objectives:

- To provide a picture of the functions of banks and RBI

Module I

Introduction to Banking : Meaning and definition - Origin and development of banking –Customer of a bank - Structure of banking in India - Banks and economic development -Functions of commercial banks (conventional and innovative functions) - Central bank -RBI – Functions - Emerging trends in banking.
Activity: List out the name of banks as per their different category
Assignment: Procedure for creating an account in a bank (15 Hours, 15 marks)

Module II

Negotiable Instruments : Definition - Characteristics - Types - Parties to negotiable instruments -Cheques - Types of cheques - Crossing of cheques - Drafts - Cheque

vs. Draft - Endorsement -Significance - Regularity of endorsement - Liability of endorser -Electronic payments.

Activity / Assignment:

- Writing of cheque , writing of challan for Demand Draft
- Procedures for a Bank Loan. (15 Hours, 15 marks)

Module III

E-Banking-centralized online real time electronic banking (CORE)-Electronic Clearing service (ECS) - Electronic Fund Transfer - Real Time Gross settlement (RTGS)—National Electronic Fund transfer(NEFT)-society for worldwide interbank financial telecommunication(SWIFT) - E-cheque - Any Time Money - ATM.s- Credit card - Debit card-smart card - Internet banking - mobile banking - Tele-banking - financial inclusion - recent initiatives in financial inclusion.

Activity / Assignment:

- Chelan filling for RTGS, EFT and NEFT
- Different types of Cards, the Procedure for application of different cards and the Procedure for blocking cards
- Procedure for application or activation of net banking, m-banking and tele-banking. (20 Hours, 20 marks)

Module IV

Introduction to insurance: Concept - need of insurance-insurance as a social security tool - insurance and economic development-principles of insurance - various kinds of insurance - life and general insurance (fire, marine, medical, personal accident, property and motor vehicle insurance) - features-life insurance Vs. general insurance.

Activity / Assignment: List out different names of insurance companies (15 Hours, 15 marks)

`

Module V

Life insurance-law relating to life insurance-general principles of life insurance contract, proposal and policy—Assignment and nomination - title and claims - general insurance - law relating to general Insurance - IRDA - powers and functions - insurance business in India.

Case Study: Preparation of a proposal for life insurance and how to claim insurance in case of any accident, death or damage. (15 Hours, 15 marks)

Specific Outcomes:

1. Candidates get clear picture of the banking business India and they can plan accordingly.
2. Knowledge of negotiable instruments, features & formalities helps to deal with care.
3. This helps the candidate to be up-to-date in banking formalities and fund transfer.
4. Knowledge of insurance business helps to hedge, avoid, and reduce risk in business.
5. Knowledge of LIC and IRDA helps to move with Insurance people with confidence.

OBJECTIVES

- To understand the features of negotiable instruments and its formalities
- To impart knowledge on modern banking facilities
- To give a general idea of insurance business in India
- To understand Life Insurance business in India and the role of IRDA

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**

Module I (15 Hours)	Banking meaning and definition,structure of banking in India , functions of commercial banks, RBI functionsIntroduction to banking,structure of banking in India, functions of commercial banks,functions of RBI	• Lecture • Discussion • Participative Learning	• Seminar on functions of commercial banks • assignments on functions of RBIAssignment on functions of central and commercial banks • List out the names of banks as per their different category • Procedure for creating an account in a bank	• To study structure of banking in India • To evaluate the functions of central and commercial banksTo learn the functions of bank • To evaluate the emerging trends in banking • To study the structure of banking in India	Assessment through MCQAssessment through MCQ
Module II (15 Hours)	Negotiable instrument, types of cheque. Regularity of endorsement Negotiable instrument, types of cheque,endors	• Lecture • Discussion • Participative Learning	• Presentation on different types of chequeWriting of cheque • Writing of challan for demand draft • Procedures for bank loan	• To study negotiable instruments • To evaluate regularity of endorsementTo study the types of cheques • To evaluate	Evaluate through test papersAssessment through test papers

	ement			the negotiable instrument	
Module III (15 Hours)	E-banking.plastic money,financial inclusionEbanking,plastic money, internet banking, financial inclusion, recent initiative in financial inclusion	• Lecture • Discussion • Participative Learning	• Group discussion in recent initiative in financial inclusionChelan filling for RTGS,EFT,and NEFT • Different types of cards,the procedure for application of different cards and procedure for blocking cards • Procedure for application or activation of net banking , m-banking and tele-banking	• To study e banking • To study plastic money • To evaluate financial inclusionTo acquire knowledge in e- banking , plastic money, internet banking	• Assessment through test papers Assessment through test papers

Module IV (15 Hours)	Insurance concept, need of insurance. Principles of insurance,types of insurance. Life insurance V/S general insuranceInsurance , need of insurance , various kinds of insurance principles of insurance, life and general insurance	• Lecture • Discussion • Participative Learning	• Seminar on different type of insuranceList out different names of insurance company • Discussion on different types of insurance	• To evaluate different types of insurance • To study principles of insurance • To analyse general insurance and life insuranceTo study different types of insurance • To evaluate life insurance and general insurance	• Assessment through test paper Assessment through MCQ
Module V (15 Hours)	Life insurance law, general principle of life insurance contract IRDA powers and functionsLaw relating to life insurance, general principles of life insurance contract, IRDA ,	• Lecture • Discussion • Participative Learning	• Discussion on life insurance contract in IndiaPresentation on general principle of life insurance	• To study life insurance law • To study law relating to general insuranceTo evaluate the law relating to life insurance	Assessment through MCQEvaluation through case study

	powers and function				

BCM4B05 COST ACCOUNTING

Number of Lecturer Hours per week: 6

Number of Credits: 4

Internal: 20, External: 80

Examination Hours : 2.5

Objectives:

- Intended to impart basic knowledge of cost accounting and the terms associated with it.

Module I

Introduction : Definition - Meaning and scope - Objectives - Functions -Merits and Demerits - Cost Accounting and Financial Accounting - Cost classification - Elements of cost - Cost units - Cost centre - Types - Methods and Techniques of Costing . (10 Hours, 5 marks)

Module II

Materials : Importance of Material cost control - Purchase Procedure - Store control -Types of Store - Stores Records - Perpetual Inventory-ABC Analysis - VED Analysis-JIT Inventory- Stock levels - EOQ - Issue of materials - FIFO , LIFO , Simple and Weighted Average methods. (18 Hours, 15 marks)

Module III

Labour and Overheads: Importance of Labour cost control - Time Keeping and Time Booking - Idle Time - Overtime - Computation of Labour cost - Remuneration Systems and Incentive Schemes. Overheads : Definition - Overhead Allocation - Apportionment - Reapportionment -Direct distribution - Step Ladder - Reciprocal Service methods - Repeated Distribution and Simultaneous Equation methods - Absorption of overheads - Methods of Absorption - Labour Hour Rate and Machine Hour Rate . (25 Hours, 20 marks)

Module IV

Methods of Costing: Specific order costing: Job costing - Contract costing – Continuous operation costing: Unit Costing - Process Costing (with adjustments of normal and abnormal losses and gains only) - Service costing (only Transport costing) (30 Hours, 30 marks)

Module V

Cost control Techniques:

A. Budgetary Control: – Budget – Budgeting – Budgetary control - Importance – Need for the preparation of budgets - Types of budgets –Preparation of Cash budget only – ZBB

B. Standard costing – Standard cost and actual cost – Variance analysis– Types of variances – Cost control by the use of standard costing (only theory – no problems expected). (13 hours, 10 marks)

(Theory and Problems may be in the ratio of 40% and 60% respectively

Specific Outcomes:

1. The learner gets insights into the costing and cost accounting tools and techniques.

2. The learner understands the scientific material cost control measures in use..
3. The scholar gets used to the scientific labour and overhead cost control measures.
4. Knowledge of various methods of costing helps the learner to practice in life.
5. Variance analysis helps to identify its causes and take corrective actions.

OBJECTIVES

- It is designed to understand measures for materials control by Management.
- To familiarize with the Labour and overhead cost control measures by Management
- To learn the various methods of costing
- To give an overview of budgeting and standard costing tools and techniques.

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**
Module I (10 Hours)	Meaning and scope of cost accounting, elements of cost , cost units , methods and technique of cost accounting	● Lecture ● Discussion ● Participative Learning	● Assignment on cost classification	● To identify different methods and technique of cost accounting	Evaluation through test papers

Module II (20 Hours)	Materials, material control technique	• Lecture • Discussion • Participative Learning	• Assignment on exercise questions	To study on material control techniques	Assessment through test papers
Module III (20 Hours)	Labour OH,computation on labour cost, OH allocation, methods of absorption	• Lecture • Discussion • Participative Learning	• Assignment on exercise question	• To study methods of labour cost calculation • To study OH allocation	Assessment through test papers
Module IV (25 Hours)	Methods of costing-job costing , unit costing, process costing, service costing	• Lecture • Discussion • Participative Learning	• Assignment on exercise questions	• To study methods of costing	Assessment through test papers
Module V (15 Hours)	Cost control techniques-budgetary control Standard costing	• Lecture • Discussion • Participative Learning	• Assignment on exercise questions	• To study cost control techniques • To evaluate standard costing	Assessment through test papers

BCM4BO6 CORPORATE REGULATIONS

Number of Lecture Hours per week: 4
Number of Credit: 4
Internal: 20, External: 80
Examination Hours : 2.5

Objectives:

- To study the Indian Companies Act 2013 and various provisions contained in it

Module I

`Introduction to Companies Act 2013: Objects of the Act - Salient features of the Act -Meaning and definition of company - Features - Kinds of companies - Private Company -Public company - Associate Company - Dormant Company - One person company -Small Company - Government Company - Lifting of corporate veil. (08 Hours, 10 marks)

Module II

Formation of Companies: Promotion - Role of promoters - Incorporation - Capital subscription - Commencement of business - Pre-incorporation and provisional contracts. Document of companies: Memorandum of Association - Definition - Contents and alteration - Doctrine of Ultravires - Articles of Association - Definition - Contents and alteration - Distinction between Memorandum and Articles - Constructive notice of Memorandum and Articles - Doctrine of Indoor management - Prospectus - Contents -Statement in lieu of prospectus - Liabilities for misstatement. (13 Hours, 18 marks)

Module III

Share Capital : Shares - Kinds of shares - Public issue of shares - Book building - Allotment of shares - Irregular allotment - Issue prices of shares - Listing of shares -Employees stock option scheme - Sweat equity shares - Right shares - Bonus shares -Shares with differential rights - Share certificate and share warrant - Calls - Forfeiture -Surrender of shares - Buyback of shares - De materialization and re materialization of shares - Transfer and transmission of shares - Transfer under Depository system. (13 Hours, 17 marks)

Module IV

Management of Companies : Board and Governance - Directors: Appointment - Position – Powers Rights - Duties and liabilities - Qualification - Disqualification - Removal of directors - Key Managerial Personnel - Introduction to Corporate Governance - Need and importance of Corporate Governance - Corporate social responsibility. Securities and Exchange Board of India Act 1992 - Object - Establishment and management of SEBI -Powers and functions of SEBI - Securities Appellate Tribunal (SAT). (18 Hours, 20 marks)

Module V

Company Meetings and Winding up : Requisites of a valid meeting - Statutory meeting -Annual general body meeting - Extraordinary meeting - Board meetings - Resolutions -Types - Company Secretary : Qualification - appointment - duties - Winding up : Meaning - Modes of winding up - Winding up by Tribunal - Members' voluntary winding up - Creditors' voluntary winding up - Liquidator: Powers - Duties and liabilities -Consequences of winding up. (12 Hours, 15 marks)

Specific Outcomes:

1. Knowledge of Indian Companies Act gives the legislative backgrounds of a company.
2. The candidate knows the formalities for formation of a company which will help to form more corporates in life.
3. The knowledge of raising funds will help the candidate to choose between debt and equity easily
4. The candidate can easily manage a company as he knows the rights, duties and powers of all positions.
5. Knowledge of situations when a company may go for liquidation helps to run the business effectively.

OBJECTIVES

- To learn the legal formalities in the formation of a company.
- To know the clauses related to Shares and its transfer.
- To seek the rights, duties and powers of directors and corporate governance.
- To Understand the methods of winding up of a company

Lesson Plan

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (05 Hours)	Introduction of companies Act 2013, different types of company	● Lecture ● Discussion ● Participative Learning	● Assignment on different types of company	● To evaluate introduction of companies Act 2013 ● To study different types of company	Assessment through MCQ
Module II (20 Hours)	Formation of companies,role of promoters,commencement of business document of companies,prospectus	● Lecture ● Discussion ● Participative Learning	● Seminar on role of promoters ● Assignment on prospectus of issue	● To identify how to form a company ● To evaluate documents of the company	Assessment through case study

Module III (15 Hours)	Share capital,kinds of share capital.employees stock option schemes , right issue , bonus issue , forfeiture of shares, materialization and dematerialization of shares	• Lecture • Discussion • Participative Learning	Assignment on different types of shares	• To study share capital • To study right issue , bonus share, forfeiture of shares • To evaluate materialization and dematerialization	Assessment through test paprers
Module IV (20 Hours)	Management of companies ; board and governance.corporate social responsibility, SEBI Act1992. Powers and functions of SEBI	• Lecture • Discussion • Participative Learning	• Discussion on CSR • Assignment on powers and functions of SEBI	• To study management of companies • To evaluate CSR • To study SEBI act	Assessment through case study
Module V (10 Hours)	Company meeting and winding up Directors appointment-meaning and	• Lecture • Discussion • Participative Learning	• Seminar on company meeting	• To evaluate company meeting • To study company secretary	Assessment through test papers

	modes of winding up			• To evaluate winding up of company	

BCM4C04 QUANTITATIVE TECHNIQUES FOR BUSINESS

Number of Lecture Hours per week: 5
Number of Credits: 4
Internal: 20, External: 80
Examination Hours : 2.5

Objectives:

- To provide a basic idea of quantitative techniques used in business

Module I

Quantitative Techniques - Introduction - Meaning and definition - Classification of Q.T - QT and other disciplines - Application of QT in business - Limitations. (10 Hours, 10 Marks)

Module II

Correlation and Regression Analysis: Meaning and definition of Correlation - Karl Pearson's coefficient of correlation - Rank correlation - Regression - Types - Determination of simple linear regression - Coefficient of determination. (20 Hours, 20 Marks)

Module III

Set Theory - Venn Diagrams - Probability: Concept of probability - Meaning and definition - Approaches to probability - Theorems of probability - Addition Theorem - Multiplication Theorem -Conditional probability- Inverse probability- Baye'sTheorem. (15 Hours, 15 Marks)

Module IV

Theoretical Distribution: Basic assumptions and characteristics - Probability distribution - Fitting of probability distribution - Binomial distribution - Fitting of binomial distribution - Poisson distribution - Fitting of Poisson distribution - Normal distribution - Features and properties - Standard normal curve. (20 Hours, 20 Marks)

Module V

Quantitative approach to decision making- Types and steps in decision making- Decision tree analysis-Different types of models-Model building steps - Linear programming-concepts - Mathematical formulation - Solution of LPP using graphic method (15 Hours, 15 Marks)

Specific Outcomes:

1. Knowledge of QT broadens vision and outlook of the candidate to face business problems.
2. Understanding of correlation and regression analysis helps to predict with greater degree of accuracy.
3. Awareness of probability and other theories helps to have critical thinking and rational decisions.
4. Familiarity with theoretical distributions helps to correlate issues with standard theories and take decisions.
5. Knowledge of LPP and modeling will be of great help in decision making

OBJECTIVES

- To study the correlation and regression techniques

- To learn probability theories
- To understand theoretical distributions prominently in use
- To learn linear programming methods.

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**
Module I (05 Hours)	Quantitative techniques introduction - meaning and definition QT and other disciplines- application of QT	● Lecture ● Discussion ● Participative Learning	● Online Group discussion Application of QT in business	● To study the meaning and concepts of QT ● Application of QT in business	Evaluation through essay writing
Module II (20 Hours)	Correlation and regression analysis , karl pearson's co - efficient of correlation - regression, types	● Lecture ● Discussion ● Participative Learning	Assignment on exercise question	To study correlation and regression To study karl pearson's efficient of correlation	Evaluation through test papers

Module III (15 Hours)	Set theory , venn diagram, probability,approaches to probability addition theorem, multiplication theorem bayes theorem	• Lecture • Discussion • Participative Learning	Assignment on exercise questions	To study set theory To study theorems of probability	Evaluation through test papers
Module IV (15 Hours)	Theoretical distribution , basic assumptions and characteristics , probability distribution , binomial distribution poisson distribution normal distribution	• Lecture • Discussion • Participative Learning	Assignment on exercise questions	To study theoretical distributions	Evaluation through test papers
Module V (20 Hours)	Quantitative approaches to decision making, decision tree models, model building steps,linear	• Lecture • Discussion • Participative Learning	Assignment on exercise question	To study quantitative approaches to decision making To evaluate decision tree modes To study linear programming	Assessment through test papers

	programming				

BCM5B07 ACCOUNTING FOR MANAGEMENT

Number of Lectures Hours per week: 4

Number of Credits: 4

Internal: 20, External: 80

Examination Hours : 2.5

Objectives:

- To give an overview of Management Accounting

Module I

Management Accounting: Nature and Scope - Difference between cost Accounting, Financial accounting and Management accounting - Recent trends in Management Reporting. (05 Hours, 5 marks)

Module II

Analysis and Interpretation of Financial Statements: Meaning - Types and Methods of Financial Analysis - Comparative Statements - Trend Analysis - Common size Statements (a general discussion only). (10 Hours, 10 marks)

Module III

Ratio Analysis: Meaning - Nature - uses and limitations of Ratios - Liquidity, Profitability, Turnover, Solvency, Leverage. Market test Ratios. Construction of Financial Statements from ratios - Judgment of financial stability through ratios - (Focus to be given to problems solving and Interpretation skills) (25 Hours, 25 marks)

Module IV

Fund Flow and Cash Flow Analysis:
A. Fund Flow Statements: Meaning and concept of Fund - Current and Non Current Accounts Flow of fund - Preparation of Fund Flow statement - Uses and Significance.
B. Cash Flow Statement: Difference between Fund flow Statement and Cash flow Statement - Preparation of Cash Flow Statement as per AS - 3 Norms - Direct and Indirect methods (Stress to be given to Problems). (25 hours, 25 marks)

Module-V
Managerial Decision making with the help of CVP Analysis : Marginal Costing - Fixed Cost-Variable Cost - Contribution - P/V Ratio - Break Even Analysis - Algebraic and Graphic presentation - Decision making : Fixation of Selling Price - Exploring new markets - Make or Buy - Key Factor - Product Mix - Operate or Shutdown. (15 Hours, 15 marks)

(Theory and Problems may be in the ratio of 40% and 60% respectively).

Specific Outcomes:

1. To make the learner aware of the methodologies of Management Accounting
2. It is to make the candidate learn how to conceive and interpret financial statements
3. Ratios are very helpful tools for analysis and interpretations.
4. Knowledge of movements in working capital helps to check/control flow of funds/cash.
5. Knowledge of CVP analysis will be of great help for managerial decision making.

OBJECTIVES

- To study the methods of analysing financial statements
- To learn Ratio analysis
- To learn Fund Flow and Cash Flow analysis
- To understand CVP analysis

Lesson Plan

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (05 Hours)	Management accounting, difference between cost accounting , financial accounting and management accounting	● Lecture ● Discussion ● Participative Learning	Online peer group discussion on recent trends in management accounting	To evaluate difference between cost accounting and management accounting To analyse recent trends in management accounting	Assessment through case study
Module II (05 Hours)	Analysis and interpretation of financial statement,methods of financial analysis	● Lecture ● Discussion ● Participative Learning	Collect final accounts of various companies and make financial analysis	To develop the skill for financial analysis on financial statement	Assessment trough test papers
Module III (25 Hours)	Ratio analysis , liquidity ratios, profitability ratios.solvenc	● Lecture ● Discussion ● Participative Learning	Assignment on exercise questions	To study judgement analysis on financial statement with the help of ratio analysis	Assessment trough test papers

	y , leverage, judgement of financial stability				
Module IV (20 Hours)	Fund flow statement- preparation Cash flow statement - direct and indirect method	● Lecture ● Discussion ● Participative Learning	Assignment on exercise questions	To study the preparation of fund flow and cash flow statement	Assessment through test papers
Module V (20 Hours)	Managerial decision making with the help of CVP analysis- marginal costing,break even analysis	● Lecture ● Discussion ● Participative Learning	Assignment on exercise questions	To study managerial analysis through CVP analysis	Evaluation through case study

BCM5B08 BUSINESS RESEARCH METHODS

Number of Lecture Hours per week: 4

Number of Credits: 4

Internal: 20, External: 80

Examination Hours :2.5

Objectives:

- To impart a general idea of research and types of research.

Module I

Business Research: – Definition and significance - Features of business research – The research process – Variable - Proposition - Types of research – Exploratory and causal research –Theoretical and empirical research - Basic and applied research - Descriptive research - Phases of business research – Research Hypothesis – Characteristics – Research in an evolutionary perspective – Role of theory in research - Theory building - Induction and Deduction Theory. (10 Hours, 15 marks)

Module II

Research Design – Definition – Types of research design – Exploratory and causal research design - Descriptive and experimental design – Types of experimental design – Validity of findings – Internal and external validity – Variables in research – Measurement and scaling – Different scales –Construction of instrument - Validity and reliability of instrument (15 Hours, 15 marks)

Module III

Data Collection: - Types of data – Primary Vs secondary data – Methods of primary data collection – Survey Vs observation – Experiments – Construction of questionnaire and instrument – Validation of questionnaire – Sampling plan – Sample size – Sampling methods- Determinants of optimal sample size – Sampling techniques – Probability Vs non probability sampling methods. (15 Hours, 20 marks)

Module IV

Data Processing: Processing stages - Editing - Coding and data entry – Validity of data – Qualitative Vs quantitative data analysis – Frequency table - Contingency table - Graphs - Measures of central tendency and index number – Testing of Hypothesis - Bivariate and multi variate statistical techniques – Factor analysis – Discriminant analysis- Cluster analysis – Interpretation. (15 Hours, 20 marks)

Module V

Research Report:Different types – Contents of report – Need of executive summary – Chapterisation – Contents of chapter - Report writing stages – The role of audience – Readability – Comprehension – Tone – Final proof – Report format – Title of the

report – Ethics in research – Subjectivity and objectivity in research. (09 Hours, 10 marks.

Specific Outcomes:

1. The learner knows the primary matters of business research
2. The student know how to fix a research design, scaling checking validity etc
3. The candidate knows the method of data collection and its processing and validation.
4. The learner knows to process collected data, test hypothesis and arrive at conclusions
5. The student knows well how to write an academic report and present it

OBJECTIVES

- To study the fundamentals of research and measurement of reliability
- To learn scientific data collection process
- To understand scientific data processing techniques and testing of hypothesis
- To study drafting of a research report and matters to be kept in mind.

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**
Module I (10 Hours)	Business research - definition, significance.t	● Lecture ● Discussion ● Participative Learning	Seminar on different types of research	● To study business research and its	Assessment through test papers

	ypes of research, role of theory in research			significance ● Evaluate different types of research	
Module II (15 Hours)	Research design , types of research design,validity of findings	● Lecture ● Discussion ● Participative Learning	Discussion on types of research design	● To study research design ● To evaluate different types of research design	Assessment through test paper
Module III (15 Hours)	Data collection.types of data,methods of primary data collection, sampling plan sample size, sample methods,sampling technique	● Lecture ● Discussion ● Participative Learning	Assignment on sampling technique Group discussion on methods of data collection	To study data collection methods To study sampling technique To evaluate sample methods	Assessment through case study
Module IV (15 Hours)	Data processing, qualitative v/s quantitative data analysis.testin	● Lecture ● Discussion ● Participative Learning	Seminar on quantitative v/s qualitative data analysis	To study data processing To study testing of hypothesis	Assessment through test papers

	g of hypothesis, bivariate and multivariate data analysis. Factor analysis			To study factor analysis	
Module V (15 Hours)	Research report. Contents of report, report writing stages. Report format	● Lecture ● Discussion ● Participative Learning	Assignment on content of project report	To study project report content To evaluate report format	Assessment through test papers

BCM5 B09 INCOME TAX LAW AND ACCOUNTS

Number of Lecture Hours per week: 5

Number of Credits: 4

Internal: 20, External: 80

Examination Hours: 2.5

Objectives:

- To learn taxation system in India, and to learn taxable income, exempted income,agricultural income, calculation of taxable income, residential status etc.

Module I

Basic Concepts: Income - Agricultural income - Person - Assessee - Assessment Year - Previous Year - Gross total income - Total income - Maximum marginal rate of lax - Residential status - Scope of total income on the basis of residential status – Exempted incomes. (10 Hours, 15 marks)

Module II

Computation of Income under Different Heads: Salaries - Allowances - Perquisites -Profit in lieu of salary - Gratuity – Pension. (20 Hours, 20 marks)

Module III

Income from house property: Annual Value of House property - Computation under different circumstances - Deduction from annual value.
(15 Hours, 15 marks)

Module IV

Profits and Gains of Business or Profession: Definition - Computation - Allowable expenses and non-allowable expenses - General deductions - Provisions relating to Depreciation. (17 Hours, 15 Marks)

Module V

Capital Gains: Definition of Capital Assets - Long term and Short term - Transfers - Cost of acquisition - Cost of improvement - Exempted Capital gains. Income from Other Sources: Definition– Computation. (18 Hours, 15marks)

(Theory and problems may be in the ratio of 40% and 60%respectjvely .Only simple problems are to be expected)

Specific Outcomes:

1. To understand the method and methodology of taxation on income in India.
2. To learn the provisions related to computation of Taxable Salary Income.
3. Knowledge of taxing income from house property helps the learner to compute taxable income under the head House Property correctly.
4. Knowledge of computing income under the head profits and gains of business or profession helps the learner to do it effectively in life.

5. Knowledge of computing income under the head Capital Gains and other sources makes the learner self-confident and competent to practice income tax.

OBJECTIVES

- To learn computation of taxable income under the head Salaries.
- ➢ To understand taxation of income under the head House Property.
- ➢ To study calculation of taxable profits and gains of business or profession.
- ➢ To seek provisions of taxing capital gains and other sources

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**
Module I (10 Hours)	Basic concepts of income, agricultural income, assessment year, previous year, gross total income,, total income ,residential status, scope	• Lecture • Discussion • Participative Learning	assignment on residential status Assignment on exercise questions	To study concepts of income To evaluate agricultural income To study residential status	Assessment through case study

	of total income, exempted income				
Module II (20 Hours)	Computation of income under different heads- salaries - allowances- perquisites- profit in lieu of salary gratuity- pension	● Lecture ● Discussion ● Participative Learning	Assignment on exercise questions	To study how to compute income from salary	Assessment through test paper
Module III (15 Hours)	Income from house property - annual value of house property, deduction from house value	● Lecture ● Discussion ● Participative Learning	Assignment on exercise questions	To study computation of income from house property	Assessment through test papers
Module IV (20 Hours)	Profits and gains of business or profession- definition- computation	● Lecture ● Discussion ● Participative Learning	Assignment on exercise questions	To study computation of income from business or profession	Assessment through test papers

Module V (20 Hours)	Capital gain - definition of capital asset - long term and short term capital gain- exempted capital gain, income from other source- computation	● Lecture ● Discussion ● Participative Learning	Assignment on exercise questions	To study computation of income from short term and long term capital gain To study computation of income from other source	Assessment through test papers

BCM5B10 FINANCIAL MARKETS AND SERVICES

Number of Lecture Hours per week: 5
Number of Credits: 4
Internal: 20, External: 80
Examination Hours: 2.5

Objectives:

- To study functions of financial markets and to evaluate feasibility of financial products

Module I

Financial System: Meaning and Significance - Functions of the financial system - Financial concepts - Financial Assets - Financial markets - Classification - Financial instruments - Weakness of Indian Financial system – Financial services – meaning – Types. (10 hours, 12 marks)

Module II

Money Market: Definition - Features - Objectives - Features of a developed .money market - Importance of Money market - Composition of Money market - Operations and Participants - Money market Instruments - Features of Indian money market - Recent developments (15 Hours, 20 marks)

Module III

Capital Market: New issue market - meaning - functions - methods floating new issue - intermediaries in the new issue market - Merchants bankers and their functions - Recent trends in new issue market - Stock Exchanges - Functions - Structure of Stock ExchangesBSE - NSE - Listing of securities - Advantages of listing - Methods of trading in stock exchanges - On line trading - Stock indices - Venture Capital - Concept and meaning. (20 Hours, 23 marks)

Module IV

Financial Institutions: Commercial banks - Development financial institutions - Non-Banking Financial Corporations - Mutual Funds, Insurance Companies - Objectives and functionsLease Financing-meaning- Factoring and forfeiting (only a brief outline) (14 Hours, 15 marks)

Module V

Regulatory Institutions - RBI - Role and Functions - The Securities and Exchange Board of India: Objectives - Functions - Powers - SEB1 Guidelines for primary and secondary market. (5 Hours, 10 marks))

Specific Outcomes

1. The; learner acquires thorough knowledge about the financial markets and products available
2. The scholar understands Indian Money Market, Players in the market, Instruments traded, and
their functions.
3. The candidate gets clear idea of the composition Indian Capital Market, Who all are the major
players in it, how indices are constructed and major indices in use. This will help the

candidate to enter such a market with confidence.

4. The Student get acquainted with various NBFCs in playing in India, major instruments traded

in the country, factoring, leasing etc.

5. The scholar gets clear idea of the regulatory mechanism in India and role of RBI and SEBI in enforcing transparent fair dealings. This will help the candidate to master the topic easily with confidence.

OBJECTIVES

- Intended to learn various terms used in Indian money market, players in it and their roles.
- This is envisaged to learn composition of Indian Capital Market and Players in the Indian. Capital Market, features, intermediaries, constructing Indices-important indices in use.
- It is planned to study the NBFCs in India, roles, Leasing, Factoring and its importance.
- To learn regulatory mechanism in India to regulate the financial markets and services offered.It is also intended to learn the role of regulatory agencies like RBI and SEBI,

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**

Module I (15 Hours)	Financial system- meaning and significance . functions of the financial system. Financial market, financial instrument, weakness of Indian financial system, financial services	• Lecture • Discussion • Participative Learning	Group discussion on weakness of Indian financial system Presentation on financial services	To study financial system concepts, meaning, significance and importance To evaluate weakness of Indian financial system To study financial services	Assessment through MCQ
Module II (15 Hours)	Money market - definition - features- features of developed money market- operation and participants of money market instrument, features of Indian money market	• Lecture • Discussion • Participative Learning	Assignments on participants of money market instruments Presentation on Indian money market	To study money market definition and features To evaluate the operations and participants of money market instrument To evaluate the features of Indian money market	Evaluation through test papers

Module III (25 Hours)	Capital market- meaning and definition, intermediaries in the new issue market, merchant bankers, stock exchanges, listing of securities. Venture capital	● Lecture ● Discussion ● Participative Learning	Assignment on stock exchange functions Presentation on method of trading in stock exchanges	To study capital market To evaluate the functions of stock exchanges To study the methods of trading in stock exchanges	Assessment through test papers
Module IV (15 Hours)	Financial institutions;- commercial banks., non banking financial corporations, mutual funds, insurance companies, lease financing. Factoring forfaiting	● Lecture ● Discussion ● Participative Learning	Assignment on non banking financial institutions	To study financial institutions	Assessment through essay writing
Module V (10 Hours)	Regulatory institutions- RBI.SEBI	● Lecture ● Discussion ● Participative Learning	Assignment on role and functions of regulatory institutions	To study role and functions of regulatory financial institutions	Assessment through test papers

BCM5B10 COMPUTER APPLICATIONS IN BUSINESS

Number of Lecture Hours per week: 5

Number of Credits: 4

Internal: 20, External: 80

Examination Hours: 2.5

Course Objectives:

The course is intended to equip students with modern technologies, terminologies, facilities, avenues and application of computers in business. It aims to help students in the process of adapting modern technology in business and reap benefits.

Module I

Computer Systems : Introduction – Features and Parts of new generation Computers- Factors to be considered while selecting computer - Importance of computers in business –NetworkTypes of network, LAN, WAN, MAN, PAN ,BAN,SAN&CAN.Computer applications in various areas of business- Internet, Features and uses in business- Social media & its uses in business. (12 Hours, 15 marks)

Module II

Business and web sites – introduction to web design – concepts – principles involved in developing a website - golden rules of web designing-page design-home page-web standardsaudience requirement-Role of websites in a business-Cascading Style Sheet-Concept of CSSHTML-HTML documents-Basic structure of an HTML Document-creating an HTML Document-HTML Tags. (14 Hours, 20 marks)

Module III

Elements of HTML-Introduction-working with text-working with Lists, Tables, Hyperlinks, images and multimedia-web publishing or hosting-creating the website

-saving the siteworking on the web site-themes-publishing websites-website for business growth. (13 Hours, 15 marks)

Module IV

E-Commerce & Digital payments: E-Commerce, Business Models - B2B, B2C, B2G, C2C & B2E– Requirements of e-commerce website – Modes of delivery-Digital payments: USSD, NUUP, AEPS, UPI, Debit card, Credit card, Pre-paid cards, Internet Banking, Mobile banking, e-wallets – POS Terminals, M-POS, V-POS. (15 Hours, 15 marks) `

Module V

Digital Security – Security threats in Internet & e-Commerce, Virus & Trojan horses, Phishing,Hacking, Spyware – Security Measures, Antivirus, Firewall, Encryption, Bio-metrics–Precautions while using Internet & epayments - IT Act, Major Provisions of IT Act. (10 Hours, 15 marks)

Specific Outcomes:

1. Knowledge of networking and its application business helps students to learn in a networked community much more easily.
2. Knowledge of website creation and its updation and maintenance magnifies the identity and scope of business at much cheaper cost.
3. This helps to grow business across borders easily.
4. Students become more competitive in this digital era for he knows these entirely well.
5. Knowledge of the threats present in the Net helps to take preventive measures early and thereby could be avoided on time.

Specific Objectives:

1. To examine various types of types of network – to evaluate the computer application in LAN, VAN and similar other networks.
2. To equip the students with the theoretical and practical knowledge in developing website and to understand the basic structure of HTML
3. To enable the student to develop websites for the business and equip them in modern technology relevant for the business survival.

4. To equip the student with various ecommerce platforms and enable them to evaluate the various pros and cons of digital payments

5. To keep the students learnt the threats associated with Computers and Internet and to learn the legislative background and support available.

Lesson Plan

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (15 Hours)	Computer systems,features and parts of new generation computer , importance of computers in business, types of network, computer application in various areas of business	● Lecture ● Discussion ● Participative Learning	Pictorial presentation on types of network Group discussion on computer application in business	To study computer systems to evaluate importance of computers in business To study type of computer network To evaluate application of computers in business	Assessment through MCQ

Module II (15 Hours)	Business and websites, introduction to web design, principles involved in developing a website, golden rules of web design, concepts of CSS, HTML	• Lecture • Discussion • Participative Learning	Seminar on golden rules of web designing	To study business and websites To study principles involved in developing web design To evaluate role website in business	Evaluation trough test papers
Module III (15 Hours)	Elements of HTML, web publishing , creating website,working on the website, website for business growth	• Lecture • Discussion • Participative Learning	Assignment on elements of HTML Presentation on creating website	To study elements of HTML To study creating website To evaluate website for business growth	
Module IV (20 Hours)	E-commerce and digital payments. Business models,requirement of ecommerce websites, modes of delivery, digital	• Lecture • Discussion • Participative Learning	Assignment on business models Debate on for and against digital payment	To study e-commerce and digital payments	Assessment through test papers

	payments, internet banking, e-wallets				
Module V (10 Hours)	Digital security, security threats in e commerce and internet,virus, biometrics - precautions while using internet and e payments, IT act	• Lecture • Discussion • Participative Learning	Presentation on virus Group discussion on threats in internet and e commerce	To evaluate digital security To study virus	Evaluation through test papers

BCM5 B11 FINANCIAL MANAGEMENT

Lecture Hours per week: 4, credits 4

Internal: 20, External: 80

Examination 2.5 Hours

Course Objectives:

To familiarize the students with the concepts, tools and practices of financial management and to learn about the decisions and processes of financial management in a business firm

Module I

Introduction: Nature, scope and objectives of financial management - Time value of money and mathematics of finance - Concept of risk and return. (10 Hours, 15 marks)

Module II

Investment Decision: Capital budgeting process - Estimation of relevant cash flows -Payback Period method - Accounting Rate of Return - Net Present Value - Net Terminal Value - Internal Rate of Return - Profitability Index - Capital budgeting under risk -Certainty Equivalent Approach and Risk Adjusted Discount Rate. (18 Hours, 20 marks)

Module III

Financing Decision: Cost of capital and financing decision - Estimation of components of cost of capital : Equity capital - Retained earnings - Debt and Preference capital -Weighted average cost of capital and Marginal cost of capital - Sources of long term financing - Capital structure - Operating and financial leverage - Determinants of capital structure. (18 Hours, 20 marks)

Module IV

Dividend Decision: Relevance and irrelevance of dividend decision - Cash and stock dividends - Dividend policy in practice. (8 Hours, 10 marks) Module V Working Capital Management: Meaning and nature of working capital - Determination of working capital requirement - A brief overview of Cash management, Inventory management and Receivables management. (10 Hours, 15 marks)

Specific Outcomes:

1. Knowledge of financial management and time of value money helps make decisions effectively.
2. Understanding of capital investment evaluation techniques makes investment selection easier.

3. Familiarity with cost of capital helps to use capital judiciously
4. Knowledge of dividend policies helps to take appropriate decision on dividend
5. Helps to have effective working capital management.

Specific Objectives:

1. To provide a general idea of financial management and time value of money
2. To impart knowledge on capital investment evaluation process
3. To study calculation of individual and overall Cost of capital
4. To Study dividend Policies
5. To learn working capital management tools and techniques

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**
Module I (20 Hours)	Introduction nature and objectives of financial management,time value of	● Lecture ● Discussion ● Participative Learning	Assignment on objectives of financial management	To study meaning and scope of financial management	Assessment through test papers

	money and mathematics of finance-concepts of risk and return		Assignment on exercise questions	To study time value of money	
Module II (10 Hours)	Investment decisions , capital budgeting process, estimation of relevant cash flows, payback period method .ARR, NPV,NTV.IRR,PI, capital budgeting under risk , risk adjusted discount rate	• Lecture • Discussion • Participative Learning	Assignment on exercise questions Seminar on capital budgeting process	Tpo study capital budgeting process To evaluate investment decisions To study estimation of relevant cash flows	Assessment through test papers
Module III (20 Hours)	Financing decisions, cost of capital and financing decisions, estimation of components of cost of capital, sources of long term	• Lecture • Discussion • Participative Learning	Seminar on source of long term financing Assignment on exercise questions	To evaluate financing decisions To study cost of capital calculation To evaluate capital structure	Assessment through case study

	financing, capital structure, operating and financial leverage, determinants of capital structure				
Module IV (20 Hours)	Dividend decision. Dividend policy in practice	● Lecture ● Discussion ● Participative Learning	Seminar on dividend policy in practice Assignment on exercise questions	To study relevance and irrelevance of dividend decision To evaluate dividend policy in practice	Assessment through test papers
Module V (10 Hours)	Working capital management. Determination of working capital management, a brief overview of cash management, inventory management and receivables management	● Lecture ● Discussion ● Participative Learning	Seminar on inventory management and receivables management Assignment on working capital management	To study working capital management To evaluate cash management , inventory management. And receivables management	Assessment through test papers

BCM5B11 BUSINESS INFORMATION SYSTEMS

Number of Lecture Hours per week: 5

Number of Credits: 4

Internal: 20, External: 80

Examination Hours: 2.5

Course Objectives:

To enable the students to acquire basic knowledge in information technology and its relevance to the various areas of business.

Module I

Management Information System: Data, Information & Knowledge – Information Technology & Communication technology - Role of Information & Communication technology in Business – Management Information System , Meaning , Concepts, Purpose & Features of MIS, Basic structural concepts. (12 Hours, 15 marks) `

Module II

Types of Management Information Systems: Transaction Processing System - Decision Support Systems (DSS) - Characteristics and capabilities of DSS – Components of DSS – Executive Information System - Expert System – Management Reporting System. (12 Hours, 15 marks)

Module III

Data Base Management Systems : DBMS - Definition - Necessity of a database - Characteristics of database - Database management systems - Types of database management systems - Logical data models - Hierarchical model - Network model - Relational model - Object-oriented model - Object relational model

Deductive/inference model - Comparison between various database models. (20 Hours, 25 marks)

Module IV

Enterprise Resource Planning (ERP) – Meaning - Need for ERP - Benefits of an ERP system – ERP software – Phases in ERP implementation - Issues and challenges in the implementation of ERP. (12 Hours, 15 marks)

Module V

Business Process Reengineering: Meaning and definition of BPR – Reengineer - Need and Objectives of BPR - Process of BPR – Advantages of BPR - Issues and problems of BPR. (8 Hours, 10 marks)

Specific Objectives:

1. To impart a general awareness on MIS
2. To learn types of MIS
3. To understand DBMS and types and models
4. To study ERP, benefits and drawbacks
5. To familiarize with Business Process Reengineering and merits and demerits

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**

Module I (15 Hours)	Management information system, role of information and communication technology in business, meaning concepts and features of MIS	● Lecture ● Discussion ● Participative Learning	Seminar on role of information and communication technology in business	To study meaning , concepts, and features of MIS To evaluate role of information and communication technology in business	Assessment through test papers
Module II (15 Hours)	Types of management information system	● Lecture ● Discussion ● Participative Learning	Assignment on transaction processing system	To study types of management information system	Assessment through test papers
Module III (20 Hours)	Database management system, necessity of database, types of database management system, logical data model, comparison between various database	● Lecture ● Discussion ● Participative Learning	Assignment on types of database management system	To study definition of database management system To evaluate necessity of database To study different types of database management system	Assessment through test papers

	models				
Module IV (15 Hours)	Enterprise resource planning - meaning , need , benefits- ERP software, phases in ERP implementation . issues and challenges in the implementation of ERP	● Lecture ● Discussion ● Participative Learning	Group discussion on issues and challenges in the implementation of ERP	To study ERP concepts To evaluate the phases in ERP implementation To evaluate the issues and challenges in the implementation of ERP	Assessment through test papers
Module V (10 Hours)	Business process reengineering. Need and importance of BPR, process of BPR, issues and problems of BPR	● Lecture ● Discussion ● Participative Learning	Seminar on issues and problems of BPR	To study the concept of BPR To evaluate the process of BPR To evaluate the issues and problems of BPR	Assessment through test papres

BC5D01 E-COMMERCE

Lecture Hours per week: 2 Credits : 2
Internal: 10, External: 40
Examination Hours: 2

COURSE OBJECTIVES:

- It is intended to enable the students to know the basics of ECommerce and to prepare them for E- Commerce in life. It is planned to provide a practical exposure to E-Commerce and E- Business management.

Module I

Introduction to E-Commerce: Meaning and concept - E-Commerce v/s Traditional Commerce - E-Business &. E-Commerce - History of E- Commerce - EDI - Importance, features & benefits of E- Commerce - Impacts, challenges & limitations of E-Commerce -Supply chain management & E-Commerce - E- Commerce infrastructure - Business Models of E - Commerce: Business to business - Business to customers -customers to customers - Business to government - Business to employee - E - Commerce strategy - Influencing factors of successful E- Commerce. (20 Hours, 20 marks)

Module II

Marketing Strategies & E - Commerce: Website - Components of website - Concept & designing website for E- Commerce - Corporate website - Portal - Search Engine - Internet advertising - Emergence of the internet as a competitive advertising media - Models of internet advertising - Weakness in internet advertising. (18 Hour, 10 marks)

Module III

Electronic Payment System: Introduction - Online payment systems - prepaid and postpaid payment systems - E-cash - E- cheque - Smart card - Credit card - Debit card -Electronic purse - Security issues on electronic payment system - Solutions to security issues - Biometrics - Types of biometrics. (10 Hours, 10 marks)

COURSE OUTCOMES:

- At the end of the course students know the basics of E-Commerce and the various Business Models of E-Commerce. This enhances the students' skills for designing and developing websites.
- It helps them to use the emerging modes of E-payment.
- It also Identify the security issues on electronic payment system and solutions to various security issues relating to E-payment

OBJECTIVES

- To Gain a practical orientation to E-Commerce and E- Business management

Lesson Plan

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (15 Hours)	E commerce - meaning and concept,history of e-commerce, impact , challenges and limitations of e commerce, supply chain management, business models of ecommerce, influencing factors of successful e-commerce	● Lecture ● Discussion ● Participative Learning	Seminar on challenges and limitations of e commerce Group discussion on influencing factors of successful e commerce	To know meaning and basic concepts of e-commerce To evaluate the history of e-commerce To study supply chain management To study business models of e-commerce To identify the influencing factors of successful e-commerce	Assessment through test papers

Module II (15 Hours)	Marketing strategies and e - commerce, website,components of website, corporate website, portal , search engine, internet advertising,emergence of internet as a competitive advertising media, models of internet advertising, weakness in internet advertising	• Lecture • Discussion • Participative Learning	Debate on internet advertising Assignment on corporate website	To study marketing strategies and e-commerce To study components of website To evaluate emergence of the internet as a competitive advertising media To evaluate the weakness in internet advertising	Assessment through MCQ
Module III (10 Hours)	Electronic payment system, security issues on electronic payment system,biometrics	• Lecture • Discussion • Participative Learning	Presentation on security issues on electronic payment system Assignment on biometrics	To study electronic payment system To evaluate the issues of electronic payment system To study bio metric system	Assessment through test papers

BCM6B12 INCOME TAX AND GST

Lecture Hours per week: 6 Credits: 4

Internal: 20, External: 80

Examination Hours : 2.5

Course Objectives:

- It is intended to equip students with specialized knowledge in the field of direct and indirect taxation system and inspire them for better employment opportunities and self-employment. It also aims to understand the importance of Income Tax and GST in the Indian and global economy and its contribution to the economic development

Module I

Income Tax Contd: Deemed Incomes and Clubbing of income – Set- off and carry forward of losses - Deductions to be made in computing total income – Computation of total Income of individuals – Computation of Tax liability of individuals – Rebate and relief of tax. (25 hours, 25 marks)

Module II

Income tax authorities – Powers and functions – Provisions of advance payment of tax – Tax payment – Deduction and payment of tax at source – Recovery of tax. Procedure of assessment of income tax – Filing of returns of income – Voluntary return of income – Statutory obligations in filing of returns – Return of loss – Belated returns – Revised returns – Defective returns – PAN – Different types of assessment – Self assessment – Assessment on the basis of return – Best judgment assessment – Regular assessment – Reassessment – Protective assessment. (20 Hours 20 marks)

Module III

Goods and Services Tax: Brief history behind the emergence of GST – The scope of GST – Definitions and meaning - Central Goods and Services Tax Act–Integrated Goods and Services Tax Act - State Goods and Services Tax Act - Levy and Collection of Central/State Goods and Services Tax - Taxable person - Power to grant exemption from tax - Time and value of supply of goods - Time of supply of services (17 Hours, 15 hours)

Module IV

Registration - Amendment of registration - Cancellation of registration - Revocation of cancellation of registration - tax invoice, credit and debit notes – Returns - First Return - Annual return - Final return - Tax Return Preparers - Levy of late fee - Notice to return defaulters (17 Hours, 10 marks)

Module V

Payment of tax, interest, penalty and other amounts - Interest on delayed payment of tax - Tax deduction at source - transfer of input tax credit - refund of tax - accounts and records - demands and recovery I - Inspection, search, seizure and arrest - offences and penalties - Audit by tax authorities - Special audit - Power of CAG to call for information. (17 Hours, 10 marks)

(The syllabus of GST will be revised after the rules and regulations relating to GST Act are framed).

Specific Outcomes:

1. Students will be able to Compute tax liability of individuals
2. The Learner can do filing of returns of income meeting statutory obligations
3. The scholars understand the concept of GST and e-filing procedures
4. The candidates understand the offences and penalties under the Acts.
5. The Learner learns the rights, duties and powers of CAG and tax authorities.

Specific Objectives:

1. To impart knowledge on the computation of total income and tax liability of individuals
2. To make students aware of Income Tax authorities, their powers and functions

3. To enable students to differentiate between Direct and Indirect tax and its structure.
4. To study the registration procedures, cancellation, payment and e-filing under GST.
5. To develop understanding on penalty recovery, audit procedures and power of CAG

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**
Module I (25 Hours)	Deemed incomes and clubbing of income, set off carry forward losses, deductions to be made in computing income, computation of total income of individuals, computation of tax liability of individuals	• Lecture • Discussion • Participative Learning	Seminar on set off and carry forward of losses Assignment on exercise questions	To study clubbing of income To study set off and carry forward To study computation of total income To computation of tax liability of individuals	Assessment through test papers

	rebate and relief of tax				
Module II (15 Hours)	Income tax authorities, powers and functions, provisions for advance payment of tax ,TDS, recovery of tax. Filing of returns of income. PAN. different types of assessment	● Lecture ● Discussion ● Participative Learning	Seminar on powers and functions of income tax authorities	To evaluate the powers and functions of income tax authorities To study filing of returns	Assessment through test papers
Module III (15 Hours)	Goods and service tax. History. Scope of GST,definitio n and meaning	● Lecture ● Discussion ● Participative Learning	Collage Seminar on scope of GST	To study GST	Assessment through test papers
Module IV (15 Hours)	Registration . amendment of registration . cancellation of registration. Tax invoice, returns	● Lecture ● Discussion ● Participative Learning	Assignment on revocation of cancellation of registration	To study registration and amendment of registration To study tax return preparer	Assessment through test papers

Module V (10 Hours)	Payment of tax ,interest, penalty and other amounts,TDS , refund of tax, accounts and records , demands and recovery, audit by tax authorities. Power of CAG to call for information	• Lecture • Discussion • Participative Learning	Seminar on demands and recovery of tax	To study payment of tax , interest, penalty and other amounts To evaluate audit by tax authorities To study power of CAG to call for information	Assessment through test papers

BCM6B13 AUDITING AND CORPORATE GOVERNANCE

Lecture Hours per week: 5 Credits: 4
Internal: 20, External: 80
Examination Hours: 2.5

Course Objectives:

It is intended to provide knowledge of auditing principles and techniques and to familiarize the students with the understanding of issues and practices of corporate governance in the Global and Indian context. It also envisages imparting knowledge

on the framework of corporate governance in terms of codes and standards to be applied.

Module I:

Auditing – Meaning – Objects - Basic Principles and Techniques – Auditing and investigation - Classification of Audit – Management audit – Proprietary audit – Performance audit – Tax audit – Social audit – Environmental audit - Audit Planning – Qualities of an auditor – Advantages and limitations of audit (10 hours, 10 marks)

Module II

Audit Procedures: Vouching - Definition - Features - Examining vouchers - Vouching of cash book - Vouching of trading transactions - Verification and valuation of assets and liabilities: Meaning - Definition and objects - Vouching v/s verification - Verification and Valuation of different assets and liabilities (20 hours, 20 marks)

Module III

Internal Control - Internal Check - Internal Audit --Definitions - Necessity - Difference between internal check and internal control - Fundamental Principles of internal check - Difference between internal check and internal audit - Special Areas of Audit: Tax audit and Management Audit - Recent trends in auditing - Relevant Auditing and Assurance Standards (AASs) - Rights duties and liabilities of auditor - Audit committee - Auditor's Report - Contents and types – Auditors certificate. (20 hours, 25 marks)

Module IV:

Conceptual Framework of Corporate Governance: Meaning, Theories, Models and Benefits of Corporate Governance; Board Committees and their Functions; Insider Trading; Rating Agencies; Green Governance/E-governance; Clause 49 of Listing Agreement; Class Action; Whistle Blowing; Shareholders Activism (20 hours, 15 marks)

Module V

Major Corporate governance failures - BCCI (UK) - Maxwell Communication (UK) - Enron (USA – Satyam Computer Services Ltd - TATA Finance - Kingfisher

Airlines - Common Governance Problems Noticed in various Corporate Failures - Codes and Standards on Corporate Governance (10 hours, 10 marks)

Specific Outcomes:

1. It is intended to provide knowledge of auditing principles and techniques
2. To familiarize the students with the understanding of issues and practices of corporate governance in the Global and Indian context.
3. It also envisages imparting knowledge on the framework of corporate governance in terms of codes and standards to be applied.

Specific Objectives:

1. To familiarise the basic principles, techniques and classification of audit.
2. To study vouching, verification and valuation of assets and liabilities.
3. To learn internal control by way of internal check and internal audit.
4. To provide insight on the framework of corporate governance.
5. To discuss common governance problems noticed in various corporate failures.

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**
Module I (10 Hours)	Auditing, basic principles and techniques, classification of audit, qualities of an	● Lecture ● Discussion ● Participative Learning	Seminar on qualities of auditor Assignment on different types of audit	To know the meaning and concepts of auditing To evaluate different types of audit	Assessment through test papers

	auditor advantages and limitations of audit			To evaluate the qualities of auditor To evaluate the advantages and disadvantages of audit	
Module II (20 Hours)	Audit procedures, vouching. Verification and valuation of assets and liabilities, vouching v/s verification	• Lecture • Discussion • Participative Learning	Assignment on vouching V/S verification	To study vouching To study verification To evaluate vouching v/s verification	Assessment through essay writing
Module III (20 Hours)	Internal control , internal check, internal audit, special areas of auditing, recent trends in auditing,AASs, rights duties and liabilities of auditor, audit	• Lecture • Discussion • Participative Learning	Assignment on internal check , internal audit, internal control. Group discussion on duties and liabilities of auditors	To study internal check , internal control, internal audit To evaluate special areas of audit To evaluate recent trends in auditing To identify duties and liabilities of	Assessment through descriptive exam

	committee , auditors report, auditors certificate			auditor To study auditors report	
Module IV (20 Hours)	Conceptual framework of corporate governance, models and benefits of corporate governance, board committee and their functions, insider trading, green governance, clause 49, whistle blowing	● Lecture ● Discussion ● Participative Learning	Assignment on models and benefits of corporate governance Seminar on green governance	To study corporate governance To evaluate insider trading	Assessment through test papers
Module V (10 Hours)	Major corporate governance failures, codes and standards on corporate governance	● Lecture ● Discussion ● Participative Learning	Presentation on major corporate governance failures	To evaluate major corporate governance failures To study codes and standards on corporate governance	Evaluation through test papers

BCM6B14 FUNDAMENTALS OF INVESTMENTS

Lecture Hours per week: 5 Credits: 4

Internal: 20, External: 80

Examination 2.5 Hours

Course Objectives:

To understand the concepts of investment management, Investment analysis, valuation of securities, portfolio management, prominent theories in the subject and to acquire skills to redress issues with ease and become a professional in investment management.

Module I

Introduction to Investment - Meaning of Investment – essential features of Investment-Investment Alternatives- Investment Environment (brief description on elements such as Financial Securities, Financial Markets, Financial Services, Financial Intermediaries, Regulators, and Investors) –Investment Management Process –Sources of Financial Information- Calculation of return on investment and expected return-Calculation of expected return under CAPM- Types of risk-Calculation of Standard deviation- calculation of beta under correlation and regression methods (Simple Problems). (15 Hours, 18 marks)

Module II

Security Valuation:

a) Valuation of Fixed Income Securities: Bonds- Essential Features- Types of Bonds- Types of bond risks- estimating Bond Yields-Bond valuation (redeemable and irredeemable)-Valuation of Preference Shares (redeemable and irredeemable).

b) Valuation of Equity- Dividend Yield Method- Dividend Yield plus growth method (single-stage growth and multi-stage growth) - Discounted Cash Flow method-P/E multiple approach. (20 Hours, 20 Marks)

Module III

Approach to Security Analysis:

Security Analysis- Fundamental Analysis – EIC analysis – Tools for company analysis- Technical Analysis- stock charts(line, bar, candle stick and point and figure charts)- Support and Resistance levels- Trends and Trend Reversals – Patterns - continuation patterns(Triangles, Rectangles, Flags and Pennants) -reversal patterns(head and shoulders, double tops and double bottom, wedges)- Indicators -a brief description on leading and lagging indicators)- brief description of DOW theory and Elliot Wave theory. (20 Hours, 20 Marks)

Module IV

Portfolio Analysis: Concept of portfolio – need and importance- portfolio diversification- a brief description of Markowitz model, Random Walk Theory, Efficient Market Hypothesis, Efficient Portfolio -Calculation of Portfolio Risk with two securities (Covariance, Correlation, Standard deviation)- Portfolio Return (15 Hours, 12 Marks)

`

Module V

Investor Protection: Role of SEBI & Stock Exchanges in investor protection – Investor Education & Awareness Measures- Investor grievances and their redressal system – SCORES – Prohibition of Insider trading practices - UPSI-Rights and Duties of Investors - Investor activism. (10 Hours, 10 marks)

(Theory and problems may be in the ratio of 50% and 50% respectively)

Specific Outcomes:

1. Develops a broad understanding of the concept of investment management
2. Learn security valuation of bonds, preference shares and equity shares
3. Study calculation of return on investment and expected return through examples
4. Understand analysis of securities, approaches, tools, stock charts, patterns and theories
5. Understands portfolio management, analysis and redress issues easily.

Specific objectives:

1. To study investment awareness, investment management and calculation of return on investment
2. To enable students to do valuation of fixed income securities and equity.
3. To learn approaches to security analysis, fundamental/technical analysis & theories thereof.
4. To understand the concept of portfolio, its diversification, models, Theories & portfolio return
5. To provide knowledge on the measures for investor protection & grievance redressal.

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**
Module I	Introduction To investment, essential features of investment, investment alternatives, investment environment, investment management , source of financial information,c	● Lecture ● Discussion ● Participative Learning	Assignment on investment environment Seminar on source of financial information	To study essential features of investment To study investment environment To study investment management process To study calculation of return on	Assessment through test papers

	alculation of expected return			investment and expected return	
Module II	Security valuation; Valuation of fixed income securities, valuation of security, valuation of equity	• Lecture • Discussion • Participative Learning	Assignment on exercise questions	To study valuation of fixed income securities To study valuation of equity	Assessment through test papers
Module III	Approach to security analysis, security analysis, EIC analysis, tools for company analysis,technical analysis, indicators, brief description of DOW theory and Elliott Wave theory	• Lecture • Discussion • Participative Learning	Pictorial presentation of stock chart Seminar on trend and trend reversals	To study security analysis To study leading and lagging indicators	Assessment through test papers

Module IV	Portfolio analysis-need and importance, portfolio diversification , calculation of portfolio risk , portfolio return	• Lecture • Discussion • Participative Learning	Seminar on portfolio diversification, Assignment on exercise question	To study portfolio analysis To study portfolio diversification To study calculation of portfolio risk To study portfolio return	Assessment through test papers
Module V	Investor protection, role of SEBI and stock exchange in investor protection, investor education and awareness measures, investor grievance and their redressal system, SCORES, prohibition of insider trading practices,	• Lecture • Discussion • Participative Learning	Presentation on investors grievances and redressal system Group discussion on investors education and awareness measures	To evaluate role of SEBI and stock exchanges in investor protection To evaluate investor grievance and redressal system	Assessment through case study

	rights and duties of investors				

BCM6B14 OFFICE AUTOMATION TOOLS

Lecture Hours per week: 5 Credits: 4`

Internal: 20, External: 80

Examination 2.5 Hours

Course Objectives:

To familiarize the students on preparation of documents and presentations with office automation tools and its application in the various areas of business. To enable the students to craft professional word documents using the Microsoft suite of office tools.

Module I

MS-Word : Word Basics - Starting word - Creating a new document - Opening pre existing document - The parts of a word window - Typing text - Selecting text - Deleting text -Undo - Redo – Repeat- Inserting text - Replacing text - Formatting text - Cut - Copy -Paste - Formatting Text and Documents - Auto format - Line spacing - Margins - Borders and Shading.

Headers and Footers : Definition - Creating basic headers and footers - Tables - Creating table - Adding, changing, deleting rows - Inserting, changing, deleting

column - Graphics - Importing graphics - Clipart - Insert picture - Clip Art Gallery - Drawing objects - Text in drawing .
Templates : Template types - Using templates - Exploring templates - Modifying templates - Macros : Record in macros - Editing macros - Running a macro - Mail Merge: Mail Merge concept - Main document - Data sources - Merging data source and main document - Overview of word menu options - Word basic toolbar. (Theory 15 Hours and Practical 10 Hours, 20 marks)

Module II

MS EXCEL : Electronic Spreadsheet – Creating and rearranging worksheet - Structure of spreadsheet and its applications to accounting, finance, and marketing functions of business -Creating a dynamic / sensitive worksheet - Concept of absolute and relative cell reference - Using built in functions – Mathematical, statistical and financial functions – Conditional formatting –filters- Charts – Pivot table and pivot chart - Goal seeking and solver tools - Sharing data with other desktop applications - Strategies of creating error free worksheet. (Theory 15 Hours and Practical 10 Hours, 20 marks)

Module III

Ms-Power Point : Power point - Basics - Terminology - Getting started - Views - Creating presentations - Using auto content wizard - Using blank presentation option -Using design template option - Adding slides Deleting a slide - Importing images from the outside world - Drawing in power point - Transition and build effects - Deleting a slide - Numbering a slide - Saving presentation - Closing.(Theory 9 Hours and Practical 6 Hours, 20 marks)

Module IV

The Internet and its Basic Concepts: Internet concept - History - Development in India -Technological foundation of internet - Distributed computing - Client-server computing -Internet protocol suite - Application of distributed computing - Client-server computing. (7 Hours, 10 marks)

`

Module V

Internet protocol suite in the internet environment - Domain Name System (DNS) - Generic Top Level Domain (g TLD) - Country Code Top Level Domain (cc TLD) -

Indian - Allocation of second level domains - IP addresses - Internet Protocol Applications of internet in business, Education, Governance, etc. (Theory 10 Hours, 10 marks)

Course Outcome

1. Students understand how to prepare documents using MS-Word
2. Learner demonstrates excel spreadsheets and its applications.
3. The candidate knows PowerPoint Presentations and its use in business meetings.
4. Scholar acquires knowledge on distributed and client server computing.
5. Understand the applications of the internet in the field of business education and governance..

Specific Objectives:

1. To make students aware of MS-Word basics, importing graphics, using templates, macros, data sources, mail merge and menu options
2. Applications of MS-Excel-creating worksheets, mathematical, statistical and financial functions, using charts, pivot table and sharing data
3. Using MS-PowerPoint, auto content wizard, blank presentation, design templates, importing images, transition and build effects
4. To study basics of Internet, distributed computing, client server computing
5. To know about different levels of domain names, IP addresses and applications of the internet in business, education and governance.

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**

Module I	MS word, starting , creating a new document, headers and footers, templates	● Lecture ● Discussion ● Participative Learning	Practical lab Assignment on preparing document	To study creating new document	Assessment through test papers
Module II	MS EXCEL, creating rearranging spreadsheet, sharing data with other desktop applications	● Lecture ● Discussion ● Participative Learning	Practical lab Assignment on creating worksheet	To study creating worksheet	Assessment through exam
Module III	MS-Powerpoint, basics, terminology, using design template option, adding and deleting slides, importing images, saving presentation	● Lecture ● Discussion ● Participative Learning	Practical lab	To study creating powerpoint slide To study transitions and build effects	Assessment through presentation competition

Module IV	The internet and basic concepts, history , development in India, technological foundation of internet, distributed computing, client server computing. Internet Protocol suit	● Lecture ● Discussion ● Participative Learning	Assignment on internet concept	To study basic concepts of internet To study technological foundation of internet	Assessment through MCQ
Module V	Internet protocol, domain name system, g LTD, ccLTD, IP address, internet protocol application in business	● Lecture ● Discussion ● Participative Learning	Seminar on internet protocol applications of internet in business, education, governance	To study;- Internet protocol Domain name Internet Protocol applications	Assessment through test papers

BCM6B15 FINANCIAL DERIVATIVES

Lecture hours per week: 5

Credits: 5

Internal: 20, External: 80

Examination 2.5 Hours

Comprehensive Objectives:

To familiarize with the capital market, financial instruments and raising of funds in the secondary market through cheaper sources. It aims to provide an in-depth understanding of financial derivatives in terms of concepts, structure, types of instruments and their trading strategies.

Module I

Financial Derivatives: Introduction - Meaning – Types of financial derivatives: Forwards – Futures – Options – Swaps – Economic functions of derivative contracts. (12 Hours, 10 marks)

Module II

Derivative Markets: History of financial derivative market – Participants in a derivative market – Cash market Vs derivative market – Stock market derivatives in India – Other derivatives in India – The regulatory framework for derivatives trading in India. (15 Hours, 20 marks)

Module III

Forward Contracts : Features – Limitations of forward markets – Introduction to Futures – Meaning and definition - Features of futures – Difference between forwards and futures – Futures - terminology – Types of future contracts - Financial futures – Stock futures – Currency futures - Interest rate futures – Index futures - Commodity futures – Futures pay-offs – Trading strategies in stock futures . (20 Hours, 20 marks)

Module IV

`Options: Meaning – Definition – Need - Difference between options and futures – Fundamental option strategies – Types of options contracts - Call – Put – options – Intrinsic value Vs Time value of options - Trading strategies in stock options. (20 Hours, 20 marks)

Module V

Swaps: Meaning – Definition - Features of swaps – Terms used in swaps – Types of swaps: Interest rate swap - Currency swap - Commodity swap - Equity swap – Difference between Swaps and Futures. (13 Hours, 10 marks)

Course Outcome:

1. This helps to master capital market segment and derivatives market
2. This develops knowledge on derivatives trading and its legal framework
3. It helps to differentiate between various types of derivatives.
4. Understand the trading strategies adopted on option trading
5. It helps to learn forwards, futures, and swaps.

Specific Objectives

1. To study the financial derivatives and instruments traded on the derivatives market.
2. To acquire knowledge on derivatives trading in India and its regulatory framework.
3. To understand the forward and future markets and their trading strategies.
4. To make students aware of Option trading, types of options and trading strategies.
5. To familiarize students with swaps and various types of swaps.

Lesson Plan

Unit /session/ hours (time required)	**Topics to be taught(input)**	**Procedure(process)students centric method of teaching**	**Activity**	**Learning Outcome**	**Assessment**

Module I	Financial derivatives, types, economic functions of derivative contracts	● Lecture ● Discussion ● Participative Learning	Group discussion on functions of derivative contracts Assignment on types derivatives	To study financial derivatives To study types of financial derivatives	Assessment through essay writing
Module II	Derivative market, history, participants of derivative market. Cash market v/s derivative market, stock market derivatives in India, the regulatory framework	● Lecture ● Discussion ● Participative Learning	Seminar on derivative market in India	To study derivative market To identify the participants of derivative market To evaluate cash market v/s derivative market To evaluate stock market derivatives in India	Evaluation through test papers
Module III	Ure contracts, trading strategies in stock exchange	● Lecture ● Discussion ● Participative Learning	Assignment on trading strategies in stock futures	To study forward contracts To study futures To evaluate the difference between forwards and `futures To evaluate trading strategies in stock exchanges	Assessment through test papers

Module IV	Options , basic concepts, types of option contracts, intrinsic value V/S time value of options , trading strategies in stock options	• Lecture • Discussion • Participative Learning	Seminar on trading strategies in stock options	To study options	Assessment through test papers
Module V	SWAPS; meaning, features of swaps, types of SWAPS , difference between swaps and futures	• Lecture • Discussion • Participative Learning	Seminar on difference between SWAPS and Futures	To study SWAPS, features, types To evaluate the difference between swaps and futures	Assessment through MCQ

BCM6B15 COMPUTERIZED ACCOUNTING WITH TALLY

Lecture Hours per week: 5 Credits: 5
Internal: 20, External: 80
Examination 2.5 Hours

Course Objectives:

To familiarize well rated accounting packages in use capable of recording accounting information as per Generally Accepted Accounting Principles (GAAP) and produce reports as per user requirements. It is also intended to provide an understanding on the computerized accounting and computation of GST using Tally and inspire students to build a career in the field of accounting.

Module I

Introduction to Accounting: Accounting basis and terms -Branches of accounting - Mode of accounting - Manual accounting - Computerized accounting fundamentals. Accounting with Tally : Introduction to Tally - Tally interface - fll features - fl2 configuration - Company creation - Accounting groups - Accounting ledgers - Accounting vouchers - Vouchers entry. (15 Hours, 15 marks)

Module II

Inventory Management with Tally - Stock groups - Stock items - Stock category - Unit of measures - Godown inventory vouchers (Pure inventory and inventory vouchers).Integration of Accounting with Inventory : Bill wise details - Invoicing - Voucher entry -Cost center - Cost category - Budget and control - Bank reconciliation - Interest calculation – Order Processing - Stock valuation methods - Reorder levels - Tracking numbers - Bill of material - Inventory ageing. (25 Hours, 25 marks)

Module III

Tax Application in Tally - Introduction to GST - GST activation and classification - GST computation - Composite GST - Input Tax credit - Tax Invoice, Credit and Debit Notes-Returns-Transfer of Input Tax Credit- Time and Value of Supply-Recent features. (15 Hours, 15 marks)

Module IV

Accounting and Inventory Reports - Trading, Profit and loss A/c - Balance Sheet - Ledgers - Cost center and budget reports - Cash book and bank book - Inventory reports - Decision supporting tools - Ratio analysis - Cash flows - Fund flow - Budgeting system - Printing of reports - Voucher and bill printing etc. (15 Hours, 15 marks)

Module V

Technology Advantage of Tally - Tally audit - Tally vault - Back up, restore, merge and split of database - ODBC interface - Export and import of data - web enabled reporting - On line support of software. (10 Hours, 10 marks)

Specific outcomes

1. Helps to develop awareness on accounting concepts and principles
2. Aids to perform documentation, accounting and inventory operations using Tally
3. Assist preparation of financial statements, tax documents, budgets and presentations
4. Develop adequate knowledge on accounting information systems and their application. 5. To excel in budgets, reporting and accounting using Tally

Specific objective;-

1. To provide a basic knowledge on Computerized accounting and introduction to Tally
2. To study inventory management with Tally and integration of accounting with inventory
3. To apply computation of GST in Tally and recent features.
4. Preparation of financial statements, budgets and other reports and highlights using Tally.
5. To study technology advantage of Tally, web enabled reporting and online support.

Lesson Plan

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I	Computerised accounting fundamentals Accounting with tally	● Lecture ● Discussion ● Participative Learning	Practical in computer lab Assignment on company creation	To know how to create company To study accounting group and accounting ledgers , accounting vouchers	Assessment through practical exam
Module II	Inventory management with tally, integration of accounting with tally	● Lecture ● Discussion ● Participative Learning	Practical knowledge in computer lab	To study inventory management with tally To study integration of accounting with inventory	Assessment through test papers
Module III	Tax application in tally	● Lecture ● Discussion ● Participative Learning	Assignment on GST activation and classification	To study tax application in tally	Assessment through test papers
Module IV	Accounting and inventory reports, decision supporting tools, printing	● Lecture ● Discussion ● Participative Learning	Practical experience in computer lab	To study accounting and inventory reports in tally	Assessment through test papers

	of reports, voucher and bill printing				
Module V	Technology advantage of tally,tally audit , tally vault, ODBC interface, export and import of data	• Lecture • Discussion • Participative Learning	Assignment on export and import of data	To study technology advantage of tally	Assessment through test papers

BCM6B16: PROJECT REPORT

Course Objectives:

1. To provide practical insight on one of the interesting topics of learning.
2. To acquaint students with the practical knowledge of doing things.
3. To impart a self-esteem among students as to how to collect data on various topics, how to process it and how to interpret it.
4. To provide students with the practical problems involved in executing a study as planned.
5. To nurture a culture of research, extension and publication among students.

Course Outcomes:

1. Students get clear ideas on idea generation, topic selection, factors to be considered before selection of a topic, drafting methodology, sampling, etc.
2. Gets insight on collection, tabulation, processing, analysis and interpretation of data clearly.
3. Students get clarity of expressions and judgments.
4. Students get acquitted with the forms, formalities and methodology of presenting an academic document.

5. It improves skill, enthusiasm and a spirit of inquisitiveness among younger generations to look further and further and elicit hidden facts before academia.

MCM1C01: BUSINESS ENVIRONMENT AND POLICY

Number of Lecture Hours per week : 5
Number of credits: 4
Internal Credit: 0.8 External Credit: 3.2
Duration of Examination : 3 Hours

Objective:

- To familiarise students with the concepts of macro-economic in which a Business organization operates

Module I

Business Environment: Meaning & Elements -Components and significance– Scope–political, Economic, Social, Technological, Legal, Cultural and Labour Environment – Trade Unions – Quality Circles – External Factors Influencing Business Environment – Dimensions of International Business Environment – Challenges
(15 Hours)

Module II

Structure of Indian Economy: Economic Systems-Economic Planning– Planning Commission and NITI Ayog – Public Sector – Changing Role– Relevance – Public Sector Reforms – Public Private Participation – Privatization and Disinvestments – Fiscal Policy – Monetary Policy – Structure of Union and State Budgets – Sources of Revenue – Management of Public Debt. – GSTHistory and Development in India (20 hours)

Module III

Profile of Indian Economy: New Economic and Industrial Policy–Recent Economic & Tax Reforms in India – GST-Land Reforms – Liberalization – Problems of Growth – Unemployment – Poverty – Regional Imbalances – SEZ – Social Injustices – Inflation – Black Money – Lack of Technical Knowledge and Information – Globalization Various Aspects – Consequences. (15 hours)

Module IV

Foreign Direct Investment and Institutional Investment: Forms–Policy - FDI in Retail

Trade – Problems and Consequences – FEMA – Multinational Corporations Role and Recent Trends – Problems and Consequences – Competition Law-Import & Export Policies- Start-ups- Digital economy- CRYPTO currency, Fin tech (10 hours)

Module V

Environment management-Degradation of Natural Environment-Air pollution, Water Pollution, Land Pollution, National Wetland Policy-Madhav Gadgil Committee Report-KasturiRangan Report-Global warming-causes & Effects, Climate Change, KYOTO Protocol, GreenNi Financing, Carbon Credit, Environment Protection Act 1986(Basics)-National Green Tribunal Act (Basics) - Consumer Protection Act,1986 (Basics) – RTI 2005(Basics) Salient features of Information Technology Act:2000.

(20 hours)

References:

1. M. Adhikari: Economic Environment of Business, Sultan Chand and Sons, New Delhi.
2. Ian Worthington, Chris Britton: Business Environment.
3. Francis Cherunilam: Business Environment, Himalaya Publishing House, Mumbai.
4. Claire Capon: Understanding the Business Environment.
5. K.V.Sivayya and VBM Das: Indian Industrial Economy, Sultan Chand Publications, Delhi.
6. David Baron: Business and Its Environment.
7. Panday G.N: Environmental Management, Vikas Publishing House.
8. Raj Agarwal: Business Environment, Excel Publications, New Delhi.

OBJECTIVES

- To give an idea about the policies of the government and assess their impact on business

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (15 Hours)	Meaning and definition of Business Environment, Components and significance, Types, Trade unions, Factors influencing Business Environment, Challenges	Lectures, Discussion and Participative learning	PowerPoint presentation on different types of business environment, Group discussion trade unions	To learn about business environment and its components. To understand the various challenges of business environment.	Evaluation through test paper
Module II (20 Hours)	Structure of Indian Economy, Economic Systems, PlanningCommission and	Seminars, Discussion and Participative learning	Seminar presentations on role of public sector in Indian economy, Group discussion on privatisation and disinvestment.	To evaluate the structure of Indian economy. To understand the history and development of GST	Evaluation through seminar

	NITI Ayog, Relevance of Public sector, Privatization and Disinvestment, Fiscal policy and Monetary policy, Union and State Budget, Management of Public debt, GST - History and Development in India			in India.	
Module III (15 Hours)	Profile of Indian Economy, Recent economic and Tax reforms in India, Liberalization and problems of growth, SEZ, Inflation and Black money, Globalisation.	Lectures, Discussion and Participative learning	PowerPoint presentation on profile of Indian Economy, Group discussion on inflation and Black money.	To provide an overview on the profile of the Indian economy. To understand the tax reforms in India.	Evaluation through assignmets

Module IV (10 Hours)	Introduction to Foreign Direct Investment and Institutional Investment, FDI in retail trade - Problems and consequences, Foreign Exchange Management Act, Role and problems of MNC, Competition Law, Start-ups and Digital economy, CRYPTO currency and Fintech	Lectures, Discussion and Participative learning	PowerPoint presentation on Foreign Direct Investment and Institutional Investment	To learn about Foreign Direct Investment and Institutional Investment. To know the problems and consequences of Multinational Corporations.	Evaluation through test paper
Module V (20 Hours)	Introduction to Environment Management, Degradation of natural environment, National	Lectures, Discussion and Assignments	Seminar on degradation of natural environment, Discussion on Global warming.	To provide an overview on environment management and various committees on environment. To learn about	Evaluation through assignment and seminars

	Wetland Policy, Madhav Gadgil Committee Report - Kasturi Rangan Report, Global warming, KYOTO Protocol, Carbon Credit, Environment Protection Act 1986, Consumer Protection Act 1986, Salient Features of IT Act 2000.			Environment Protection Act 1986, Consumer Protection Act 1986, and IT Act 2000.	

COURSE OUTCOME

CO1	Analyse the environment of a business from the various internal and external perspectives
CO2	Evaluate how the economic environment and its configurations influence in business decision making

CO3	Apply the role of New Economic Policy and the Economic reforms in the perspective of Business
CO4	To make understand the various policies related to FDI &Multi-National Corporations
CO5	To give an in-depth knowledge about the recent Government policies regarding Environment management

MCM1C02 CORPORATE GOVERNANCE AND BUSINESS ETHICS

Number of Lecture Hours per week : 5
Number of credits: 4
Internal Credit: 0.8 External Credit: 3.2
Duration of Examination : 3 Hours

Objectives:

- To familiarise the students with the knowledge of corporate ethics

Module-I

Meaning and Definition of Corporate Governance- Evolution of Corporate Governance- Major Stakeholders of a Corporate Body and their goals- Communication mechanism of corporate organisation with stakeholders-Objectives Corporate Governance- Principles of Corporate Governance. (15 Hours)

Module-II

Theories and Models of Corporate Governance- Conceptual Framework of Corporate Governance- Legal framework of Corporate and administrative framework- regulatory framework of corporate governance in India- SEBI guidelines and clause 49- Reforms in the Companies Act-Secretarial Audit-Class action- NCLT- Insider trading- rating agencies- green governance- shareholders' activism- corporate governance in PSUs and banks- Legislative framework of corporate governance- an international perspective (UK, USA, Australia, China, Russia, South Africa) (20 Hours)

Module-III

Various Committees on Corporate Governance- International- Blue riband Committee-Cadbury Committee- Greens burry Committee- Kings Committee- Securities and Exchange Commission Report- Indian; Birla Committee, Narayanamurthy Committee- JJ Irani Committee, Naresh Committee Report.

Uday Kodak Committee Report Corporate Reporting Framework- Reporting of Remuneration- Service Contract of Directors- Financial Reporting of the activities of the company as per clause 49 of the Companies and SEBI Act. IFRS- Need-Importance- Significance-Use. (15 Hours)

Module-IV

Elements of Corporate Governance- Board of Directors- Executive Directors-Independent Directors- Appointment, Remuneration- Powers, Duties and Responsibilities- Audit Committee- Composition Power and Responsibilities-Statutory Officers- Duties, Board Committees- Responsibilities and Powers-

Board meetings- Whistleblowing and Corporate Governance- The Concept of Whistle blowing-Types of whistle blowers- Whistle blower policy- the Whistle Blower Legislation across countries- Developments in India. (20 Hours)

Module-V

Business Ethics- Meaning-scope-Importance-Dimensions-Role of ethics in business-Law & ethics- Ethics and values-Important ethical principles in business-The new management philosophy-Ethics in business functional areas-integrity-Sales-HRM-Management of quality. Corporate excellence -corporate culture- Styles & values of management-managing cultural diversity in organisation- Building corporate image-knowledge workers & knowledge mgt.

(10 Hours)

Suggested Readings:

Books

1. Mallin, Christine A., Corporate Governance (Indian Edition), Oxford University Press, NewDelhi.
2. Blowfield, Michael, and Alan Murray, Corporate Responsibility, Oxford University Press.
3. Francesco Perrini, Stefano and Antonio Tencati, Developing Corporate Social Responsibility- AEuropean Perspective, Edward Elgar.
4. Sharma. J.P., Corporate Governance and Social Responsibility of Business., Ane Books Pvt Ltd,New Delhi
5. Jawahar Lal Corporate Financial Reporting Theory and Practice- Taxman
6. Singh S: Corporate Governance-Global Concepts and Practices- Excel Books
7. Robert A.G Monks & Nell Minow: Corporate Governance: Wiley
8. Bob Tricker: Corporate Governance: Principles, Policies and Practices- Oxford University Press.
9. Fernando.AC: Corporate Governance: Principles, Policies and Practices: Pearson Education
10. Indian Institute of Corporate Affairs- Corporate Governance: Taxman
11. Indrajit Dube: Corporate Governance- Lexis Nexis
12. Satheesh Kumar. T.N: Corporate Governance: Principles and Practices: Oxford University Press
13. Ghosh.B.N. Business Ethics and Corporate Governance- Mc Graw Hill Education
14. Robert Cobbaut et al: Corporate Governance: An Institutional approach- Kluwer Law International.

Cases-International

1. Bank of Credit and Commerce International – UK
2. Maxwell Communication Corporation and Mirror Group Newspapers (UK)
3. Enron (USA)
4. Anderson worldwide (USA)
5. Vivendi (France), Lehman Brothers (USA)

Cases-Indian
1.Satyam Computer Services Ltd
2. Sahara
3. Kingfisher Ltd
(Common governance problems noticed in various corporate failures; policy actions including major codes and standards.
Journal: Chartered Accountant

OBJECTIVES

- To enable the students to understand the emerging trends in good governance practices.
- To create corporate financial reports in the global and Indian context.

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (15 Hours)	● Meaning and definition of corpora	● Lectures ● Participative learning	● PowerPoint presentation on meaning and definition of	To understand the meaning of corporate governance To identify the	● Evaluation through test

	te governance, ● Objectives and principles of corporate governance		corporate governance ● Group discussion on objectives and principles of corporate governance	objectives and principles of corporate governance	paper
Module II (20 Hours)	● Theories and models of corporate governance ● Insider trading, green governance, shareholders activism	● Discussion ● Lecture ● Demonstration	● Seminar presentations on theories and models of corporate governance ● Group discussion on insider trading, green governance and shareholders activism	● To provide an insight into the Theories and models of corporate governance ● To know more about the insider trading, green governance and shareholders activism	Evaluation through case study
Module III (15 Hours)	● Various committees on corporate	● Lectures ● Participative learning	● Assignments on various committees on corporate governance	● To learn about different committees on corporate	● Evaluation through test

	governance ● IFRS need and importance		● PowerPoint presentation on need and importance of IFRS	governance ● To provide a clarity with regard to the need and importance of IFRS	paper
Module IV (20 Hours)	● Board of Directors, duties responsibilities and powers of board committee ● Whistle blowing and developments in India	● Lecture ● Discussion ● Participative learning	● Group discussion on duties, responsibilities and powers of board of committees ● PowerPoint presentation on whistle blowing	● To understand the powers, duties and responsibilities of board of directors	Evaluation through seminar presentations
Module V (10 Hours)	● Role of ethics in business law ● The new	● Seminars ● Assignments	● PowerPoint presentation on role of ethics in business law ● Group discussion on	● To observe and identify the role of ethics in business law ● To understand the new	● Evaluation through test paper

	management philosophy, corporate excellence ● Styles and values of management	● Discussion	the new management philosophy	management philosophy	

COURSE OUTCOME

CO1	To make an understanding about the concept of Corporate Governance and the communication mechanism
CO2	To Apply the various Theories and Models of Corporate Governance and the recent initiatives in India and abroad
CO3	To make an understanding about the various committees on Corporate Governance and theLegal framework
CO4	Evaluate the role of various stakeholders, whistleblowing and the recent developments in India.
CO5	To create Important ethical principles in Business in the cultural diversity

MCM1C03: QUANTITATIVE TECHNIQUES FOR BUSINESS DECISIONS

Number of Lecture Hours per week : 5
Number of credits: 4
Internal Credit: 0.8 External Credit: 3.2
Duration of Examination : 3 Hours

Objectives:

- To acquaint students with important quantitative techniques, which enable sound business decision making

Module 1

Quantitative Techniques: Introduction to quantitative techniques-Qualitative and quantitative approaches–role in decision making – Significance of quantitative decisions – Probability distributions- Discrete & Continuous-Binomial, Poisson, Uniform, Exponential, Normal distributions- Inferential analysis for management – statistical estimation – point estimation – interval estimation – Properties of a good estimator. Confidence intervals for means (a) when σ is known, and (b) when σ is not known. Sample size determination for a mean. Confidence intervals for proportions. (25 hours)

Module 2

Hypothesis Testing: One and Two-sample Tests: General methodology of hypothesis testing. One and two-tailed tests. Type I and type II Errors. One Sample Tests: Hypothesis testing of means when the population standard deviation is known and when it is not known. Hypothesis tests concerning proportions. Two-sample Tests: Tests for difference between means – when population standard deviations are known, and when they are not known. Inferences about difference between two means for matched samples. Testing the difference between two proportions. (15 hours)

Module 3

Analysis of variance & Non parametric tests: F-test of equality of variances. One-factor ANOVA (Completely Randomised Model) and Two-factor ANOVA without replication (Randomised Block Model). Chi-square test for independence & Goodness of fit. Sign test, one sample runs test and rank correlation test
(20 hours)

Module 4

Correlation and Regression analysis: Simple, partial & Multiple correlation, Simple & multiple linear regressions, Coefficient of Determination (10 Hours)

Module 5

Use of Excel and SPSS for quantitative methods (Application level)- Analysis tools - Descriptive statistics and inferential analysis (10 hours)

(Theory 30% Problem 70%)

References:

1. Levin & Rubin, Quantitative Approaches for Management, Pearson 2.
Anderson, 2. 2.QuantitativeMethods for Business Decisions, Thomson
2. Barry Render, Quantitative Analysis for Management, Prentice Hall of India
3. D.V.D. Vohra, Quantitative Techniques for Management
4. Anand Sharma, Quantitative Techniques for decision making, Himalaya Publishing House 15 hours
5. Gupta & Khanna, Quantitative Techniques for decision making, Prentice Hall of India.
6. Gupta SP, Statistical Methods, S. Chand & Sons.
7. P.N. Arora, Sumeet Arora, S. Arora, Comprehensive Statistical Methods, S. Chand and CompanyPrivate Limited, New Delhi
8. G.C. Beri, Business Statistics, Tata McGraw,Hill New Delhi

OBJECTIVES

- To make students learn the process of applying appropriate quantitative techniques for validating findings and interpreting results

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (25 Hours)	• Introduction to QT, Qualitative and quantitative approaches • Probability distribution- Discrete and continuous	• Lectures • Discussions	• PowerPoint presentation on introduction to QT • Group discussion	• To learn about the qualitative and quantitative techniques • To provide an insight into the probability distribution	• Evaluation through test paper
Module II (15 Hours)	• Hypothesis testing, one and	• Lectures • Part	• Seminar presentations on hypothesis	• To understand about the hypothesis testing on one	• Evaluation through

	two tailed test ● One sample test, two sample test	icipativ e learnin g ● Discuss ion	testing ● Group discussion on one sample test and two sample test	sample tests and two sample tests.	test paper
Module III (20 Hours)	● ANOVA (one factor and two factor) ● Chi square test and rank correlation test	● Lectures ● Assignments ● Discussion	● Power point presentation on ANOVA ● Group discussion on chi square test	● To provide a thorough knowledge about ANOVA and chi square test	● Evaluation through test paper
Module IV (10 Hours)	● Simple, partial and multiple correlation ● Simple and multiple linear regressions	● Lectures ● Seminars ● Assignments	● Power point presentation on correlation and regressions	● To evaluate the role of correlation and regressions	● Evaluation through test paper

Module V (10 Hours)	• Use of Excel and SPSS for quantitative methods • Analysis tools • Descriptive statistics and inferential analysis	• Lectures • Discussion • Participative learning	• Power point presentation on Excel and SPSS	• To know about the applicational levels of use of Excellence and SPSS • To understand the descriptive statistics and inferential analysis	• Evaluation through test paper

COURSE OUTCOME

CO1	To remember and understand properties of probability distribution and to solve the problems
CO2	To apply hypothesis testing for validation and interpretation of the results
CO3	To evaluate the application of non-parametric tests for validation
CO4	To understand the tool for finding the relationship between variables and its magnitude
CO5	To create soft skill knowledge for data analysis

MCM1C04: MANAGEMENT THEORY AND ORGANISATIONAL BEHAVIOUR

Number of Lecture Hours per week : 5
Number of credits: 4
Internal Credit: 0.8 External Credit: 3.2
Duration of Examination : 3 Hours

Objectives:

- To understand human behaviour at Individual, Interpersonal, Group and InterGroup levels

Module I

Introduction to management –management concept-Historical evolution schools of management thought –Major contributors to management thought- Principles of management-modern techniques in management- Japanese Management System- Korean Management system - Leadership and Management-Theories of Management, Theories of Leadership, Quality circle- TQM- Six sigma- Kaizen- Benchmarking –Core competence-Bottom of pyramid approach-MDP- steps in MDP - Need for the knowledge of OB – Need for a contingency approach to the study of OB – Emerging challenges and opportunities for OB – the organization as a system – System – System approach to organizational behaviour – Managerial functions – The organization and people.(20 Hours)

Module II

Basic psychological process-Perception-Factors influencing perception - Attribution theory – Specific applications in organizations – Learning - Theories of learning – Using learning concepts for self-management – implications for performance and satisfaction – Remembering – Basic motivational concepts – Theories of motivation. HRM approach to managing and controlling performance.
Behavioural aspects of Control (15 hours)

Module III

Personality–Determinants of personality–Theories of personality–Major personality attributes influencing organization behaviour - Building and maintaining the self-values, attitudes and job satisfaction – Ethical issues in organizational behaviour – Mental and health problems in organizations – role of counselling. Building, leading and managing teams (20 hours)

Module IV

Group dynamic and inter group relationships–Characteristics of workgroup – Basic forces of group behaviour – Quality of Work Life-Work Life Balance-Dynamics of effective operating groups – Work group behaviour and productivity - Team management – Styles and skills in leadership and communication – Power and politics in organization – Managing differences and conflicts – managing change – Organization and society.(15 hours)

Module V

Organisational Culture, Organizational development–Techniques of organizational development Interventions – Grid management – Transactional analysis – Sensitivity training – Process consultancy -Case discussions and analysis. Techniques for managing organisational relationships. (10 hours)

References:

1. Fred Luthans: Organisational behaviour
2. Danial C. Fieldman and Hugh Arnold: Managing individual and group behaviour in organization.
3. Henry Mint berg: The structure of organization
4.Edwin Gerlog: Organization theory and design

OBJECTIVES

- To recognise issues inherent in organisational change, growth, development and conflict

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (20 Hours)	*Introduction to management , theories of management, new concepts in management *Introduction to Organisational behaviour	• Lectures • Discussion • Participative learning	• PowerPoint presentation on concepts and theories of management • Group discussion on one sample test and two sample test	• To provide an overview about management concepts and theories • To learn about basics of Organisational behaviour	• Evaluation through test paper

Module II (15 Hours)	*Basic psychological process *Perception,learning and motivation	• Lectures • Discussions	• Group discussion on perception and learning • Powerpoint presentation on theories of motivation	• To understand basics of psychological process • To know perception and attitudes	• Evaluation through test paper
Module III (20 Hours)	*Personality and attitudes theories and concepts	• Lectures • Assignments • Discussion	• Assignments on personality and different attitudes	• To evaluate about personality learning and motivation	• Evaluation through assignments
Module IV (15 Hours)	*Group dynamic and intergroup relationships *Team management *Power and politics *Organisational change.	• Lectures • Seminars • Assignments	• Seminar presentations on group behaviour and team management • Group discussion on power and politics and organisational change	• To know group behaiour and intergroup relationships • To understand power and politics • To evaluate organisational change	• Evaluation through seminar presentations
Module V (10 Hours)	*Organisational development	• Lectures • Group discussion • Participative	• Group discussion leadership	• To examine organisational development • To understand	• Evaluation through

	*Leadership	learning	theories	leadership concepts and theories	test paper

COURSE OUTCOME

CO1	To impart a thorough understanding about various concepts and theories in management and organisational behaviour
CO2	Understand the various psychological process and different motivation theories which will influence the performance
CO3	To Evaluate the personality traits of human beings and various ethical issues in Organisational Behaviour.
CO4	To understand importance of group dynamics, need for work life balance and managing change
CO5	To apply the the various terms related to organisational culture and Techniques for managing organisational relationships

MCM1C05: ADVANCED MANAGEMENT ACCOUNTING

Number of Lecture Hours per week : 5

Number of credits: 4

Internal Credit: 0.8 External Credit: 3.2

Duration of Examination : 3 Hours

Objectives:

- To enable students to understand and apply tools, techniques, and concepts in the managerial decision-making process

Module 1

Introduction to Management Accounting : Meaning and importance of Management Accounting- Tools of Management Accounting (Descriptive, Analytical, Diagnostic, Predictive) – Skills required for Management Accountants- Strategic Role of Management Accountants- Functions of Management Accountants. (10 Hours)

Module 2

Performance Measurement : Financial and non-financial measurement of performance- ROI – Residual Income – KPI-Economic Value Added (EVA) – concept and measurement - Balanced ScoreCard- concepts and objectives- Multiple Scorecard measures- New horizons in management control- Responsibility Accounting- Performance Budgeting- ZBB and ABB – Social Cost-benefit Analysis- Modern production Management techniques originating from Japan – Flexible Manufacturing Systems (FMS)- TQM. (15 Hours)

Module 3

Decision making under Risk and Uncertainty: Nature and Types of risk- Techniques for decision making under risk and uncertainty- Optimistic and Pessimistic estimates- Risk adjusted Discount Rate- Certainty Equivalent Coefficient Method- Sensitivity technique- Probability technique- Standard Deviation method- Coefficient of Variation method- Simulation Technique- Decision Tree Analysis. (15 Hours)

Module 4

Standard Costing and Variance Analysis: Types of Standards – setting standards- Variance Analysis- Importance- Material, Labour, Overhead, Sales and Profit

Variance – Interpretation of variance - Control and Efficiency Ratios- Investigation of Variance – Techniques of interpretation of variance. (20 Hours)

Module 5

Marginal Costing and its Application: CVP analysis and decision making – Managerial applications of CVP analysis- make or buy decision-Alternative methods of production- Buy or Lease Decision- Shut down or continue- Repair or replace –Accepting bulk orders for Idle capacity utilization- pricing under different situations- suitable product mix and Key Factor. (20 Hours)

(Theory 30% and Problems 70%)

References:

1. Cost and Management Accounting- Jain and Narang, Kalyani Publishers
2. Management Accounting and Financial Control-S N Maheshwari, Sultan Chand & Sons
3. Management Accounting N.K Kulshrestha, Taxman Publications
4. Management Accounting – Paresh Shah, Oxford Publishers
5. Advanced Management Accounting – Ravi.M Kishore, Taxman
6. Management and Cost accounting – Colin Drury, Cengage Learning
7. Management Accounting – Dr. S.P Gupta, SahityaBhavan Publishers
8. Catherine Stenzel& Joe Stenzel, Essential of Cost Management, John Wiley and sons, Latest Edition.
9. Roman I wiel& Michael W mahr Hand book of Cost Management, John Wiley and Sons, Latest Edition.
10. Lianabel Oliver, The cost management tool box. AMA Publication, Latest Edition.
11. John K. Shank & Vijay Govindarajan, Strategic Cost management: The new tool for competitive advantage, The free press, Latest Edition.
12. K.P. Gupta, Cost Management: Measuring, monitoring and motivating performance, Global India Publications, Latest Edition.

Journals/Newspapers

Management Accountant

Chartered Financial Analyst

Chartered accountant
Business line
Economic times.

OBJECTIVES

- To inculcate analytical skills in interpreting and diagnosing business problems

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment	
Module I (10 Hours)	**Module I (20 Hours)**	Meaning and importance of Management Accounting Skills and Functions of Management Accountant	1.Lectures 2.Discussion	1.Group discussion on skills of Management Accountant 2.Power point presentation on meaning of Management Accounting	To provide an insight about meaning of Management Accounting To get an idea about skill and	Evaluation through case study

					functions of Management Accountant	
Module II (15 Hours)	**Module II (20 Hours)**	Financial measurement of performance New horizon in Management Control	1.Participative learning 2.Discussion	1.Seminars on financial performance measurement 2.Discussion on new horizons	To know more about performance measurement To understand new horizons of Management Control	Evaluation through Seminars
Module III (15 Hours)	**Module III (15 Hours)**	Techniques for decision making under risk and uncertainty	1.Demonstration 2.Lectures	1.Power point presentation on different techniques	To get more knowledge about techniques for decision making under risk and uncertainty	Evaluation through test paper

Module IV (20 Hours)	**Module IV (20 Hours)**	Standard costing and techniques of interpretation of variances	1.Lectures 2.Participative Learning	1.Assignments on Standard Costing 2.Group discssion on Variance Analysis	To understand Standard costing and variance analysis	Evaluation through assignment
Module V (20 Hours)	**Module V (05 Hours)**	Meaning of marginal costing Applications of CVP Analysis	1.Discussion 2.Lectures 3.Participative Learning	1.Power point presentation on marginal costing 2.Seminars on Application of CVP Analysis	To provide more knowledge about marginal costing To undeestand applications of CVP analysis	Evaluation through test paper

COURSE OUTCOME

CO1	To remember and understand the knowledge to use different methods of measuring financial and non-financial performance
CO2	To measure and solve financial and non-financial performance-based business problems
CO3	To understand and apply comprehensive performance management initiatives for organizations

CO4	Understand and apply the significance of risk and uncertainty in decision making
CO5	To apply various techniques of interpreting Variances

MCM2C06: ADVANCED CORPORATE ACCOUNTING

Number of Lecture Hours per week : 5
Number of credits: 4
Internal Credit: 0.8 External Credit: 3.2
Duration of Examination : 3 Hours

Objectives:

- To provide knowledge and skills in the theory and practice of corporate financial accounting

Module 1

Group Financial Statements: Group accounts and group structures – consolidation procedures (IFRS 10 /Ind AS 110)- Non- Controlling Interest (NCI)- Goodwill valuation (IFRS 3/Ind AS 103)- Goodwill arising on consolidation – Intra-group transactions and mutual owing – Treatment of unrealised profit- revaluation of assets and liabilities- Treatment of dividend and bonus shares. (20 Hours)

Module 2

Accounting for Corporate Restructuring : Accounting for Mergers, Acquisition and Reconstruction (internal and external)- Accounting for liquidation of companies- preparation of Statement of Affairs – Deficiency /Surplus Account- Liquidator's final statement of account- Receiver's statement of accounts. (20 Hours)

Module 3

Accounting for Taxation: Current Tax Expense –calculation and accounting entries- Deferred Tax – Temporary Difference- TTD and DTD – Deferred Tax Assets and Deferred Tax Liabilities – Deferred Tax Expense and Deferred Tax Income (Deferred Tax Reversal)- Recognition, Measurement, Presentation and Disclosure of Deferred Tax (15 Hours)

Module 4

Accounting for Revenue and Leases:Revenue from contact with customers (IFRS 15 / Ind AS 115) – Revenue Recognition model – Variable Consideration- Long term contracts – Revenue recognition from construction contracts Accounting for Leases (IAS 17 / Ind AS 17) – Classification of lease – Operating Lease – recognition, measurement,presentation and disclosure in the books of Lessor and Lessee – Financial Lease- recognition, measurement, presentation and disclosure in the books of Lessor and Lessee- New standard on lease (IFRS 16 /Ind AS 116) - major changes in the lease accounting (especially in the books of lessee).
(20 Hours)

Module 5

Modern Concepts in Accounting : Human Resource Accounting- Forensic Accounting – Social Responsibility Accounting – Environmental Accounting- Investment Accounting – Proactive Accounting – Inflation Accounting. (5 Hours)

(30% Theory and 70% Problems)

References:

1. Shukla and Grewal: advanced Accounts. (S. Chand & Co Ltd. New Delhi)
2. Jain and Narang: Advanced Accounts (Kalyani Publishers, Ludhiana)
3. Sr. K. Paul: Accountancy, Volume-I and II (New Central Book Agency, Kolkata)
4. R.K., Lele and Jawaharlal; Accounting Theory (Himalaya Publishers)
5. Dr. L.S. Porwal; Accounting Theory (Tata Mc Graw Hill)
6. Robert Anthony, D.F. Hawkins & K.A. Merchant: Accounting Text & Cases. (Tata Mc Graw Hill).
7. Dr.S.N. Maheshwari: Corporate Accounting (Viakas Publishing House Pvt. Ltd. New Delhi)

8. Dr. Ashok Sehgal & Dr. Deepak Sehgal; Advanced Accounting (Taxman, New Delhi).
9. RL Gupta & Radha Swamy Advanced Accountancy. (Sultan Chand and Co.)
10. Anthony, RN & Reece, JS: Accounting Principles, Richard Irwin, Inc.
11. Barker, P & O'hOgartaigh, C: Group Accounts – Theory and Practice, Oaktree Press 1st Edn.
12. Narayanswamy, R: Financial Accounting - A Managerial Perspective, PHI, New Delhi,
13. Hani & Mukherjee: Corporate Accounting, TMG, New Delhi.
14. Xavier, g Francis: Fundamentals of Advanced Accounts, Vol-III, TMG, New Delhi.
15. Financial Reporting Vol. 1 by The Institute of Chartered Accountants of India.
16. Advanced Accountancy MC Shukla. T.S. Grewal. & S.C. Gupta.
17. IFRS Red Book (Official Publication of IASB)
18. ICAI study material for Financial Reporting
19. Indian Accounting Standards, Chinten Patel & Bhupendra Mantri (Taxman Publication)
20. Illustrated Guide to Ind AS, T P Ghosh (Taxman Publication)

Journals : Chartered Accountant.

OBJECTIVES

- To provide insight into some of the important accounting standards of IFRS /Ind AS
- To enable problem solving abilities among students in matters of various corporate situations such as consolidation of group information, corporate restructuring and liquidation

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (20 Hours)	Group accounts and group structures, consolidation procedures	● Lecture ● Discussion ● Participative Learning	Assignment on exercise questions	To study how to prepare financial statements	Assessment through test papers
Module II (20 Hours)	Accounting for mergers, accounting for liquidation of companies, preparation of statement of affairs, liquidators final statement of accounts	● Lecture ● Discussion ● Participative Learning	Seminar on accounting for mergers , acquisition, and reconstruction Assignment on exercise questions	To study accounting for liquidation of companies	Assessment through test papers
Module III (15 Hours)	Current tax expenses , calculation and	● Lecture ● Discussion ● Participative Learning	Assignment on exercise questions	To study current tax expenses To study deferred	Assessment through test papers

	accounting entities, deferred tax asset and deferred tax liabilities			tax asset and liabilities	
Module IV (20 Hours)	Revenue from contract with customers, revenue recognition model, classification of lease, recognition , measurement , presentation, disclosure	• Lecture • Discussion • Participative Learning	Presentation on different types of lease Assignment on exercise questions	To study revenue from contract with customers To study recognition, measurement,presentation and disclosure in the books of Lessor and lessee	Assessment through test papers
Module V (05 Hours)	Human Resource Accounting- Forensic Accounting – Social Responsibility Accounting – Environmental Accounting- Investment Accounting – Proactive Accounting –	• Lecture • Discussion • Participative Learning	Seminar on social responsibility accounting Group discussion on responsibility accounting Assignment on inflation accounting	To study modern concepts in accounting	Assessment through test papers

	Inflation Accounting				

COURSE OUTCOME

CO1	To understand the theory and practice of Corporate Financial Accounting
CO2	To create problem solving capacity in Corporate restructuring and liquidation
CO3	To understand skill in recognition, measurement and presentation of deferred tax
CO4	To understand insight into Accounting standards of IFRS, Ind AS, and Lease accounting
CO5	To evaluate different types of accounting

MCM2C07: ADVANCED STRATEGIC MANAGEMENT

Number of Lecture Hours per week : 5

Number of credits: 4

Internal Credit: 0.8 External Credit: 3.2
Duration of Examination : 3 Hours

Objectives:

- To provide an awareness regarding various types of strategies

Module 1

Introduction: Basic concepts of strategy and strategic management–level of strategy – Strategic Management Process – Models of strategic management – Approaches to strategic decision making – vision – mission – objectives – goals – strategic implications of social and ethical issues. (15 hours)

Module 2

Environmental Analysis : SWOC- Strategy and Competitive Advantage-Emerging trends in strategic management- New modes of leadership- Organisational Redesign (15 hours)

Module 3

Strategic Choice: Generating strategic alternatives–Strategic options at corporate level – Stability, Growth and Defensive Strategies – Strategic Alliance – SBUs – Portfolio models – BCG matrix – Michael Porter's competitive strategies Mintzberg's five Ps Strategy, KPI, KSF – External growth strategies – Competitive Advantage, Porters Value Chain Merger, acquisition, joint venture and strategic alliance (with business cases) (20 hours)

Module 4

Strategy implementation: Various approaches to implementation of strategy – Planning and allocating resources – Strategic Control. (15 hours)

Module 5

Strategy evaluation and control: Tools and techniques of evaluation-control techniques and process –DuPont Control model, Balanced scorecard-etc
(15 Hours)

At least one relevant case shall be discussed in each module and assignments shall be encouraged to be in the form of case studies

References:

1. Krishna Kumar: Cases in Strategic Management – Managerial Experiences, Global Business Press(1996).
2. RM Srivastava: Corporate Strategic Management, Pragati Prakashan.
3. AzharKazmi: Strategic Management and Business Policy, Tata McGraw-Hill Publishers (2010).
4. Stephen Hains: Strategic Thinking, Jaico Publishing House (2008)
5. RM Srivastava and DivyaNigan: Corporate Strategic Management, PragatiPrakashan (2000).
6.Frank T Paine and Carl R Anderson: Strategic Management, The Dryden Press

OBJECTIVES

- To study applications of the various strategies along with strategic formulation, implementation and evaluation.

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (15 Hours)	Concepts of strategy and strategic management,	Lectures Discussion Participative learning	• PowerPoint presentation on concept of strategy and	To understand the concept of strategy, strategic management. To	Assessment through test paper, performance

	Levels of strategy, Strategic Management Process, Models of strategic management, Approaches to strategic decision making, strategic implications of social and ethical issues		strategic management, and process of strategic management ● Group discussion on levels of strategy andstrategic decision making	know the strategic management process, strategic decision making etc.	in group discussion
Module II (15 Hours)	Strategy and Competitive Advantage, Emerging trends in strategic management, New modes of leadership, Organisational Redesign	Lectures Discussion Participative learning	● Presentation on SWOT analysis of various companies ● Group discussion on emerging trends in strategic managemnt	To understand more about SWOT analysis, emerging trends in strategic management, modes of leadership and organizational design .	Assessment through test paper, Assessment of performance of presentation of SWOT analysis
Module III (20 Hours)	Strategic Choices, Corporate level strategies, Portfolio	Lectures Discussion Participative learning	● PowerPoint presentation on corporate level strategies ● Group	To understand the types of corporate level strategies, portfolio models, competitive advantage.	Assessment through test paper, performance in group discussion

	models, Competitive Advantage, Porter's Value Chain Merger, acquisition, joint venture and strategic alliance		discussion on Competitive advantage		
Module IV (15 Hours)	Strategy implementation, Various approaches to implementation of strategy, Planning and allocating resources, Strategic Control.	Lectures Discussion Participative learning	• PowerPoint presentation on strategic implementation process • Group discussion on Strategic control	To understand strategic implementation and strategic control	Assessment through test paper, performance in group discussion
Module V (15 Hours)	Strategy evaluation and control: Tools and techniques of evaluation, control techniques and process	Lectures Discussion Participative learning	• PowerPoint presentation on strategic evaluation and controlling process and techniques	To understand the strategic evaluation and controlling process and various techniques of strategic control	Assessment through test paper

COURSE OUTCOME

CO1	To understand the Strategic Management Process and to provide basic idea about the Social and ethical issues
CO2	To understand and evaluate the Environment analysis and SWOC
CO3	Evaluate the strategic options at Corporate level and the different growth strategies
CO4	To understand the Strategy implementation and different approaches in planning and allocating resources
CO5	To apply and evaluate the Strategy evaluation, tools and techniques used and processes with case studies

MCM2C08 STRATEGIC COST ACCOUNTING

Number of Lecture Hours per week : 5

Number of credits: 4

Internal Credit: 0.8 External Credit: 3.2

Duration of Examination : 3 Hours

Objectives:

- To enable the students to know the applications of Cost accounting tools, Techniques and concepts in the managerial decision-making process.

Module I

Overview of Cost Accounting- Cost, Costing, Cost Accounting, Cost Accountancy, Scope of Cost Accounting, Objectives of Cost Accounting, Limitations of Cost Accounting, Art, Science and Practice. Cost Accounting System- Importance of Cost Accounting to Management, Workers, creditors, investors, government, general public, Advantages of Cost Accounting System, Essentials of a good Cost Accounting System, Reports provided by Cost Accounting Dept., Practical difficulty in installation of Costing System, suggestions to overcome practical difficulties. Comparison of Cost Accounting with other subjects- Cost Accounting and Financial Accounting, Cost Accounting and Management Accounting.
(10 hours)

Module II

Performance Measurement in Cost Accounting- Cost Unit, Composite Cost Unit, Cost object, Cost Centre, Profit Centre, Investment Centre. Costing Systems- Historical Costing, Absorption Costing, Direct Costing, Marginal Costing, Standard Costing, Uniform Costing. Cost Classification by Nature of Production Process- Batch Cost, Process Cost, Operation Cost, Operating Cost, Contract Cost,
Joint Cost. Classification of Cost based on Behaviour- Variable Cost, fixed cost, semi-variable or semi fixed cost, stepped costs, specific and common fixed cost, committed fixed cost, discretionary fixed cost,engineered cost, managed cost, capacity cost, programmed cost. Importance of Behaviour wise cost classification, cost control, decision making, marginal costing, flexible budgets, CVP analysis, direct costing. (10 hours)

Module III

Process Costing- Features, Applications, Difference between Job Costing and Process Costing, Normal loss, abnormal loss, abnormal gain, inter process profits, equivalent production-FIFO, average method, weighted average method. Joint and By-Products-Difference between Joint products and co-products, features of Joint Products, accounting for joint costs- split-off point, joint costs. Accounting treatment-physical quantity method, average unit cost method, weighted average method, selling price method. Meaning of by-products, accounting treatment-Non-cost methods, cost methods, difference between Main product and Joint & By products, value, manufacturing objective. (20 hours)

Module IV

Decision Making Tools-Absorption Costing-limitations of Absorption Costing, Marginal Costing-meaning, features, advantages/merits of Marginal Costing-limitations of marginal costing (Theory only), Throughput Accounting-concepts, throughput accounting and contribution approach, comparison of throughput costing and absorption costing, steps to be followed to increase throughput, problems faced in throughput accounting (theory and problems), Activity based costing-limitations of traditional costing system, definition, objectives, steps in ABC, limitations of ABC, Activity Based Budgeting, Activity Based Management, Difference between Activity Based Costing and Activity Based Management (problems in ABC). Transfer Pricing- Introduction, meaning, objectives of Inter Company Transfer Pricing, Methods of Transfer Pricing (Problems). Treatment of special expenses in Cost Accounts- Research and Development Expenses, Preliminary Expenses, Rectification Cost,

Obsolescence, Waste, Scrap, Spoilage –normal & abnormal spoilage, conceptual difference of waste, scrap & spoilage, accounting and control of defectives.

(20 hours)

Module V

Emerging Costing Approaches: Productivity Management-meaning, measurement of productivity, misconceptions in measuring Productivity, ratios in measuring productivity index and total productivity index, distinction between productivity and profitability, productivity and value added, Productivity and quality, productivity and cost effectiveness, higher productivity and reduced cost, importance of human factor in productivity drive, productivity objectives, Plan, audit, advantages, causes of Low productivity, criticism, Total Productivity Management (TPM), Pareto analysis and Theory of Constraints- meaning, usefulness, practical application of Pareto Analysis, meaning of TOC, steps, key

measures, methodology of implementation of TOC, TOC and Cost Accounting Procedures. JIT or Lean Manufacturing, steps, implementation, features, merits and demerits, role of JIT in elimination of waste, increasing profitability, Project Life Cycle Costing, meaning, benefits, cost management in LCC, Value Chain Analysis-concept, definition, meaning, steps, Porter's Value Chain, Kaizen- concept,

procedure for implementation, benefits, Target Costing- meaning, need, types, methods of establishment of target costs, backflush accounting.(20 hours)

(Theory 30% and Problems 70%)

References:

1. Catherine Stenzel& Joe Stenzel, Essential of Cost Management, John Wiley and sons, Latest Edition.
2. Roman I wiel& Michael W mahr Hand book of Cost Management, John Wiley and Sons, Latest Edition.
3. Lianabel Oliver, The cost management tool box. AMA Publication, Latest Edition.
4. John K. Shank & Vijay Govindarajan, Strategic Cost management: The new tool for competitive advantage, The free press, Latest Edition.
5. K.P. Gupta, Cost Management: Measuring, monitoring and motivating performance, Global India Publications, Latest Edition.
6. Strategic Cost Management- Ravi M. Kishore, Taxman Publications

Further reading

• http://icmai.in/upload/Students/Syllabus-2012/Study_Material_New/Inter-Paper8-Revised.pdf

OBJECTIVES

- To provide students adequate knowledge of cost management and control techniques and to enable them to apply these for managing business profitably

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (10 Hours)	● Meaning and Definition of cost accounting, classification of cost accounting, cost accountancy,objectives importance and limitation of costing ● Practical difficulties to the installation of cost accounting and their suggestions, comparison of cost accounting	● Lectures ● Discussions	● Powerpoint presentation on meaning and definition of cost accounting and related concepts ● Group discussion on practical difficulties of to the installation of cost accounting and their suggestions	● To understand the conceptual knowledge of Cost Accounting, comparison of cost accounting with other branches of accounting	● Evaluation done through test papers

	with other subjects like Cost Accounting and Financial Accounting, Cost Accounting and Management Accounting				
Module II (10 Hours)	• Performance measurement in cost accounting and classification of different types of cost • Importance of behaviour wise cost classification,cost control ,decision making,ma	1. Demonstrations 2. Lectures and 3. Discussions	1. Seminar presentations on classification of cost 2. Powerpoint presentation on meaning of flexible budgets	1. Provide students with a basic understanding of the different terminologies used in Cost Accounting and 2. different types of cost	Evaluation through seminar presentation

	rginal costing,flexible budget and CVP analysis				
Module III (20 Hours)	• Meaning of Process Costing-Features, Applications, Difference between Job Costing and Process Costing, Normal loss, abnormal loss, abnormal gain, inter process profits, equivalent production-FIFO, average method, weighted average method.	• Lectures • Discussion • Participative Learning	Assignment on exercise questions	• Understand the treatment regarding the application of process costing and treatment of Joint products and By products	Assessment through test papers

	• Joint and By-Products- Difference between Joint products and co-products, features of Joint Products, accounting for joint costs- split-off point, joint costs				
Module IV (20 Hours)	1. Deals with decision making tools like Absorption costing, throughput costing and ABC costing. 2. Meaning of transportation costing and methods of transfer	1. Lectures 2. Discussion 3. Participative learning	1. Seminar on absorption, marginal and throughput accounting 2. Assignment on exercise questions	To understand and evaluate the practical application of Absorption Costing, Throughput Accounting, ABC Analysis and Transfer Pricing.	Assessment through test papers

	pricing 3. Treatment of special expenses in cost accounts and conceptual difference of waste ,scrap and spoilage.				
Module V (20 Hours)	● Meaning of emerging costing approaches like Productivity management, TPM, Theory of constraints and cost accounting procedure, JIT, Value chain analysis, Kaizen Concept,target costing and	● Lectures ● Discussion ● Participative learning	Assignment on exercise question	To evaluate the application of Productivity Management	Assessment through test papers

	Blackflush accounting				

COURSE OUTCOME

CO1	To understand the conceptual knowledge of Cost Accounting, comparison of cost accounting with other branches of accounting
CO2	Provide students with a basic understanding of the different terminologies used in Cost Accounting and different types of cost
CO3	Understand the treatment regarding the application of process costing and treatment of Joint products and By products
CO4	To understand and evaluate the practical application of Absorption Costing, Throughput Accounting, ABC Analysis and Transfer Pricing.
CO5	To evaluate the application of Productivity Management

MCM2C09: INTERNATIONAL BUSINESS

Number of Lecture Hours per week : 5

Number of credits: 4

Internal Credit: 0.8 External Credit: 3.2

Duration of Examination : 3 Hours

Objectives:

- To give a broader picture of different aspects of international trade and monetary systems and the operation of firms in an international environment

Module I

Meaning and Scope–Theories of International trade: classical and modern theories – protectionism vs. free trade – Trade barriers - Tariff and Non-tariff barriers – Terms of trade – Balance of payment– Components of BOP: Current account, Capital account and Official reserve account-disequilibrium and corrective measures International business-Local, regional, national, international and global business—management orientation of overseas business-ethnocentric, poly centric, region centric and geocentric orientation--reasons for internationalization of business-factors restricting internationalization of business—major global companies in the world.- Export –Import policy of India – Regulation and Promotion of foreign trade in India (20 Hours)

Module II

International business environment: Cultural, social, political and legal, technological, economic and trade environment—natural and demographic environment. Opportunities and threats of Indian companies in the international market. – Modes of Entry - exporting – Licensing – franchising – contract manufacturing – Management contracts, turnkey projects – Foreign Direct Investments- Theories of FDI-Cost & Benefits to Home & Host countries- Recent trends. Problems and prospects of foreign companies in the Indian market.
(18 Hours)

Module III

Strategy development in international business—the firm as a value chain—global expansion plan-: International business locations- factors influencing locations-factors restricting location. Value chain analysis, risk analysis, cost benefit analysis. Business entry strategy-exporting, licensing, investment, joint ventures, green fiend investment, strategic alliance, global strategic partnerships.
(15 Hours)

Module IV

International economic institutions and integrations: Types of Trade Agreements-WTO-GATT TRIPS- TRIMS-Regional economic integration-Levels of economic integrations –Arguments surrounding economic integration-E. U-NAFTA -ASEAN-SAARC-International Monetary Fund— International liquidity and SDRs- World Bank. (10 Hours)

Module V

International business functional strategies: International production strategy—international financing strategy—international humanK resources strategy and international marketing strategy. Stages of Internationalisation: International, Multinational, Global and Transnational corporations – strategic orientations – Growth of MNCs - contributing factors – merits and demerits of MNC – transfer of technology – regulation of MNCs-MNCs in India-Contribution of MNCs to India. (17 Hours)

References:

1. Francis Cherunilam, International Business: Text and Cases, PHI, New Delhi.
2. Shyam Shukla, International Business, Excel Books, New Delhi
3. Rakesh Mohan Joshi, International Business, Oxford University Press, New Delhi.
4. P. Subba Rao, International Business, Himalaya Publishing House, Mumbai.
5. ManabAdhikary, Global Business Management in an International Economic Environment, Macmillan, New Delhi.
6. Charles W L Hill, International Business, McGraw Hill, New York.
7. Michael Czinkota, International Business, Wiley, New York.
8. Justin Paul, International Business, PHI, New Delhi.
9. Anant Kumar Sundaram and J, Stewart Black, The International Business Environment: Text and Cases, PHI, New Delhi.
10. John Daniels, Lee Radebaugh, Daniel Sullivan International Business, Pearson Education, New York.
11. Friedmann & J. Kim: Political risk and international Business

OBJECTIVES

- To evaluate various aspects on International Trade and Monetary Systems

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (20 Hours)	Introduction to theories of International trade,Tariff and Non tariff barriers, Export and import policy of India, Regulation and promotion of foreign trader in India	Lecturers, Discussion and Participative learning	PowerPoint presentation on various theories of International trade.	To learn about theories of International trade. To understand the Export and Import policy of India.	Evaluation through test paper
Module II (18 Hours)	Introduction to International Business Environment,	Lectures, Discussion and Assignments	Group discussion on International Business Environment, Seminar	To understand the components of International Business Environment	Evaluation through seminar

	Opportunities and threats of Indian companies in International market, Theories of FDI		presentations on Opportunities and threats of Indian companies in the International market.	To provide knowledge on theTheories of FDI	
Module III (15 Hours)	Strategy Development in International business, Value chain analysis,Risk analysis and cost benefit analysis, Business entry strategies	Lectures, Seminar and Assignments	PowerPoint presentation on developments in International business,	To provide an overview on the Development in International business To understand various business entry strategies.	Evaluation through assignments
Module IV (10 Hours)	International economic institutions and integrations, Types of trade agreements, International Monetary Fund and World bank	Lecturers, Discussion and Participative learning	PowerPoint presentation on International economic institutions and integrations, Seminar on International Monetary Fund and World bank	To evaluate various International economic institutions and integrations. To provide knowledge on International Monetary Fund and World bank	Evaluation through seminar presentations

Module V (17 Hours)	Functional strategies of International business, Stages of Internationalisation, Growth and contributions of MNCs in India.	Lecturers and Discussions	Seminar and discussion on Growth and contributions of MNCs in India	To provide an overview on Functional strategies of Internationalisation. To learn about Growth and contributions of MNCs in India.	Evaluation through seminar presentations

COURSE OUTCOME

CO1	To study about the Theories of International Trade and reasons for internationalisation
CO2	Evaluate the International Business Environment opportunities and threats of Indian Companies
CO3	To understand the Strategy development in IB and the different business entry strategies
CO4	To evaluate the role International economic situations in the development of Business
CO5	To analyse the different strategies of internationalization and the contribution to Indian Course outcome economy

MCM2C10: MANAGEMENT SCIENCE

Number of Lecture Hours per week : 5

Number of credits: 4

Internal Credit: 0.8 External Credit: 3.2

Duration of Examination : 3 Hours

Objectives:

- To familiarize students with concepts of management science and tools supporting decision making

Module 1

Introduction to Management Science- Types of decisions; Steps in decision making; Quantitative analysis and decision making; Different types of models and their uses; Model building steps. (5 hours)

Module 2

Linear Programming: Basic concepts; mathematical formulation and applications; Solution of LP problem using graphic and simplex method; – Application in Business. Transportation and Assignment: Formulation; Solving transportation (NWC method – Least Cost method – Vogel's approximation method – stepping stone method – Modified Distribution method) and assignment problems (Hungarian Method).(30 hours)

Module3

Inventory and Queuing Management: Concepts of inventory management; Inventory models – classical EOQ, planned shortage model- deciding optimum safety stock and reorder level. Queuing models: Elements of a queuing system; Models with Poisson arrival and Exponential services rates single server and infinite and finite population. (17hours)

Module 4

Project Scheduling: Concepts of PERT & CPM techniques and their applications; Network analysis scheduling activities, determining critical path, calculation of floats; Time-cost trade-off; Resource allocation and resource levelling. (18 Hours)

Module 5

Markov Chains and Theory of Games: Markov Chains- decision processes; Market share analysis; Account receivable analysis. Game Theory- Pure strategy games; Mixed strategy games; Value of the game; Rules of Dominance.(10 hours)

Theory 30% Problems 70%

References:

1. Anderson: Introduction to Management Science – Quantitative Technique for Decision making Thomson.
2. Operations Research – Kautiswarup, P.K. Gupta, Manmohan – Sultan Chand & Sons.
3. Operations Research SD Sharma, Kadar Notes, Ramnath&G. Meerut.
4. Operations Research Techniques for management – VK Kapoor &Sumant Kapoor – Sultan Chand & Sons.
5. Quantitative Techniques in Management, Vohra N.D., The McGraw Hill companies
6. Anderson: Introduction to Management Science – Quantitative Technique for Decision making Thomson.
7. Operations Research – Kautiswarup, P.K. Gupta, Manmohan – Sultan Chand & Sons.
8. Operations Research SD Sharma, Kadar Notes, Ramnath&G. Meerut

OBJECTIVES

- To enable students to apply Management science techniques in appropriate decision situations

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (05 Hours)	● Types of decision, steps in decision making ● Different types of models and their uses	● Lectures ● Participative learning	● Power point presentation on steps in decision making ● Group discussion on different types of models and their uses	● To learn more about the steps in decision making ● To evaluate the role of quantitative analysis and decision making	● Evaluation through test paper
Module II (30 Hours)	● Mathematical formulation and applications ● Solutio	● Lectures ● Seminars ● Assignments	● Power point presentation on LPP methods ● Group discussion on transportation and	● To understand the application of LPP methods in business ● To know more about the	● Evaluation through test paper

	n of LPP ● Transportation and assignment (NWC method - least cost method -etc)		assignment problems	transportation and assignment problems	
Module III (17 Hours)	● Concepts of inventory management ● Inventory models, classical EOQ ● Queuing models	● Lectures ● Seminars ● Assignments	● Power point presentation on inventory models ● Group discussion on queuing models	● To evaluate different types of inventory models ● To identify the elements of a queuing system	● Evaluation through test paper
Module IV (18 Hours)	● Concepts of PERT & CPM techniques	● Lectures ● Discussions ● Participative learning	● Power point presentation on PERT&CPM techniques	● To understand and identify the network analysis and their applications	● Evaluation through test paper

				• To determine the critical path	
Module V (10 Hours)	• Markov chains • Market share analysis • Game theory	• Lectures • Discussions • Seminars • Assignments	• Power point presentation on market share analysis • Group discussion on game theory	• To analyse the decision processes • To understand game theory and value of the game	• Evaluation through test paper

COURSE OUTCOME

CO1	To understand students with concepts of management science
CO2	To evaluate the application of various tools which support decision making process
CO3	To apply inventory management and managing the queue system in service sector
CO4	To evaluate and create the technique of project planning scheduling and controlling
CO5	To understand knowledge in share analysis and different strategies in game theory

MCM3C11 FINANCIAL MANAGEMENT

Number of Lecture Hours per week : 5
Number of credits: 4
Internal Credit: 0.8 External Credit: 3.2
Duration of Examination : 3 Hours

Objectives:

- To acquaint the students with the basic analytical techniques and methods of financial management of business organization

Module I

Foundation of Finance: Goals and functions of finance–Legal–Operating and Tax environment for financial decisions –Financial manager-Agency problem in financial management-Time value of money-compounding and discounting-An overview of capital investment decisions (25 hours)

Module II

Sources of long-term finance and Cost of Capital: Conventional and innovative sources leasing-factoring-securitisation- financial engineering-cost of capital-Concept–significance–Computation of cost of Debt, Preference capital, Equity capital and Retained Earnings – Opportunity cost of capital – Marginal cost of capital – WACC – Capital Asset Pricing Model. (10 hours)

Module III

Working Capital Management: Working Capital–meaning–concept and cycle – Working capital management strategy – Estimation of working capital– Mathematical and simulation models of working capital decisions – Management of

cash and marketable securities – Cash management techniques – Lock box system, Concentration baking – Methods of Inventories – Techniques of inventory management – Management of receivables – Techniques of receivable management-working capital financing for Indian industry (25 hours)

Module IV

Financial leverage and Capital Structure: Definition of capital structure-Leverage Analysis– Operating, Financial & Combined leverage – EBIT – EPS Analysis – Financial Breakeven – Indifference Point – Capital Structure Theories – Optimum capital Structure – NI approach, NOI approach, Traditional approach & Modigliani Miller approach – Arbitrage process– Determinants of Capital Structure- over capitalisation, under capitalisation and fair capitalisation (10 hours)

Module V

Mechanics and practices of dividend payment–factors affecting dividend policy – legal framework of payment of dividend – dividend theories – determinants of dividend policy and some case studies. (10 hours)

(Theory 30%, Problems 70%)

References:

1. Soloman, Ezra, Theory of Financial Management, Columbia Press (Latest Edition)
2. James C Van Horne. Financial Management and Policy Prentice Hall of India (Latest Edition)
3. Weston, J. Fred and Brigham, Eugne F. Managerial Finance, Dryden Press (Latest Edition)
4. Prasanna Chandra. Financial Management, Tata McGraw Hill (Latest Edition)
5. Khan, M.Y. and P.K. Jain. Financial Manager, Tata McGraw Hill (Latest Edition).
6. Pandey, I.M. Financial Management, Tata McGraw Hill (Latest Edition)
7. Ravi M. Kishore. Financial Management, Taxmann (Latest Edition)
8. Brigham, Ehrhavdt. Financial Management, Cengage Learning India Private Ltd. New Delhi – 110082 (Latest Edition)
9. Ross S.A., R.W. Westerfield and J. Jaffe, Corporate Finance, McGraw Hill (Latest Edition)

10. Anderson, Sweeney and Williams. An Introduction to Management Science, Cengage Learning India Private Ltd. New Deli – 110092 (Latest Edition)
11. Brigham and Houston. Fundamentals of Financial Management, Cengage Learning India Private Ltd., New Delhi – 110091 (Latest Edition)
12. Brealey R.A. and S.C. Myers. Principles of Corporate Finance, McGraw Hill, (Latest Edition)
13. Sudhirbhat. Financial Management. Excel Book (Latest Edition)
14. Damodaran, A. "Corporate Finance: Theory and Practice". John Wiley & Sons (Latest Edition)

Journals
Finance India
Applied Finance, ICFA
Journal of Finance
Journal of Financial Economics
Chartered Financial Analyst
Financial Dailies

OBJECTIVES

- To provide the students the exposure to certain advanced analytical techniques that are used for taking financial policy decisions

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment

Module I (25 Hours)	Goals and functions of finance– Legal– Operating and Tax environment for financial decisions – Financial manager- Agency problem in financial management- Time value of money- compounding and discounting- An overview of capital investment decisions	• Lectures • Group discussions • Working out practical problems	• Lectures on basics of finance, legal and operating environment, agency problems • Practical problems on Time value of money, Capital budgeting techniques	To understand the concept of financial management, legal operating and tax environment, time value of money , capital investment decisions etc	Evaluation done through test papers
Module II (10 Hours)	Sources of long-term finance and Cost of Capital: Conventional and innovative sources	• Lectures • Group discussions • Working out practical problems • Seminars	• Seminars by students on sources of finance, leasing, factoring, securitization etc. • Practical	To understand Various sources of long term finance, and to know the calculation of cost of different sources of capital using different methods	Evaluation done through test papers and assessment of seminars

	leasing-factoring-securitisation-financial engineering-cost of capital-Concept–significance–Computation of cost of Debt, Preference capital, Equity capital and Retained Earnings – Opportunity cost of capital – Marginal cost of capital – WACC – Capital Asset Pricing Model.		problems on Cost of capital of different sources of finance as well as overall cost of capital (WACC)		
Module III (25 Hours)	Working Capital Management: Working Capital–meaning–concept and cycle –	• Lectures • Group discussions • Working out practical problems	• Seminars by students on Management of Working Capital, Inventory management etc	To understand the concept of working capital, Working capital management and its estimation.	Evaluation done through test papers and assessment of seminars

	Working capital management strategy – Estimation of working capital– Mathematical and simulation models of working capital decisions – Management of cash and marketable securities – Cash management techniques – Lock box system, Concentration baking – Methods of Inventories – Techniques of inventory management – Management of receivables – Techniques	• Seminars	• Lectures and Practical problems on Working capital management, estimating working capital requirements etc.		

	of receivable management-working capital financing for Indian industry				
Module IV (10 Hours)	Financial leverage and Capital Structure: Definition of capital structure- Leverage Analysis– Operating, Financial & Combined leverage – EBIT – EPS Analysis – Financial Breakeven – Indifference Point – Capital Structure Theories – Optimum capital Structure – NI approach,	• Lectures • Group discussions • Working out practical problems	• Lectures and discussion on Capital structure, and Leverage analysis • Exercising practical problems in Leverage analysis and Capital structure	To understand the concept of Capital structure, capital structure theories, Leverage analysis, Determinants of capital structure etc.	Evaluation done through test papers

	NOI approach, Traditional approach & Modigliani Miller approach – Arbitrage process– Determinants of Capital Structure- over capitalisation, under capitalisation and fair capitalisation				
Module V (10 Hours)	Mechanics and practices of dividend payment– factors affecting dividend policy – legal framework of payment of dividend – dividend theories – determinants of dividend	• Lectures • Group discussions • Working out practical problems • Seminars	• Lectures and discussion on Dividend theories, and dividend policy • Seminars on mechanics and practices of dividend payment • Exercising practical problems dividend	To understand the concept of Dividend theories, develop knowledge on dividend theories and dividend policy	Evaluation done through test papers and assessment of seminars

	policy and some case studies		theories		

COURSE OUTCOME

CO1	To understand the role of finance and finance manager in an organisation
CO2	To Evaluate and apply sources of financing and corresponding cost of capital
CO3	To Understand and evaluate working capital decisions
CO4	To understand and apply Capital structure and leverage analysis
CO5	To understand and apply dividend theory and dividend decisions

MCM3C12: INCOME TAX: LAW, PRACTICE AND TAX PLANNING I

Number of Lecture Hours per week : 5

Number of credits: 4

Internal Credit: 0.8 External Credit: 3.2

Duration of Examination : 3 Hours

Objectives:

- To enable students to understand computation of income under various heads, taxable income of various entities, tax planning and procedure of assessment

Module 1

Basic Concepts-Direct and indirect taxes- Capital& revenue- Tax planning, tax evasion, tax management, tax avoidance - residence and incidence of tax- exempted income- Tax planning relating to residence & incidence of tax (10 hours)

Module 2

Computation of Taxable Income under different heads-income from salary- house property-income from business/profession- capital gains-other sources – Tax planning relating to different heads of income (20 hours)

Module 3

Assessment-Clubbing of incomes and aggregation of income – Set off and carry forward of losses – Incomes exempt from taxes – Deductions in computing total income – Rebates and reliefs of tax- Assessment of agricultural Income – Computation of Agricultural Income – Calculation of tax on integration. Assessment of individuals- AMT- Assessment of HUF -Tax planning related to clubbing and aggregation of income, set off and Carry forward of losses- Agricultural income, Individual Assessment –Tax planning- Assessment of HUF- Tax planning (20 hours)

Module 4

Income Tax Authorities: Powers and functions–Provisions of advance payment of tax – Tax payment – Deduction and collection of tax at source – Recovery of tax – Computer applications in tax management. (15 hours)

Module 5

Procedure for assessment of Income Tax: Filing of return of Income–Voluntary return of income – Statutory obligations for filing of return – Time and documents for filing of returns – Return of loss – Belated returns – Revised returns – Defective returns – PAN – Different types of assessment – Self assessment – Assessment on the basis of return – Best judgment assessment – Regular assessment – Reassessment – Protective assessment. (15 hours)

(30% theory and 70% problems)

References:

1. BB Lal, Income Tax, Pearson (Dorling Kindersley (India) Publication, Latest Edition,
2 Dr. H C. Mehrotra and Dr.S P . Goyal, Income Tax including Tax Planning and Management, Sahitya Bhavan Publications, Agra – latest
3. Ahuja GK & Gupta Ravi, Systematic Approach to Income Tax, Bharat Law House, Latest Edition.
4. BB Lal, Income Tax, Pearson (Dorling Kindersley (India) Publication, Latest Edition.
5. AC SampatAyengar, Law of Income Tax, Bharat Law House, Latest Edition.

OBJECTIVES

- To impart basic knowledge about income tax rules and equip the students to compute the total income of an individual.

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (10 Hours)	Basic concepts of Income Tax, Tax Planning,	● Lectures ● Seminars ● Discussio-ns	● Discussion on residential status ● Seminar	● To understand the basic concepts Income Tax	● Evaluation through

	evasion, management, Residence and incidence of Tax		presentations on exempted income	• To understand the residential status of an individual. and incidence of tax	test paper
Module II (20 Hours)	Computation of Taxable Income under different heads, Tax Planning relating to different heads of Income	• Discussions • Lectures	• Discussion on different heads of incomes • Discussion on Tax Planning relating to different heads of incomes	• To provide an insight into different heads of income • To get an idea about Tax Planning relating to different heads of incomes	Evaluation through Test Paper
Module III (20 Hours)	Assessment , clubbing and aggregation of Income, set off and carry forward, deductions, rebates and reliefs, agricultural income, Assessment of individual and HUF	• Lectures • Seminars • Assignme-nts	• Assignments on Assessment of Individuals • Seminars on Deductions in computing total income	• To learn about Assessment of Individuals • To know about various deductions available to an assessee	• Evaluation through test paper

Module IV (15 Hours)	Income Tax Authorities, powers and functions, advance payment of tax, TDS and TCS, Computer applications in tax	• Lecture • Discussion • Seminars	• Discussions on tax authorities and their powers and functions. • Seminars on TDS and TCS	• To understand the powers and functions of Tax Authorities • To know about TDS and TCS	• Evaluation through asking questions
Module V (15 Hours)	Procedure for assessment of Income Tax, filing of returns, types of return, PAN, Different types of assessment.	• Lectures • Discussions	• Discussion on filing of returns and different types of returns	• To understand about filing of returns	• Evaluation through Seminars.

COURSE OUTCOME

CO1	To understand tax planning tips to individuals on the basis of residential status.
CO2	To understand and evaluate the computation of income under five heads and to apply tax planning tips for these five heads of income
CO3	To understand and apply tax planning tips for Hindu Undivided family, set

	off and carry forward provisions and tax planning tips for individuals
CO4	To remember and understand the powers of income tax authorities and should be able to calculate advanced tax liability and TDS of an individual
CO5	To create ability to file the return of income of individuals and should be aware of different types of assessment

MCM3C13: RESEARCH METHODOLOGY

Number of Lecture Hours per week : 5
Number of credits: 4
Internal Credit: 0.8 External Credit: 3.2
Duration of Examination : 3 Hours

Objectives:

- To acquaint students with process and methodology of research

Module I

Research: Basic concepts - Meaning–Objectives–Types–Approaches – Significance of research in social sciences – Process of research – Formulating problem – Literature Survey – Hypothesis – Research Design – Types – Exploratory, Descriptive, Diagnostic, Experimental – Sample Design – Collecting, analysing, testing, interpreting and presenting result. (15 hours)

Module II

Population Survey and Sample Study: Population & Sample–Sampling theories - Techniques of sampling – Random and Non-random techniques – Sample Size – Determination of sample size – Sampling Errors – Non sampling Errors – Factors influencing sample size – Optimum sample size – Case Study – Pilot Survey.
(10 hours)

Module III

Data collection: collection of Primary Data–Methods of Data Collection – Observation – Field Survey – Questionnaire - Interview Schedule – Preparation of Questionnaire – Process of Interviewing – Collection of secondary data – Sources of secondary data. (10 hours)

Module IV

Measurement and Scaling: Variables–Attributes – Process of measurement – Attitude Measurement – Scaling - Scaling Techniques – Graphic Rating – Likert – Thurstone – Semantic Differential – Stapel – Dichotomous – Scales – Types of Scales – Scale Values – Validity and Reliability of Scales – Errors in measurement. (20 hours)

Module V

Data Processing and Presentation : Field Work–Editing–Classification – Coding – Tabulation – Summarization – Analysis of data – One way ANOVA - Univariate, Bivariate and Multi variable methods - Tools of Analysis – Descriptive Analysis – Inferential analysis – Interpretation – Presentation – Report Writing - Types of Reports – Contents of Reports – Format of Reports – Documentation StylesPlagiarism (Theory only) (25 hours)

Theory 70% Problem 30%

References:

1. S. Kevin, Research Methodology for Social Sciences, Ane Publishing House, New Delhi.
2. Tandon BC, Research Methodology in Social Sciences, Chaitanya Publishing House
3. Whitney FL, Elements of Research, Prentice Hall o India
4. Ferber R, Research Methods in Economics and Business, Macmillan
5. Deming W Edwards, Sample Design in Business Research, John Wiley
6. Bailey Kenneth D, Method of Social Research, Macmillan
7. Krishna Swamy, Methodology of Research in Social Science Prentice Hall of India.

8.Achalapathi KC, Readings in Research Methodology in Commerce and Business Management, Himalaya Publishing House.

OBJECTIVES

- To enable students to identify research problems, collect and analyse data and present results.

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (15 Hours)	● Basic concepts, meaning and definition of research ● Types and Proeces s of research ● Hypoth	● Lectures ● Seminars ● Group discussion	● Group discussion on types and process of research ● PowerPoint presentation on Hypothesis and research design	● To understand the basic concepts of research ● To evaluate different types of research ● To identify the process of research	● Evaluation through test paper ● Evaluation through presentations

	esis and research design				
Module II (10 Hours)	• Population and sample • Techniques of sampling • Case study and pilot survey	• Lectures • Participative learning • Demonstrations	• Seminar presentations on techniques of sampling • Group discussion on population and sample	• To provide an insight into the techniques of sampling • To know more about the population, sample, case study and pilot survey	• Evaluation through case study
Module III (10 Hours)	• Methods of data collection • Collection and sources of secondary data	• Lectures • Group discussion	• PowerPoint presentation on data collection methods • Group discussion on sources and collection of secondary data	• To understand different types of data collection methods	• Evaluation through test paper
Module IV (20Hours)	• Measurements and scaling • Types	Seminar presentations Assignments Discussions	• PowerPoint presentation on measurements and scaling	• To provide an idea about the types of scaling • To learn more	• Evaluation through test

	of scales ● Validity and reliability of scales		● Group discussion on validity and reliability of scales	about the validity and reliability of scales	paper
Module V (15 Hours)	● Data processing and presentation ● Analysis of data ● Report writing ● Documentation styles	● Lectures ● Participative learning ● Discussions ● Seminar presentations	● PowerPoint presentation on data processing and presentation ● Assignments on different types of report writing ● Seminars on analysis tools	● To provide an exact idea about data processing, its analysis and so on. ● To deliver a picture about different types of report writing	● Evaluation through test paper

COURSE OUTCOME

CO1	To understand and apply different research approaches and methodologies
CO2	To evaluate and apply Population survey and sample survey – theories and techniques

CO3	To understand and apply the Data collection methods and enable them to conduct a comprehensive research
CO4	To Evaluate the Measurement and scaling and the validation and reliability testing
CO5	To understand and evaluate Data processing, analysing, interpretation and report writing a create awareness about plagiarism

MCM3EF01: INVESTMENT MANAGEMENT

Number of Lecture Hours per week : 5
Number of credits: 4
Internal Credit: 0.8 External Credit: 3.2
Duration of Examination : 3 Hours

Objectives:

- To establish a conceptual framework for the study of security analysis and portfolio management

Module I

Investments: Meaning and concept–Investment objectives–various asset classes – factors in investment decisions- Investment process – concept of risk and return – sources of risk – Measurement of risk and return – Diversification and hedging – ethical investing. (10 hours)

Module II

Bond Investment analysis: Types of bonds–International bonds–Bond yields – Yield to Maturity (YTM) – risk analysis is bonds – Bond value theorem – Bond immunization strategies. (10 hours)

Module III

Equity Analysis: Approaches to equity analysis–Fundamental analysis – Economy, Industry and Company (EIC) analysis – Equity valuation models – Dividend Discount Models (DDM) and PriceEarnings Ratio (PER) models – Technical analysis – Dow theory – Chart and Chart Patterns – Market and Mathematical Indicators (Problems)– Efficient Market Hypothesis (EMH) and Random Walk theory – Tests of market efficiency – Critique of Investor rationality – Behavioural Finance. (20 hours)

Module IV

Portfolio analysis and selection: Risk return analysis of investment portfolio – Individual and Interactive risks – measurement of portfolio risks – Risks tolerance and asset allocation – optimal portfolio – portfolio selection models-Markowitz model – Sharpe single index model – Capital Asset Pricing Model (CAPM) – Capital Market Line (CML) and Security Market Line (SML) – Market anomalies : calendar effect, size effect and market overreaction – Arbitrage Pricing Theory (APT) – Multifactor asset pricing Models – Behavioural finance – Behavioural finance theories . (25 hours)

Module V

Portfolio Management: Active and Passive investment strategies–Value and growth investing, contrarian strategies – index investing and tracking efficiency, Portfolio evaluation- Sharpe, Treynor and Jensen measures, Fama'sDecomposition Index – Portfolio revision- Investment accounting (15 hours)

Theory 40 % Problems 60 %

References:

1. Bodie, Zvi, Kane Alex and Alan, J. Marcus, Investments, McGraw Hill.
2. Bhalla, V.K. Investment Management, S. Chand & Company Ltd.

3. Chandra, P. Security Analysis and Portfolio Management, Tata McGraw Hill.4.Elton, E. and Gurber, M.
4. Modern Portfolio Theory and Investment Analysis, John Wiley and Sons
5. Fischer, Donald E. and Ronald J. Jordan, Security Analysis and Portfolio Management, PHI Learning.
6. Preeti Singh, Investment Management, Himalaya Publishers.
7. Sharpe William, F. and Bailey Jeffery V. Alexander Gordon, J. Investments, PHI Learning.
8. S. Kevin , Security Analysis and Portfolio Management, PHI Learning
9. Stephen Ross and R. Westerfield, Corporate Finance, McGraw-Hill.
10.Vishwanath, R and Krishna Murthi,C., Investment Management, Springer.
11.V.A. Avadhani, Security Analysis and Portfolio Management, Himalaya Publishers.
12. Fabozzi, Frank, J. Investment Management, PHI learning

OBJECTIVES

- To provide the students the ability to understand and utilize the skill of optimizing returns

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment

Module I (10 Hours)	Investments: Meaning and concept– Investment objectives– various asset classes – factors in investment decisions- Investment process – concept of risk and return – sources of risk – Measurement of risk and return – Diversification and hedging – ethical investing	● Lectures ● Seminars ● Group discussion	● Powerpoint presentations on various asset classes and factors in investment decisions ● Group discussion on measurement of risk and return	To understand the concept of risk, return, diversification and hedging	Evaluation done through test papers
Module II (10 Hours)	Equity Analysis: Approaches to equity analysis– Fundamental analysis – Economy, Industry and Company	● Lectures ● Seminars ● Group discussion	● powerpoint presentations on Equity analysis ● Group discussion on different types of bonds and their	To understand and apply the different types of bonds and bond valuation	Evaluation done through test papers

	(EIC) analysis – Equity valuation models – Dividend Discount Models (DDM) and PriceEarnings Ratio (PER) models – Technical analysis – Dow theory – Chart and Chart Patterns – Market and Mathematical Indicators (Problems)– Efficient Market Hypothesis (EMH) and Random Walk theory – Tests of market efficiency – Critique of Investor rationality – Behavioural Finance		valuation		

Module III (20 Hours)	Equity Analysis: Approaches to equity analysis– Fundamental analysis – Economy, Industry and Company (EIC) analysis – Equity valuation models – Dividend Discount Models (DDM) and PriceEarnings Ratio (PER) models – Technical analysis – Dow theory – Chart and Chart Patterns – Market and Mathematical Indicators (Problems)– Efficient Market Hypothesis (EMH) and	• Lectures • Seminars • Group discussion	• powerpoint presentations on fundamental and technical analysis	Provide thorough understanding and evaluation of fundamental analysis and technical analysis	Evaluation done through test papers

	Random Walk theory – Tests of market efficiency – Critique of Investor rationality – Behavioural Finance				
Module IV (25 Hours)	Portfolio analysis and selection: Risk return analysis of investment portfolio – Individual and Interactive risks – measurement of portfolio risks – Risks tolerance and asset allocation – optimal portfolio – portfolio selection models- Markowitz model – Sharpe single	• Lectures • Seminars • Group discussion	• Powerpoint presentation on risk returns analysis of investment portfolio • Assignment on CAPM model	To understand the measurement of portfolio risk, optimal portfolio, portfolio selection models	Evaluation done through test papers

	index model – Capital Asset Pricing Model (CAPM) – Capital Market Line (CML) and Security Market Line (SML) – Market anomalies : calendar effect, size effect and market overreaction – Arbitrage Pricing Theory (APT) – Multifactor asset pricing Models – Behavioural finance – Behavioural finance theories				
Module V (15 Hours)	Portfolio Management: Active and Passive investment	● Lectures ● Seminars ● Group discussion	● powerpoint presentations on portfolio management ● Group	To understand and create portfolio management, portfolio evaluation and revision	Evaluation done through test papers

	strategies– Value and growth investing, contrarian strategies – index investing and tracking efficiency, Portfolio evaluation- Sharpe, Treynor and Jensen measures, Fama'sDeco mposition Index – Portfolio revision- Investment accounting		discussion on portfolio evaluation and its strategies		

COURSE OUTCOME

CO1	To understand the concept of risk, return, diversification and hedging

CO2	To understand and apply the different types of bonds and bond valuation
CO3	Provide thorough understanding and evaluation of fundamental analysis and technical analysis
CO4	To understand the measurement of portfolio risk, optimal portfolio, portfolio selection models
CO5	To understand and create portfolio management, portfolio evaluation and revision

MCM3EF 02: FINANCIAL MARKETS AND INSTITUTIONS

Number of Lecture Hours per week : 5
Number of credits: 4
Internal Credit: 0.8 External Credit: 3.2
Duration of Examination : 3 Hours

Objectives:

- To provide the students a sound information and knowledge of broad framework of financial markets and institutions

Module I

An overview of financial markets: Financial markets–Nature–Functions – money market – Capital markets – Markets for derivatives – Working of stock exchange in India – NSE and BSE, – Role of SEBI – Major international stock markets.
(20 hours)

Module II

Commodity markets: MCX, NCDEX, and ICEX–Functions, administration, regulations and general mechanism – International commodity markets – Debt market – Types, functions, instruments – Operational mechanism –Hindrances for the development of debt market. (15 hours)

Module III

Financial Instruments- issue of financial instruments-Primary issue, Book building process, private placement, offer for sale, buy back of shares –various innovative financial instruments, bitcoin, crypto currency etc (15 Hours)

Module IV

Development financial institutions: AMFI, IFCI, NABARD, SFCs, UTI, SIDBI – Mutual Fund, SEBI guidelines on mutual fund – Provident Fund – Pension Funds – PFRDA – Insurance Companies – IRDA. (15 hours)

Module V

Foreign capital flows: forms of foreign capital–FDI and FPI–FIIs – International financial instruments – ADR, GDR. IDR and Euro bonds – Role of foreign capital in Indian financial system – Trends in foreign capital inflows to India – Regulatory framework for foreign capital flows. (15hours)

References:

1. LM Bhole and JitendraMahakud: Financial Institutions and markets, Tata McGraw-Hill Publishers, (2009).
2. Shashi K Gupta: Nisha Agarwal and Neeti Gupta, Financial Markets and Institutions, Kalyani Publishers, (2013)
3. S Sachdeva: Indian Financial System, Educational Publishers, (2005).
4. MY Khan: Financial Services, Tata McGraw-Hill publishers (2004)
5.Keith Pilbeam: Finance and Financial Markets, Palgrave Macmillan (2005).
6. Gordon and Nataraj: Financial Markets and Services, Himalaya Publishing House.
7. Bharati V Pathak: The Indian Financial System: Markets, Institutions and Services, Dorling Kindersley India (pvt) ltd (2009).
8.Clifford Gomez: Financial Markets, Institutions and Financial Services, Prentice-Hall of India (2008)

OBJECTIVES

- To impart the students an understanding of the inter-linkages and regulatory framework within which the system operates in India

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (20 Hours)	1. An overview of financial markets nature and Functions of money market Capital market 2. Markets for derivatives –	Seminar presentations Assignments Discussions	● Powerpoint presentation on overview of financial markets nature and Functions of money market ● Group discussion on Money Market vs Capital market	To provide the students a sound information and knowledge of broad framework of financial markets and institutions	Evaluation done through test papers

	Working of stock exchange in India – NSE and BSE, – Role of SEBI – Major international stock markets.				
Module II (15 Hours)	MCX, NCDEX, and ICEX– Functions, administration, regulations and general mechanism of International commodity markets, Debt market Types, functions, instruments and	Seminar presentations Lectures Discussions	• Powerpoint presentations on commodity markets • Group discussion on Hindrances for the development of debt market	To acquire knowledge in national and international commodity market	Evaluation done through test papers

	Operational mechanism				
Module III (15 Hours)	• Meaning of Financial Instruments, Issue of financial instruments,Primary issue, Book building process , private placement, offer for sale, buyback of shares • various innovative	Seminar presentations Lectures Discussions	• Powerpoint presentations on financial instruments • Group discussion on various innovative financial instruments, bitcoin and crypto currency	To understand various types financial instruments and their sale and buy back	Evaluation done through test papers

	financial instruments, bitcoin, crypto currency				
Module IV (15 Hours)	• Meaning of financial institutions like AMFI, IFCI, NABARD, SFCs, UTI, SIDBI and Mutual Fund. • Meaning of SEBI, guidelines on mutual fund, Provident Fund	Lectures Participative learning Discussions Seminar presentations	• Powerpoint presentations on financial institutions • Webinar on Stock exchange in India.	To gain knowledge about the working of major financial institutions	Evaluation done through test papers

	,Pension Funds FRDA Companies IRDA				
Module V (15 Hours)	• Meaning of foreign capital, FDI and FPI,FIIs and International financial instruments like ADR, GDR. IDR and Euro bonds • Role of foreign capital in Indian financi	• Seminar presentations • Lectures • Discussions	• Powerpoint presentation on Foreign capital flows and International financial instruments • Group discussion on Role of foreign capital in Indian financial system and Trends in foreign capital inflows to India	To familiarize with different forms of foreign capital inflows and its role in Indian financial system Seminar on social responsibility accounting Group discussion on responsibility accounting Assignment on inflation accounting	Evaluation done through test papers

	al system Trends in foreign capital inflows to India Regulatory framework for foreign capital flows				

COURSE OUTCOME

CO1	To provide the students a sound information and knowledge of broad framework of financial markets and institutions
CO2	To acquire knowledge in national and international commodity market
CO3	To understand various types financial instruments and their sale and buy back
CO4	To gain knowledge about the working of major financial institutions

CO5	To familiarize with different forms of foreign capital inflows and its role in Indian financial system

MCM4C14: FINANCIAL DERIVATIVES AND RISK MANAGEMENT

Number of Lecture Hours per week : 5
Number of credits: 4
Internal Credit: 0.8 External Credit: 3.2
Duration of Examination : 3 Hours

Objectives:

- To make the students efficient in the area of derivatives, by giving them the knowledge of basics in options, futures, swaps etc

Module I

Introduction to risk management–Meaning and need–importance–Types of market risk – Risk management issues in business – Financial derivatives– Meaning – Need – Growth of financial derivatives markets in India – Derivative markets – Exchange traded financial derivatives for risk management in India – Participants – Functions – Types of risk management instruments – Forwards – Futures – Options – Swaps – The regulatory framework of derivative trading in India. (16 hours)

Module II

Future's growth and development - Difference between forwards and futures - financial future - Future trading – currency futures – Interest rate futures Pricing and valuation of future contracts – Value at riskHedging risk – Hedging with stock index

future – types of members and margin system in India-Future trading in stock exchange for risk management. (20 hours)

Module III

Options–meaning–needs and importance-options and futures-fundamental option strategies-type of option-put-call- Valuation of options -trading strategies of risk instruments-positions in options-stock indices-options in Indian stock market.
(16 hours)

Module IV

Risk pricing of options-intrinsic value and time value-pricing at the expiry of contact-factors affecting option pricing-put-call-parity pricing-models of pricing-binomial option-pricing models-Black Scholes pricing methods. (16 hours)

Module V

Swaps-meaning and definition-development-structure of swap dealing for risk management-interest rate swaps-forward swaps and swap option contracts-cancellable and extendable swaps-no generic swaps transactions. Currency swaps - Valuation and pricing of swaps - risk management function of swap transaction. Recent trends in derivatives –Taxation on derivatives (12 hours)

(60% Theory 40% Problems)

OBJECTIVES

- To evaluate the performance of different forward, futures and options contracts and understand the various future and option pricing models

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (16 Hours)	● Meaning and types of market risk, risk management issues in business ● Financial derivatives, participants of derivative markets, functions and types of risk management	● Lectures ● Discussions ● Participative learning	● Powerpoint presentation on Meaning and types of market risk, risk management issues in business and Financial derivatives and types of derivatives	To understand and apply the terms and concepts of underlying risk management	Assessment done through test papers

	instrument and regulatory framework of risk derivative trading in India.				
Module II (20 Hours)	1. Meaning of forward and futures, future's growth and development, future trading, currency futures and interest futures 2. Value at risk, 38	• Lectures • Discussions • Participative learning		To understand and evaluate growth and development of future	Assessment done through test papers

	hedging risk, hedging with stock index future				
Module III (16 Hours)	• Meaning and importance of option, fundamental option strategies, type of option, put call parity option, binomial and blackscholes pricing methods.	• Lectures • Discussions • Participative learning	• Group discussion on types of option • PowerPoint presentation on meaning of option and fundamental option strategies and valuation of option strategies	To understand and apply the option trading and various strategies involved in it	Assessment done through test papers
Module IV (16 Hours)	• Risk pricing of options,	• Lectures • Discussions • Participati	• PowerPoint presentation on put call	To understand about the pricing of options-call and put option	Assessment done through test papers

	intrinsic values and time value of time value,factors affecting option pricing, put call parity pricing and models of pricing	ve learning	parity pricing,models of pricing, binomial and black Scholes pricing methods.		
Module V (12 Hours)	• Meaning of swaps, structure of swap dealing for risk management, types of swap and risk	• Lectures • Discussions • Participative learning	• Group discussion on types swaps • PowerPoint presentation on valuation and pricing of swaps	To evaluate and apply SWAP contract and pricing of different instruments under SWAP	Assessment done through test papers

	management function of swap • Recent trend in derivatives and taxation on derivatives.				

COURSE OUTCOME

CO1	To understand and apply the terms and concepts of underlying risk management
CO2	To understand and evaluate growth and development of future
CO3	To understand and apply the option trading and various strategies involved in it
CO4	To understand about the pricing of options- call and put option
CO5	To evaluate and apply SWAP contract and pricing of different instruments under SWAP

MCM4C15: INCOME TAX: LAW, PRACTICE AND TAX PLANNING II

Number of Lecture Hours per week : 5
Number of credits: 4
Internal Credit: 0.8 External Credit: 3.2
Duration of Examination : 3 Hours

Objectives:

- To acquaint the students with theoretical and practical knowledge of assessment and tax planning of different assessees

Module 1

Assessment of firms- (including limited liability partnership) –Computation of book profitRemuneration to partners –Computation of taxable income and tax liability-AMT-Tax planning regarding Assessment of AOP/BOI- Computation of taxable income and tax liability-AMT-Tax planning regarding Assessment of AOP/BOI (20 hours)

Module 2

Assessment of Co-operative societies and trusts-Deductions under 80 P-Tax Planning-TrustsDefinition-creation-types-tax exemptions-Assessment of trusts-Tax planning (15 hours)

Module 3

Assessment of Companies: Residential status and incidence of tax-Special Provisions applicable to assessment of total income of companies-Deductions available to corporate assesses – Computation of taxable income of companies and determination of corporate tax liability – Minimum Alternate Tax-Tax on distributed profit of domestic companies- Tax on income distributed to unit holders-Security Transaction Tax – Tonnage Tax. (20 hours)

Module 4

Corporate tax planning and managerial decisions: Tax planning in respect of make or buy, own or lease, repair or replace, export or domestic sales, shut down or continue, expand or contract, amalgamate or demerger, invest or disinvest-Financial Management decisions, Capital Structure, dividend policy and bonus shares. (15 hours)

Module 5

Tax planning under various circumstances: Tax planning while setting up of a business-with reference to location, nature and form of organizations-Tax planning related to Special Economic Zones (SEZ), Export Processing Zones (EPZ)and Export Oriented Units (EOUs) – Infrastructure sector and background areas – Tax incentives for exporters. (10 hours)

(30% Theory and 70% problems)

References:

1. VK Singhania, Direct Tax's Planning and Management, Taxman, Latest Edition.
2. VS Sundaram, Commentaries on the Law of Income Tax in India, Pearson Law Publishers, Latest Edition.
3. AC SampatAyengar, Law of Income Tax, Bharat Law House, Latest Edition.
4. Bhagmati Prasad, Direct Taxes Laws Practice, WishwaPrakashan, Latest Edition.
5. Kaushal Kumar Agarwal, Direct Tax Planning and Management, Atlantic Publishers, Latest Edition.
6. Dr.H . C Mehrotra and Dr.S.P. Goyal , 1ncome tax including tax planning and Management, Sahitya Bhavan Publications,Latest edition

OBJECTIVES

- To familiarize the students with major and latest provisions of the India tax laws and related judicial pronouncements pertaining to various assesses with a view to derive maximum possible tax benefits admissible under the law

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (20 Hours)	● Assessment of firms, computation of taxable income and tax liability, AMT, Tax Planning regarding Assessment of AOP/BOI	● Lectures ● Assignments	● Assignments on computation of taxable income of firms	● To understand the tips for tax planning of partnership firms	● Assessment through test papers
Module II (15 Hours)	Assessment of Cooperative Societies and Trusts and tax planning regarding this	● Lectures ● Discussio-ns	● Discussions on tax planning of cooperative societies and trusts	● To learn how to compute the tax liability of cooperative societies and trusts	● Evaluation through test papers and

				• To know the tax planning tips regarding cooperative societies and trusts	case studies
Module III (20 Hours)	Assessment of Companies, Computation of Taxable Income of Companies and determination of corporate tax liability, Tonnage Tax	• Lectures • Seminars • Discussions	• Seminars on residential status of companies and incidence of tax • Discussion on computation of taxable income of companies and determine tax liabilities of companies	• To understand and evaluate the tax liability of companies including shipping companies	• Assessment through presentations
Module IV (15 Hours)	Corporate tax planning and managerial decisions: Tax planning in respect of make or buy, own or lease, repair or replace,	• Lectures • Seminars • Participative learning	• Seminars on corporate tax planning • Participative learning of different managerial decisions	• To understand the implication of tax on different managerial decisions	• Assessment through assignments

	export or domestic sales, shut down or continue, expand or contract, amalgamation or demerger, invest or disinvest.				
Module V (10 Hours)	Tax planning under various circumstances : Tax planning while setting up of a business with reference to location, nature and form of organisations, SEZ, EPZ, EOU, Infrastructure sector and background areas, Tax incentives for exporters	• Lectures • discussions	• Discussions on tax planning while setting up a new business, tax planning relating to SEZ,EPZ, EOUs	• To understand tax planning under various circumstances • To understand the tax liability of business units	• Assessment through test papers

COURSE OUTCOME

CO1	To understand and apply tax planning tips for partnership firm, AOP and BOI in India
CO2	To understand and apply tax liabilities of cooperative society and trust and should also be able to advocate tax planning tips to them
CO3	To understand and evaluate the tax liability of Companies including shipping companies
CO4	To understand and evaluate the implications of tax on various managerial decisions
CO5	To understand and evaluate the tax liability of business units

MCM4EF03: INTERNATIONAL FINANCE

Number of Lecture Hours per week : 5

Number of credits: 4

Internal Credit: 0.8 External Credit: 3.2

Duration of Examination : 3 Hours

Objectives:

- To understand the concept and significance of international finance

Module I

International Finance: Meaning, Importance- International financial environment-Risk associated with international finance- International Financial Markets-International Money Markets – Money Market Instruments – International Capital Markets – Comparison of New York, and Indian Money Market – International Bond Market - Recent changes in global financial markets. -International Monetary system- Multilateral financial institutions International Institutions –Brettenwood and International Monetary Fund (IMF)-Objectives- Role of IMF in International Liquidity Conditionalities of IMF lending-World Bank - International Development Association (IDA)- Objectives- International Financial Corporation (IFC)-Objectives- Asian Development Bank (ADB)- Objectives- International trade Centre. (20 hours)

Module II

International financial markets-foreign exchange market-foreign exchange trading-Cash and spot exchange rates-foreign exchange rate and quotation forward markets-Exchange rate behaviour cross rates-foreign exchange market participants-SWIFT Mechanism-Forecasting exchange rate measuring exchange rate movements-Exchange rate equilibrium-factors affecting foreign exchange forecasting-international parity relationship-interest rate parity, purchasing power parity and Fisher effects (20 hours)

Module III

Exchange rate definition- Spot and forward exchange- Exchange rate determination-Theories and models of exchange rate, Purchasing power parity theory, Asset market model, Portfolio balancing model- Exchange rate of rupee- recent trends in exchange rate -convertibility of Indian rupee. Foreign Exchange exposure: Management of transaction exposure-Management of translation exposure- Management of economic exposure- Management of political exposure-Management of interest rate exposure-Foreign exchange risk management-Hedging against foreign exchange exposure-Forward Market-Futures market-options market-swap market-Hedging through currency of invoicing-Hedging through selection of supplying country-Country risk analysis. (20 hours)

Module IV

International capital budgeting-concept, problems associated, evaluation of a project, factors affecting risk evaluation, impact on value-Long term asset and liability management-foreign direct investment-foreign portfolio management.
(10 hours)

Module V

Short term asset and liability management: Working capital management - international cash management- receivables and inventory management- management of short-term overseas financing resources- international banking and money market International Monetary and Financial Environment – International Monetary Investments –International Investments-Types of foreign investment-Significance of foreign investments- Factors affecting international investment (10 hours)

Theory 75% Problems 25 %

References:

1. A.K Seth, international financial management, Galgotia
2. V.K.Bhalla,international financial management, Anmol publications, 2000
3. V.Sharon, International financial management, Prentice hall
4. Jeff Madura, international financial management, Asia books
5. Eun & Resnick, international financial management, Tata McGraw Hill Publishing co.
6. John Holland, International financial management, Blackwell publishers, Oxford
7. Keith Pilbeam "International Finance" Palgrave, New York
8. Apte PG. "International Financial Management" Prentice Hall of India New Delhi
9. Alan C. Shapiro "Multinational Financial Management" Prentice Hall of India New Delhi
10. Soderston B O "International Economics" Macmillan London.
11. Cheol S Eun and Bruce G Resnick "International Financial Management" Irwin McGraw Hill, New York
12. Arthur Stonehill et al ``International Finance" Pearson Education Asia, Delhi 13. Maurice D Levi "International Finance" Tata McGraw Hill, New Delhi.

OBJECTIVES

- To understand the international financial markets and exchange theories
- To get an idea about foreign exchange exposure and risk management

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (20 Hours)	• Meaning and Importance of International Finance • Risks associated with international finance • Concepts about Internat	• Lectures • Discussion • Participative learning	• Seminar on International markets • Assignment on International Finance - Objectives, Risks	• Various concepts about International Market • Knowledge on IMF	Evaluation through test papers

	ional market ● IMF - Objectives and its role in International Liquidity ● IFC and ADB				
Module II (20 Hours)	● International Financial Market ● Different exchange rates ● International Parity Relationship	● Lectures ● Discussion ● Participative learning	● Powerpoint Presentation on various exchange rates in International market ● Seminar on International Parity relationship	● Idea about International Financial Market	Assessment through test papers
Module III (20 Hours)	● Exchange rate determination	● Lectures ● Discussion ● Participati	● Webinar on Foreign Exchange Exposure	● Determination of exchange rates	Evaluation through MCQs

	• Purchasing Power Parity Theory • Hedging against foreign exchange exposure	ve learning	• Seminar on Purchasing Power Parity Theory		
Module IV (10 Hours)	• International Capital Budgeting - Concept and Problems associated • Impact on value of Long term asset and liability manage	• Lectures • Discussion • Participative learning	• PPT on International Capital Budgeting • Assignment on Foreign Portfolio Management	• Various concepts of International Capital Budgeting • Asset - Liability Management	Evaluation through test papers

	ment ● Foreign Portfolio Management				
Module V (10 Hours)	● Working Capital Management ● International cash management, Receivables and Inventory Management ● International Investments - Types and significance	● Lectures ● Discussion ● Participative learning	● Seminar on various types of Foreign Investments ● Assignment on Working Capital Management	● Concepts of International Cash Management ● Types of Foreign Investments ● International Banking	Evaluation through test papers

COURSE OUTCOME

CO1	Students should familiarize with the concept and significance of International Finance, IDA, IFC and ADB
CO2	Students should understand international financial markets , foreign exchange rate , its measurement and movements.
CO3	Students should acquire knowledge in exchange rate theories and models of exchange rate, risk management in foreign exchange
CO4	Students should develop knowledge in international capital budgeting, asset liability management and foreign portfolio management
CO5	Students should acquaint knowledge in Working capital management, international cash and inventory management and international monetary investment

MCM4 EF04 ADVANCED STRATEGIC FINANCIAL MANAGEMENT

Number of Lecture Hours per week : 5

Number of credits: 4

Internal Credit: 0.8 External Credit: 3.2

Duration of Examination : 3 Hours

Objectives:

- To build an understanding among students about the concepts, vital tools and techniques used for financial decision making by a business firm

Module I

Financial goals and strategy: Shareholder value creation (SCV)– Economic Value Added (EVA) - Market Value Added (MVA) – Market – to – Book Value (MBV) — managerial implications of shareholder value creation – Growth ratios – Internal Growth Rate (IGR) – Sustainable Growth Rate (SGR) (12 Hours)

Module II

Financial strategy for capital structure: Leverage effect and shareholders risk – Capital structure planning and policy – Financial options and the value of the firm – Dividend policy and the value of the firm. (20 hours)

Module III

Lease Financial strategy: Leasing concept–Types–Cash flow consequences of lease – Financial evaluation of leasing - Lessee's point of view – leasing versus buying – NPV method – Equivalent loan method – Evaluation from lesser's point of view – NPV and IRR methods. (16 hours)

Module IV

Merger strategy: Theories of Merger–Horizontal, vertical and conglomerate mergers – Merger procedure – Valuation of firm – Financial impact of merger – Merger and dilution effect on EPS – Merger and dilution effect on business control. (16 hours)

Module V

Take over strategy: Types of takeovers–Negotiated and hostile bids–Take over procedures – Takeover defences – Takeover regulations of SEBI – Distress restructuring strategy – Sell offs – Spin offs – Leveraged buy outs. (16 hours)

(Theory 40% problem 60%)

References:

1. Vanhorne, James C: Financial Management and policy, Pearson, New Delhi, (Latest edition)
2. Brighham and Ehrhardt: Financial Management, Thomson India, (Latest edition)
3. Chandra, Prasanna: Financial Management, Tata McGraw Hill, New Delhi, (Latest edition)
4.Khan, MY and James PK: Financial Management, Tata McGraw Hill New Delhi, (Latest edition)
5. Pandey IM: Financial Management, Vikas Publishing House, New Delhi, (Latest edition)
6. Gitman, LJ: Principles of Managerial Finance, Harper and Row (Latest edition)
7. Hampton: Financial decision making, Concepts, problems and cases, Prentice Hall of India, New Delhi (Latest edition)
8. Brealey and Meyers: Principles of Corporate Finance, Tata McGraw Hill, New Delhi (Latest edition)

OBJECTIVES

- To apply financial management concepts and theories for strategic financial management decision making

LESSON PLAN

Unit /session/ hours (time required)	Topics to be taught(input)	Procedure(process)students centric method of teaching	Activity	Learning Outcome	Assessment
Module I (12 Hours)	Financial goals and strategy: Shareholder value creation (SCV)– Economic Value Added (EVA) - Market Value Added (MVA) – Market – to – Book Value	• Lectures • Group discussions • Working out practical problems	• Lectures and Powerponit presentations on concept of Advanced strategic financial management • Practical problems on SVC, EVA, MVA, MBV, IGR, SGR	To understand the concept of Strategic financial management, shareholder value creation, economic value added,etc	Evaluation done through test papers

	(MBV) — managerial implications of shareholder value creation – Growth ratios – Internal Growth Rate (IGR) – Sustainable Growth Rate (SGR)				
Module II (20 Hours)	Financial strategy for capital structure: Leverage effect and shareholders risk – Capital structure planning and policy – Financial options and the value of the firm – Dividend policy and the value of the firm.	• Lectures • Group discussions • Working out practical problems • Seminars	• Seminars and discussion by students on Leverage analysis and dividend policy • Lectures and powerpoint presentation on Capital structure planning and policy, financial options and value of firm. • Practical problems on leverage	To develop knowledge about financial strategy for capital structure, capital structure planning and policy, dividend policy etc	Evaluation done through test papers and assessment of seminars

			analysis dividend policy and value of firm etc.		
Module III (16 Hours)	Lease Financial strategy: Leasing concept– Types–Cash flow consequences of lease – Financial evaluation of leasing - Lessee's point of view – leasing versus buying – NPV method – Equivalent loan method – Evaluation from lesser's point of view – NPV and IRR methods.	• Lectures • Group discussions • Working out practical problems • Seminars	• Seminars and discussion by students on leasing concept and evaluation • Lectures and Practical problems on buy or lease decisions, NPV method, Equivalent loan method, Evaluation from lesser's point of view, NPV and IRR methods.	To understand the leasing concept and evaluation and to develop knowledge about NPV method, Equivalent loan method, Evaluation from lesser's point of view, NPV and IRR methods.	Evaluation done through test papers and assessment of seminars
Module IV (16 Hours)	**Module IV** Merger strategy: Theories of	• Lectures • Group discussions	• Powerpoint presentations and discussion on	To understand the concept of Merger, Merger strategies, effects of merger etc	Evaluation done through test papers

	Merger– Horizontal, vertical and conglomerate mergers – Merger procedure – Valuation of firm – Financial impact of merger – Merger and dilution effect on EPS – Merger and dilution effect on business control. (16 hours)	• Participative learning	merger strategy and types of merger and impact of merger etc. • Lectures on Merger procedure, valuation of firm etc		
Module V (16 Hours)	Take over strategy: Types of takeovers– Negotiated and hostile bids–Take over procedures – Takeover defences – Takeover regulations of	• Lectures • Group discussions • Participative learning	• Powerpoint presentations and discussion on Take over strategy • Lectures on take over procedures, takeover regulations of SEBi, Takeover	To understand the concept of takeover, to know about take over strategies, take over procedures and SEBI regulations on the same.	Evaluation done through test papers

	SEBI – Distress restructuring strategy – Sell offs – Spin offs – Leveraged buyouts.		Defences etc		

COURSE OUTCOME

CO1	To build an understanding among students about the concepts, vital tools and techniques used for financial decision making
CO2	To understand the concept of capital structure planning and policies, and to find the value of a firm.
CO3	To familiarise with the concept of lease financing and various methods of lease financing
CO4	To gain knowledge in theories of merger, different types of merger and the financial impact of merger
CO5	To understand take over strategy and procedure and regulations

MAT 1C01 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 4 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of limit, Continuity, derivatives and integration.

MODULE I

Limits and Continuity: Rules for finding limits. Target values and formal definitions of limits. Extensions of limit concept, Continuity, Tangent lines

.

MODULE II

Derivatives: The derivative of a function, a quick review of differentiation rules, rate of Change.

MODULE III

Application of derivatives: Extreme values of a function. The mean value theorem, First derivative test, Graphing with y' and y''. Limits as x approaches infinity. Asymptotes and dominant terms, Linearization and differentials. The L'Hopital's Rule.

MODULE IV

Integration: Riemann sums and Definite integrals; properties, areas and the Mean value theorem. The Fundamental theorem. Application of Integrals: Areas between curves, Finding Volumes by slicing.

TEXTBOOKS

George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.

[2] Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

OBJECTIVES

- To understand the basics of limits and continuity.
- To learn derivatives and differentiation rules
- To learn about applications of derivatives
- To understand L'Hospital's rule.
- To study in detail Riemann sums and integration.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I (20 hours)	Limits and Continuity Epsilon – delta definitions	• Discussion • Participative learning • Problem solving	Discussions Lectures and Quizzes	Limits, Sandwich theorem,	Evaluation through test paper.
MODULE II (12 hours)	Derivatives and differentiation rukes	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about differentiation rules.	Derivatives and rate of Change.	Evaluation through test paper.
MODULE III (24 hours)	Applications of derivatives, Graphing of functions	• Lecture • Discussion • Participative learning • Problem solving	Discussion Maximum minimum points	Plot graphs of a function by finding maximum and minimum points using derivatives	Evaluation through MCQ.
MODULE IV (16 hours)	Riemann Sums and integration and applications of integration	• Lecture • Discussion • Participative learning • Problem solving	Discussion on integration concepts	Integration concept using Riemann sums, area of surfaces	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about limit continuity and derivatives
CO2	To learn application of derivatives To study about plotting function graphs
CO3	To know about integration and its origin To learn about applications of integration

Faculty in Charge

Sr. Mercy Mathew

MAT 2C02 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 4 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of hyperbolic functions, improper integrals, partial differentiation, infinite series and polar coordinates.

MODULE I

Hyperbolic Functions - Definitions and Identities, Derivatives and Integrals, Inverse Hyperbolic , functions - Derivatives and Integrals, Application of Integrals :, Volumes of Solids of Revolution (Disk method only), Lengths of plane curves. Areas of surfaces of revolution Improper Integrals, Convergence and Divergence, Tests for Convergence and Divergence, Direct Comparison Test and Limit Comparison Test

.

MODULE II

Limit of Sequences of Number, Theorems for calculating limits of sequences (Excluding Picard's Method), Infinite series, The ratio and root test for series of non negative terms, alternating series, Absolute and conditional convergence, Power Series, Taylor and Maclaurin Series.

MODULE III

Polar coordinates, Graphing in Polar Coordinates, Polar equations for conic sections, integration in Polar coordinates, Cylindrical and Spherical Coordinates.

MODULE IV

Functions of Several Variables, Limits and Continuity, Partial Derivatives, differentiability, Chain rule

.

TEXTBOOKS

George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.

[2] Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

OBJECTIVES

- To understand the Hyperbolic functions and improper integrals.
- To learn about sequences and series.
- To learn about polar coordinates and is graphing.
- To understand functions of several variables.
- To study partial differntiaition .

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I (20 hours)	Hyperbolic functions, Applications of integrals, improper integrals.	• Discussion • Participative learning • Problem solving	Discussions Lectures and Quizzes	Integrats and derivatives of Hyperbolic functions, Improper integrals, Volume and area of integrals	Evaluation through test paper.
MODULE II (28 hours)	Sequences and series of real numbers	• Lecture • Discussion • Participative learning • Problem solving	.Discussion about convergence of various series.	Convergence and divergence of series. Taylor and Maclaurin series.	Evaluation through test paper.
MODULE III (10 hours)	Polar Coordinates, Graphing, Cylindrical and Spherical coordinates.	• Lecture • Discussion • Participative learning • Problem solving	Discussion on cylindrical and spherical coordinates	Plot graphs of polar coordinates	Evaluation through MCQ.
MODULE IV (14 hours)	Functions of several variables, partial derivatives	• Lecture • Discussion • Participative learning • Problem solving	Discussion on partial derivatives	Partial differentiation	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about Infinite series and its convergence.
CO2	To learn hyperbolic functions and improper integrals. To study about Taylor series and Maclaurain series.
CO3	To know about polar coordinates and its plotting. To learn about partial differentiation.

Faculty in Charge

Sr Mercy Mathew

MAT 3C03 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 5 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of Ordinary differential equations, matrices and vector calculus.

MODULE I

Basic concepts and ideas, Geometrical meaning of y' = f(x,y). Direction Fields, Separable Differential Equations. Exact Differential Equations; Integrating Factors, Linear Differential Equations; Bernoulli Equation, Orthogonal Trajectories of Curves.

MODULE II

Rank of a Matrix, Non-Singular and Singular matrices, Elementary Transformations, Inverse of an elementary Transformations, Row Canonical form, Normal form. Systems of Linear equations: Homogeneous and Non Homogenoeus Equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton Theorem (statement only) and simple applications.

MODULE III

A quick Review of vector algebra, Inner product and vector product in R^2 and R^3 . Vector and scalar functions and Fields, Derivatives, Curves, Tangents, Arc Length, Velocity and acceleration, Gradient of a scalar field; Directional Derivative, Divergence of a vector field, Curl of a Vector Field.

MODULE IV

Line Integrals, Independence of path, Green's Theorem in the Plane (without proof), surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Divergence theorem of Gauss and Stoke's theorem (without proofs).

TEXTBOOKS

1. Erwin Kreyszig : Advanced Engineering Mathematics, Eighth Edition, Wiley, India.

2. Frank Ayres JR : Matrices, Schaum's Outline Series, TMH Edition.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.

[2] Muray R Spiegel, Vector Analysis, Schaum's Outline series, Asian Student Edition.

[3] Shanthi Narayanan & P.K. Mittal, A Text Book of Matrices, S. Chand

[4] Harry F. Davis & Arthur David Snider, Introduction to Vector Analysis, 6th ed., Universal Book Stall, New Delhi.

OBJECTIVES

- To understand the concepts in ordinary differential equations
- To learn about matrices and its properties
- To learn about Cayley Hamilton theorem
- To understand vectors
- To study in detail Vector Calculus

LESSON PLAN

Unit/Session (hours required)	Topics to be taught (input)	Procedure(process) Student centric method of teaching	Activity	Learning Outcome (output)	Assessment
MODULE I (20 hours)	Modeling of differential equations, methods to solve first order differential equations.	• Discussion • Participative learning • Problem solving	Discussions Lectures and Quizzes	Geometrical meaning of ODE, solving I order ODEs	Evaluation through test paper.
MODULE II (20 hours)	Rank of a matrix, solution of system of linear equations, Cayley- Hamilton theorem	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about Eigen values and vectors	Normal and Echoleon form of matrices, Solution of linear system of equations, Eigen values and vectors	Evaluation through test paper.
MODULE III (25 hours)	Introduction to vectors and vector differential calculus	• Lecture • Discussion • Participative learning • Problem solving	Discussion on derivatives of vector functions	Know gradient, divergence, curl of a vector function	Evaluation through MCQ.
MODULE IV (25 hours)	Vector integral calculus	• Lecture • Discussion • Participative learning • Problem solving	Discussion on surface integrals	Greens theorem, Stoke's theorem, Gauss divergence theorem	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about I order ordinary differential equations
CO2	To learn solution of system of linear equations To study about eigen values and eigen vectors.
CO3	To know about vector differential calculus To learn about vector integral calculus

Faculty in Charge

Sr Mercy Mathew

MAT 4C04 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 5 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of Second order differential equations, Laplace tranforms, Fourier series, Numerical methods

MODULE I

Linear Differential equations of Second and Higher order: Differential Operators, Euler-Cauchy Equation, Wronskian, Nonhomogeneous Equations, Solutions by Undetermined Coefficients, Solution by variation of Parameters.

MODULE II

Laplace Transforms: Laplace Transform, Inverse Transform, Linearity, Shifting, Transforms of Derivatives of Integrals, Differential Equations. Unit step Function, Second Shifting Theorem, Dirac Delta Function, Differentiation and integration of Transforms, Convolution, Integral Equations, Partial Fractions, Differential Equations.

.

MODULE III

Fourier Series : Periodic Functions, Trigonometric Series, Fourier Series, Even and Odd functions, Half-range Expansions, Partial differential Equations: Basic Concepts, Vibrating String, Wave Equation, Separation of Variables, Use of Fourier Series

MODULE IV

Numerical Methods: Methods of First-order Differential Equations, Picard's iteration for initial Value Problems. Numerical Integration: Trapezoidal Rule, Simpson's Rule.

TEXTBOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.
[2] Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

[3] Murray R. Spiegel, Laplace Transforms, Schaum's Outline Series.

OBJECTIVES

- To understand the methods to solve II and higher order derivatives
- To learn Laplace and inverse Laplace equations
- To learn about Fourier series and Half range expansions
- To understand classical partial differential equations
- To study in detail some numerical methods for integration and ODEs.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I (20 hours)	Solution of II and higher order differential equations	• Discussion • Participative learning • Problem solving	Discussions Lectures on wronskian	Euler-Cauchy equations, various methods for solving II order DEs	Evaluation through test paper.
MODULE II (20 hours)	Laplace transforms, Inverse Laplace transforms, Shifting theorems	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about laplace and inverse Laplace transforms	Solution of differential equations using Laplace transforms	Evaluation through test paper.
MODULE III (30 hours)	Fourier series and its half range expansions	• Lecture • Discussion • Participative learning • Problem solving	Discussion on Fourier series expansions of periodic functions	Solution of heat and wave equations using Fourier series	Evaluation through test paper.
MODULE IV (20 hours)	Numerical methods for integration and solving differential equations	• Lecture • Discussion • Participative learning • Problem solving	Discussion on various numerical methods	Runge – Kutta, Euler methods, Trapeziodal, Simpson’s rule.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about Euler- Cauchy equations, method of undetermined coefficients and method of variation of parameters
CO2	To learn Solving differential equations using Laplace transforms To study about Fourier series
CO3	To know about solution of Heat and Wave Equations To learn about various numerical methods.

Faculty in Charge

Sr Mercy Mathew

MTH1C01: ALGEBRA I
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of abstract algebra.

MODULE I

Plane Isometries, Direct products & finitely generated Abelian Groups, Factor Groups, Factor-Group Computations and Simple Groups, Group action on a set, Applications of G-set to counting

MODULE II

Isomorphism theorems, Series of groups, (Omit Butterfly Lemma and proof of the Schreier Theorem), Sylow theorems, Applications of the Sylow theory, Free Groups

MODULE III

Group Presentations, Rings of polynomials, Factorization of polynomials over a field, Non Commutative examples, Homomorphism and factor rings

TEXT:

JOHN B. FRALEIGH, A FIRST COURSE IN ABSTRACT ALGEBRA(7th Edn.), Pearson Education Inc., 2003.

REFERENCES :

[1] N. Bourbaki: Elements of Mathematics: Algebra I, Springer; 1998.

[2] Dummit and Foote: Abstract algebra(3rd edn.); Wiley India; 2011.

[3] P.A. Grillet: Abstract algebra(2nd edn.); Springer; 2007

[4] I.N. Herstein: Topics in Algebra(2nd Edn); John Wiley & Sons, 2006.

[5] T.W. Hungerford: Algebra; Springer Verlag GTM 73(4th Printing); 1987.

[6] N. Jacobson: Basic Algebra-Vol. I; Hindustan Publishing Corporation(India), Delhi; 1991.

[7] T.Y. Lam: Exercises in classical ring theory(2nd edn); Springer; 2003.

[8] C. Lanski: Concepts in Abstract Algebra; American Mathematical Society; 2010.

[9] N.H. Mc Coy: Introduction to modern algebra, Literary Licensing, LLC; 2012.

[10] S. M. Ross: Topics in Finite and Discrete Mathematics; Cambridge; 2000.

[11] J. Rotman: An Introduction to the Theory of Groups(4th edn.); Springer, 1999.

OBJECTIVES

a) **To understand the basic concepts of groups, factor groups, simple groups and group action on a set.**

b) **To get familiarize with Isomorphism theorems and its properties.**

c) **To understand the concept of sylow theorems and its applications.**

d) **To study more about rings of polynomials and factorization of polynomials over a field.**

e) **To understand homomorphism and factor ring.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Plane Isometries, Abelian groups, Factor groups, Simple groups, group action on a set	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on groups and its properties	To understand: • the basics of different types of groups • notion of group action on a set	Evaluation Through MCQ
Module I1 (30 hours)	Isomorphism theorems, Sylow theorems and its applications	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of Isomprhism • Peer group discussion on Sylow theorems	To understand: • Isomorphism theorems and their significance • Sylow theorems and its applications	Evaluation Through test paper
Module III (30 Hours)	Ring of polynomials, factorization of a polynomial over a field, homomorphism and factor rings	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of homomorphism and factor rings	To understand: • homomorphism and factor rings • factorization of a polynomial over a field convergence	Evaluation through test paper

Course Outcomes

CO1	To get the idea of different types of groups and group action on a set
CO2	To understand the concept of isomorphism theorems and their significance, Sylow theorems and its applications
CO3	To understand factorization of a polynomial over a field, homomorphism and factor rings

Faculty in charge:
Ms. Geethu Simon

MT1C03: REAL ANALYSIS I
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of real analysis.

MODULE I

Basic Topololgy, Finite, Countable and Uncountable sets Metric Spaces, Compact Sets, Perfect Sets, Connected Sets. Continuity - Limits of function, Continuous functions, Continuity and compactness, continuity and connectedness, Discontinuities, Monotonic functions, Infinite limits and Limits at Infinity

MODULE II

Differentiation The derivative of a real function, Mean Value theorems, The continuity of Derivatives, L Hospitals Rule, Derivatives of Higher Order, Taylors Theorem, Differentiation of Vector valued functions. The Riemann Stieltjes Integral, - Definition and Existence of the integral, properties of the integral, Integration and Differentiation

MODULE III

The Riemann Stieltjes Integral (Continued) - Integration of Vector vector-valued Functions, Rectifiable curves. Sequences and Series of Functions - Discussion of Main problem, Uniform convergence, Uniform convergence and continuity, Uniform convergence and Integration, Uniform convergence and Differentiation. Equicontinuous Families of Functions, The Stone Weierstrass

TEXT:

RUDIN W., PRINCIPLES OF MATHEMATICAL ANALYSIS (3rd Edn.), Mc. Graw-Hill, 1986.

REFERENCES :

[1] H. Amann and J. Escher: Analysis-I; Birkhuser; 2006.

[2] T. M. Apostol: Mathematical Analysis(2nd Edn.); Narosa; 2002.

[3] R. G. Bartle: Elements of Real Analysis(2nd Edn.); Wiley International Edn.; 1976.

[4] R. G. Bartle and D.R. Sherbert: Introduction to Real Analysis; John Wiley Bros; 1982.

[5] J. V. Deshpande: Mathematical Analysis and Applications- an Introduction; Alpha Science International; 2004.

OBJECTIVES

a) **To understand the basic concepts of Topology: Finite, Countable and Uncountable sets, Metric spaces, Compact sets, Perfect sets, Connected sets.**

b) **To develop the notion of continuity of functions in R^K.**

c) **To understand the concept of differentiation of real valued and complex valued functions.**

d) **To study about Riemann Stieltjes Integral and Rectifiable curves.**

e) **To understand the convergence of sequence and series of functions.**

f) **To understand the relation between uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Basic topology, Continuous functions, continuity and compactness, continuity and connectedness, discontinuities	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic topology and continuity of functions	To understand: • the basics of topology • notion of continuity • difference between continuity and uniform continuity	Evaluation Through MCQ
Module I1 (30 hours)	Differentiation, derivatives of higher order, differentiation of	• Lecture • Discussion • Participative	• Student seminars to explain the	To understand: • differentiation of vector valued	Evaluation Through test paper

	vector valued functions, Riemann Stieltjes Integral	learning • Problem solving	properties of differentiation and integration	functions • integration of vector valued functions	
Module III (25 Hours)	Convergence of sequence and series of functions, uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of convergence of functions	To understand: • Convergence of sequence and series of functions • Differentiate between convergence and uniform convergence	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of basic topology, difference between continuous and uniformly continuous functions and its properties.
CO2	To understand the concept of differentiation of vector valued functions and integration of functions.
CO3	To understand the difference between pointwise convergence and uniform convergence of sequence of functions, convergence of series of functions

Faculty in charge:
M D Varghese

MTH1C02: LINEAR ALGEBRA
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of Linear Algebra.

MODULE I

Vector Spaces & Linear Transformations

MODULE II

Linear Transformations (continued) and Elementary Canonical Forms

MODULE III

Elementary Canonical Forms (continued), Inner Product Spaces

TEXT:

HOFFMAN K. and KUNZE R., LINEAR ALGEBRA (2nd Edn.), Prentice Hall of India, 199

REFERENCES :

[1] P. R. Halmos: Finite Dimensional Vector spaces; Narosa Pub House, New Delhi; 1980.

[2] A. K. Hazra: Matrix: Algebra, Calculus and generalised inverse- Part I; Cambridge International Science Publishing; 2007.

[3] I. N. Herstein: Topics in Algebra; Wiley Eastern Ltd Reprint; 1991.

[4] S. Kumaresan: Linear Algebra-A Geometric Approach; Prentice Hall of India; 2000.

[5] S. Lang: Linear Algebra; Addison Wesley Pub.Co.Reading, Mass; 1972.

[6] S. Maclane and G. Bikhrkhoff: Algebra; Macmillan Pub Co NY; 1967.

[7] N. H. McCoy and R. Thomas: Algebra; Allyn Bacon Inc NY; 1977.

[8] R. R. Stoll and E.T.Wong: Linear Algebra; Academic Press International Edn; 1968.

[9] G. Strang: linear algebra and its applications(4th edn.); Cengage Learning; 2006.

OBJECTIVES

a) **To understand the concept of vector spaces, basis and dimension.**

b) **To study about linear transformations and its properties.**

c) **To understand the concept of functionals and dual space**

d) **To study the relation between linear transformations and corresponding matrices.**

e) **To study about inner product spaces.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Vector spaces, subspace, basis, dimension, properties, linear transformations	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on properties of vector spaces	To understand: • the basics of vector spaces, basis • notion of linear transformation • properties of linear transformation	Evaluation through test papers and interaction with students
Module I1 (35 hours)	linear transformations, functionals, dual space and elementary canonical transformations	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of linear transformations	To understand: • More about linear transformation • Significance of dual space	Evaluation through test paper
Module III (25 Hours)	canonical transformations inner product spaces,	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on inner product spaces	To understand: • Inner product spaces and their relevance • Orthogonal compliment and direct sums of vector spaces	Evaluation through test paper

Course Outcomes

CO1	To understand the concept of vector spaces, their basis, dimension and linear transformations
CO2	To understand more about linear transformations and some of its important properties, elementary canonical forms
CO3	To introduce the concept of Inner product spaces, orthogonal compliment and direct sums of vector spaces

Faculty in charge:
Ms Nikita P B

MTH1C05: NUMBER THEORY

Number of hours of Lectures per week: 5

Number of Credits: 4

Objectives

To understand the basic concepts of Number Theory.

Module 1

Arithmetical functions and Dirichlet multiplication; Averages of arithmetical functions

Module 2

Some elementary theorems on the distribution of prime numbers

Module 3

Quadratic residues and quadratic reciprocity law ,Cryptography, Public key.

TEXT 1 : APOSTOL T.M., INTRODUCTION TO ANALYTIC NUMBER THEORY, Narosa Publishing House, New Delhi, 1990.

TEXT 2: KOBLITZ NEAL A., COURSE IN NUMBER THEROY AND CRYPTOGRAPHY, SpringerVerlag, NewYork, 1987.

References

[1] A. Beautelspacher: Cryptology; Mathematical Association of America (Incorporated); 1994

[2] H. Davenport: The higher arithmetic(6th Edn.); Cambridge Univ.Press; 1992

[3] G. H. Hardy and E.M. Wright: Introduction to the theory of numbers; Oxford International Edn; 1985

[4] A. Hurwitz & N. Kritiko: Lectures on Number Theory; Springer Verlag ,Universitext; 1986

[5] T. Koshy: Elementary Number Theory with Applications; Harcourt / Academic Press; 2002

[6] D. Redmond: Number Theory; Monographs & Texts in Mathematics No: 220; Marcel Dekker Inc.; 1994

[7] P. Ribenboim: The little book of Big Primes; Springer-Verlag, New York; 1991

[8] K.H. Rosen: Elementary Number Theory and its applications(3rd Edn.); Addison Wesley Pub Co.; 1993

[9] W. Stallings: Cryptography and Network Security-Principles and Practices; PHI; 2004

[10] D.R. Stinson: Cryptography- Theory and Practice(2nd Edn.); Chapman & Hall / CRC (214. Simon Sing : The Code Book The Fourth Estate London); 1999

[11] J. Stopple: A Primer of Analytic Number Theory-From Pythagorus to Riemann; Cambridge Univ Press; 2003

[12] S.Y. Yan: Number Theroy for Computing(2nd Edn.); Springer-Verlag; 2002

OBJECTIVES

a) **To understand the basic arithmetical functions and its averages.**

b) **To get familiarize with theorems on the distribution of prime numbers.**

c) **To understand quadratic residues, quadratic reciprocity law.**

d) **To study about basics of cryptography .**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Arithmetical functions and Dirichlet multiplication; Averages of arithmetical functions	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on various arithmetic functions.	To understand: • Arithmetical functions • Dirichlet multiplication and derivatives of arithmetical functions • Averages of arithmetical functions.	Evaluation Through Test paper
Module I1	Some elementary theorems on the	• Lecture • Discussion • Participative	• Student seminars to	To understand: • Equivalent	Evaluation Through test paper

(30 hours)	distribution of prime numbers	learning • Problem solving	explain theorems on distribution of prime numbers.	forms of prime number theorem. • Partial sums of Mobius function.	
Module III (30 Hours)	Quadratic residues and quadratic reciprocity law, Cryptography, Public key	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on legendre's symbol, its properties and Gauss lemma.	To understand: • Quadratic Residues and Quadratic reciprocity law,jacobi's symbol. • Basics of cryptography, types of crypto-system and its cryptanalysis.	Evaluation through test paper

Course Outcomes

CO1	To introduce the Arithmetical functions,Dirichlet multiplication and derivatives of arithmetical functions,Averages of arithmetic.
CO2	To understand the Equivalent forms of prime number theorem, Partial sums of Mobius function.
CO3	To understand the quadratic residues and quadratic reciprocity law, jacobi's symbol , basics of cryptography, types of cryptosystem and its cryptanalysis.

Faculty in charge:
Ms. Mariya Jose

MTH1C05 – DISCRETE MATHEMATICS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To understand concepts in graph theory, lattices and automata.

MODULE I

Order Relations, Lattices; Boolean Algebra Definition and Properties, Boolean Functions.

MODULE II

Basic concepts, Subgraphs, Degree of vertices, Paths and connectedness, Automorphism of a simple graph, Operations on graphs, Vertex cuts and Edge cuts, Connectivity and Edge connectivity, Trees-Definition, Characterization and Simple properties, Eulerian graphs, Planar and Non planar graphs, Euler formula and its consequences, K5 and K3,3 are non planar graphs, Dual of a plane graph.

MODULE III

Automata and Formal Languages: Introduction to the theory of Computation, Finite Automata.

TEXTBOOKS

TEXT 1: R. BALAKRISHNAN and K. RANGANATHAN, A TEXT BOOK OF GRAPH THEORY, Springer-Verlag New York, Inc., 2000.

TEXT 2: K. D JOSHI, FOUNDATIONS OF DISCRETE MATHEMATICS, New Age International(P) Limited, New Delhi, 1989.

TEXT 3: PETER LINZ, AN INTRODUCTION TO FORMAL LANGUAGES AND AUTOMATA (2nd Edn.), Narosa Publishing House, New Delhi, 1997.

REFERENCES

[1] J. C. Abbot: Sets, lattices and Boolean Algebras; Allyn and Bacon, Boston; 1969.

[2] J. A. Bondy, U.S.R. Murty: Graph Theory; Springer; 2000.

[3] S. M. Cioaba and M.R. Murty: A First Course in Graph Theory and Combinatorics; Hindustan Book Agency; 2009.

[4] J. A. Clalrk: A first look at Graph Theory; World Scientific; 1991.

OBJECTIVES

- To understand the definition of Boolean algebra and Boolean functions along with various properties.
- To study graph and its types with suitable examples.
- To learn about connectivity of graphs.
- To understand the definition of trees and learn various theorems related to it.
- To study about language, grammar and types of acceptors.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Lattices; Boolean Algebra Definition and Properties, Boolean Functions	• Discussion • Participative learning • Problem solving	Seminars by students	To study about Boolean algebra and Boolean functions.	Evaluation through test paper.
MODULE II	Graph definition with examples, isomorphism, connected graphs, planar graphs, trees and eulerian graphs	• Lecture • Discussion • Participative learning • Problem solving	Assignments on isomorphism of graphs. Discussion about various definitions.	To learn basics about graphs and trees. To study about planarity and connectivity.	Evaluation through test paper.
MODULE III	Definition of automata. Languages and Grammars. DFA and NFA	• Lecture • Discussion • Participative learning • Problem solving	Discussion on applications of automata. Working out exercise problems on DFA and NFA	To know the basic about automata. To learn about DFA and NFA	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about Boolean algebra and Boolean functions.
CO2	To learn basics about graphs and trees. To study about planarity and connectivity.
CO3	To know the basic about automata. To learn about DFA and NFA

Faculty in Charge
Ms Mariya Jose

MTH2C06: ALGEBRA II
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the ideas and concepts of insolvability of the quintic.

MODULE I

Prime and Maximal Ideals, Introduction to Extension Fields, Algebraic Extensions (Omit Proof of the Existence of an Algebraic Closure), Geometric Constructions. [27, 29, 31, 32]

MODULE II

Finite Fields, Automorphisms of Fields, the Isomorphism Extension Theorem, Splitting Fields, Separable Extensions. [33, 48, 49, 50, 51]

MODULE III

Galois Theory, Illustration of Galois Theory, Cyclotomic Extensions, Insolvability of the Quintic. [53, 54, 55, 56]

TEXT: John B. Fraleigh: A FIRST COURSE IN ABSTRACT ALGEBRA (7th Edn), Pearson Education Inc., 2003.

REFERENCES :

[1] N. Bourbaki: Elements of Mathematics: Algebra I, Springer; 1998

[2] Dummit and Foote: Abstract algebra (3rd Edn); Wiley India; 2011

[3] M.H. Fenrick: Introduction to the Galois correspondence (2nd Edn); Birkhuser; 1998

[4] P.A. Grillet: Abstract algebra (2nd Edn); Springer; 2007

[5] I.N. Herstein: Topics in Algebra (2nd Edn); John Wiley & Sons, 2006.

[6] T.W. Hungerford: Algebra; Springer Verlag GTM 73 (4th Printing); 1987

[7] C. Lanski: Concepts in Abstract Algebra; American Mathematical Society; 2010

[8] R. Lidl and G. Pilz Applied abstract algebra(2nd edn.); Springer; 1998

[9] N.H. Mc Coy: Introduction to modern algebra, Literary Licensing, LLC; 2012

[10] J. Rotman: An Introduction to the Theory of Groups (4th Edn); Springer; 1999

[11] I. Stewart: Galois theory(3rd edn.); Chapman & Hall/CRC; 2003

OBJECTIVES

a) **To understand the basic concepts of Prime and Maximal Ideals.**

b) **To get familiarize with Algebraic Extensions.**

c) **To understand the Automorphisms of fields, Separable Extensions and Splitting Fields.**

d) **To study about the Galois Theory, Cyclotomic Extensions and the Insolvability of the Quintic.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Prime and Maximal Ideals, Introduction to Extension Fields, Algebraic Extensions, Geometric Constructions.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on prime and maximal ideals and algebraic extensions	To understand: • the basics of extension fields • geometric constructions	Evaluation through MCQ
Module I1 (30 hours)	Finite Fields, Automorphisms of Fields, the Isomorphism Extension Theorem, Splitting Fields, Separable Extensions.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about separable extensions	To understand: • Isomorphism Extension Theorem Splitting and Separable Extensions	Evaluation through test paper
Module III (30 hours)	Galois Theory, Illustration of Galois Theory, Cyclotomic Extensions, Insolvability of the Quintic.	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on Cyclotomic Extensions	To understand: • Galois Theory • Insolvability of the Quintic	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of finite and extension fields, geometric constructions etc.
CO2	To understand the concept of Isomorphism Extension Theorem, Splitting and Separable Extensions.
CO3	To understand Galois theory and the Insolvability of the Quintic

Faculty in charge:
Ms. Geethu Simon

MT2C08: REAL ANALYSIS - II
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the advanced concepts of real analysis.

MODULE I

Lebesgue outer measure, measurable sets, regularity, measurable functions, Borel and Lebesgue measurability, Integration of non-negative functions, the general integral, integration of series Reimann and Lebesgue integrals

MODULE II

Differentiation, continuous non-differentiable functions, functions of bounded variation, Lebesgue's differentiation theorem, differentiation and integration, Lebegues set, Measures and outer measures, extension of a measure, uniqueness of the extension, completion of a measure, measure spaces, integration with respect to a measure

MODULE III

Signed measures and the Hahn decomposition, Jordan decompositon, Radon– Nikodym theorem, some applications of Radon Nikodym Theorem, bounded linear functionals on L^p, Lebesgue stieltjes measure, absolutely continuous functions, integration by parts, change of variable, Riesz Representation theorem for C(I).

TEXT:

G.de Barra, Measure Theory and Integration, New Age International Ltd. Publishers, New Delhi, 2006.

REFERENCES :

[1] K. B. Athreya and S. N. Lahiri, Measure Theory, Hindustan Book Agency, New Delhi, 2006.

[2] R. G. Bartle, The Element of Integration, John Wiley, 1964.

[3] S. K. Berberian, Measure and Integration, The McMillan Company, NewYork, 1965.

[4] P. R. Halmos, Measure Theory, Springer verlag.

[5] H. L. Royden, Real Analysis, Prentice Hall India, 1988 (3rd edition).

[6] W. Rudin, Real and Complex Analysis, Tata McGraw Hill, New Delhi, 2006.

[7] I. K. Rana, An Introduction to Measure and Integration, Narosa Publishing company, New York,

Analysis,Tata McGraw Hill,New Delhi,2006

[7] I K Rana:,An Introduction to Measure and Integration,Narosa Publishing Company,New York.

[8] Terence Tao: ,An Introduction to Measure Theory,Graduate Studies in Mathematics,Vol 126 AMS

OBJECTIVES

a) **To understand the basic concepts of Outer measure and measurable functions**

b) **To study about Reimann and Lebesgue Integrals**

c) **To understand Lebesgue Measure and Lebesgue Measurable Functions and its properties**

d) **To understand the concept of bounded linear functionals on L^p**

e) **To perform differentiation and Integration**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Lebesgue outer measure, measurable sets, regularity, measurable functions, Integration of non-negative functions, Reimann and Lebesgue integrals Measure, Lebesgue Measurable Functions	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Lebesgue measure and Lebesgue measurable functions	To understand: • the basics of sigma algebra • notion of Lebesgue measure and measurable functions	Evaluation through interaction with students and test papers
Module I1 (30 hours)	Differentiation,Lebesgue's differentiation theorem, differentiation and integration, Lebegues set, Measures and outer measures, measure spaces, integration with respect to a measure	• Lecture • Discussion • Participative learning • Problem solving	Student seminars on some topics Differentiation and Integration	To understand: • Concepts of Lebesgue integration and Differentiation	Evaluation through test papers and interaction with students
Module II1 (30 hours)	Signed measures and the Hahn decomposition, Jordan decompositon, Radon–Nikodym theorem, Riesz Representation theorem for C(I).	• Lecture • Discussion • Participative learning	• Peer group discussion on theorems	To understand: • Concepts of signed measures	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of Sigma Algebra, Borel sets, Lebesgue Measure, Lebesgue Measurable Functions
CO2	To understand the concept of differentiation and integration.
CO3	To understand the concept of signed measures, bounded linear functionals on $L^{p.}$

Faculty in charge:
M D Varghese

MTH2C08: TOPOLOGY
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the motivation and concepts of topology.

MODULE I

A Quick Revision of Chapter 1,2 and 3. Topological space, basic concepts [Chapter 4 and Chapter5 Section 1, Section 2(excluding 2.11 and 2.12) and Section 3 only]

MODULE II

Making Functions Continuous, quotient spaces, spaces with special properties [Chapter 5 Section 4 and Chapter 6]

MODULE III

Separation axioms: Hierarchy of separation axioms, Compactness and separation axioms, The Urysohn characterization of normality, Tietze characterization of normality.[Chapter 7 Section 1 to 3 and Section 4 up to and including 4.6]

TEXT:

JOSHI K D, INTRODUCTION TO GENERAL TOPOLOGY (Revised Edn.), New Age International (P) Ltd., New Delhi, 1983

Inc., 2003.

REFERENCES :

[1] M A Armstrong: Basic Topology, Springer- Verlag New York; 1983.

[2] J Dugundji: Topology; Prentice hall of India; 1975.

[3] M Gemignani: Elementary Topology; Addison Wesley Pub Co Reading Mass, 1971

[4] M G Murdeshwar: General Topology(2nd Edn);Wiley Eastern Ltd, 1990

[5] G F Simmons: Introduction to Topology and modern analysis; McGraw-Hill international student

Edn;1963.

OBJECTIVES

a) **To understand the basic concepts of Topological Spaces.**

b) **To get familiarize with making functions continuous, Quotient Spaces.**

c) **To understand the separation axioms, Hierarchy of separation axioms, compactness and separation axioms.**

d) **To study the Urysohn characterization of normality, Tietze characterization of normality.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Topological Spaces, Basic concepts	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic topology and topological space	To understand: • the basics of topology • topological spaces • different types of topologies	Evaluation Through MCQ
Module I1 (30 hours)	Making functions continuous, quotient spaces, spaces with special properties	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about making functions continuous	To understand: • Compact Lindeloff spaces • Connectedness Local Connectedness Path Connectedness	Evaluation Through test paper

Module III (30 Hours)	Separation axioms: Hierarchy of separation axioms, compactness and separation axioms, The Urysohn characterization of normality, Tietze characterization of normality	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on separation axioms	To understand: • Separation axioms • Urysohn characterization of normality	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of basic topology, topological space, different types of topologies.
CO2	To understand the concept of making functions continuous, quotient spaces
CO3	To understand the separation axioms, the Urysohn characterization of normality, Tietz characterization of normality

Faculty in charge:
Ms. Nikita P B

MT2C10: ODE AND CALCULUS OF VARIATIONS
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of ordinary differential equations and its applications.

MODULE I

Power Series Solutions and Special functions; Some Special Functions of Mathematical Physics.

MODULE II

Some special functions of Mathematical Physics (continued), Systems of First Order Equations; Non linear Equations

MODULE III

Oscillation Theory of Boundary Value Problems, The Existence and Uniqueness of Solutions, The Calculus of Variations.

TEXT:

SIMMONS, G.F., DIFFERENTIAL EQUATIONS WITH APPLICATIONS AND HISTORICAL NOTES (3rd Edn.), New Delhi, 1974.

REFERENCES :

[1] G. Birkhoff and G.C. Rota: Ordinary Differential Equations(3rd Edn.); Edn. Wiley & Sons; 1978
[2] W.E. Boyce and R.C. Diprima: Elementary Differential Equations and boundary value problems (2nd Edn.); John Wiley & Sons, NY; 1969
[3] A. Chakrabarti: Elements of ordinary Differential Equations and special functions; Wiley Eastern Ltd., New Delhi; 1990
[4] E.A. Coddington: An Introduction to Ordinary Differential Eqution; Printice Hall of India, New Delhi; 1974
[5] R.Courant and D. Hilbert: Methods of Mathematical Physics- vol I; Wiley Eastern Reprint; 1975
[6] P. Hartman: Ordinary Differential Equations; John Wiley & Sons; 1964 [7] L.S. Pontriyagin : A course in ordinary Differential Equations Hindustan Pub. Corporation, Delhi; 1967

[8] I. Sneddon: Elements of Partial Differential Equations; McGraw-Hill International, Edn.;1957

OBJECTIVES

a) **To study how to compute power series solution of first order ODE.**

b) **To get familiarize with some special functions of Mathematical Physics.**

c) **To study the methods to solve systems of first order equations.**

d) **To study more about qualitative properties of solutions.**

e) **To understand the concept of calculus of variations.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Power series solutions of first order ODEs, special functions in Mathematical Physics	• Lecture • Discussion • Participative learning • Problem solving	• Problem solving sessions in groups. • Discussing the solutions obtained	To understand: • the basics of solutions of ODE • significance of special functions	Evaluation Through test papers
Module I1 (30 hours)	Solve systems of first order and nonlinear equations	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain nonlinear equations	To understand: • the method to solve systems of first order equations • theory of solutions of nonlinear equations	Evaluation through test paper
Module III (25 Hours)	Existence and uniqueness of solutions, calculus of variations	• Lecture • Discussion • Participative learning • Problem solving	• Assignment on existence and uniqueness of solutions • Discussion in peer groups on Calculus of Variations	To understand: • the applications in Calculus of variations • the qualitative nature of solutions	Evaluation through test paper

Course Outcomes

CO1	To understand the power series solutions of ordinary differential equations and the significance of special functions.
CO2	To know more about special functions, systems of first order equations and nonlinear equations
CO3	To understand the qualitative nature of solutions and calculus of variation.

Faculty in charge:
Ms Sruthy V

MTH2C10 – OPERATIONS RESEARCH

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn various methods to solve an LPP and study about game theory and networking.

MODULE I

Convex Functions; Linear Programming

MODULE II

Linear Programming (contd.); Transportation Problem

MODULE III

Integer Programming; Sensitivity Analysis; Flow and Potential in Networks; Theory of Games

TEXTBOOK

K.V. MITAL; C. MOHAN., OPTIMIZATION METHODS IN OPERATIONS RESEARCH AND SYSTEMS ANALYSIS(3rd. Edn.), New Age International(P) Ltd., 1996.

REFERENCES

[1] R.L. Ackoff and M.W. Sasioni: Fundamentals of Operations Research; Wiley Eastern Ltd. New Delhi; 1991

[2] C.S. Beightler, D.T. Philiphs and D.J. Wilde: Foundations of optimization(2nd Edn.); Prentice Hall of India, Delhi; 1979

[3] G. Hadley: Linear Programming; Addison-Wesley Pub Co Reading, Mass; 1975

[4] G. Hadley: Non-linear and Dynamic Programming; Wiley Eastern Pub Co. Reading, Mass; 1964

OBJECTIVES

- To learn about convex function and few theorems related to it.
- To study LPP and simplex method to solve it.
- Understand and solve transportation problems.

- ❖ To study about the sensitivity analysis.
- ❖ To learn flow and networks.
- ❖ To understand the problems related to game theory.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Convex functions. Definition of LPP.	• Discussion • Participative learning • Problem solving • Lecture	Assignments on LPP	To study about convex functions and definition of LPP	Evaluation through test paper.
MODULE II	Simplex method to solve LPP. Transportation problem. VAM and MODI method to solve transportation problem.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on simplex method and solving of transportation method	To learn to solve LPP using simplex method. To solve Transportation problem.	Evaluation through test paper.
MODULE III	Integer programming and sensitivity analysis. Networking. Introduction to Game theory.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students on sensitivity analysis. Methods to solve flow and network. Game theory problem solving.	Discussion on sensitivity analysis. To solve networks and problems on game theory.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about convex functions
CO2	To learn about methods to solve LPP and transportation problems
CO3	To know about sensitivity in LPP and methods to solve networks. To understand game theory.

Faculty in charge: Ms. Rossflower

MAT 3C03 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 5 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of Ordinary differential equations, matrices and vector calculus.

MODULE I

Basic concepts and ideas, Geometrical meaning of y' = f(x,y). Direction Fields, Separable Differential Equations. Exact Differential Equations; Integrating Factors, Linear Differential Equations; Bernoulli Equation, Orthogonal Trajectories of Curves.

MODULE II

Rank of a Matrix, Non-Singular and Singular matrices, Elementary Transformations, Inverse of an elementary Transformations, Row Canonical form, Normal form. Systems of Linear equations: Homogeneous and Non Homogenoeus Equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton Theorem (statement only) and simple applications.

MODULE III

A quick Review of vector algebra, Inner product and vector product in R^2 and R^3 . Vector and scalar functions and Fields, Derivatives, Curves, Tangents, Arc Length, Velocity and acceleration, Gradient of a scalar field; Directional Derivative, Divergence of a vector field, Curl of a Vector Field.

MODULE IV

Line Integrals, Independence of path, Green's Theorem in the Plane (without proof), surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Divergence theorem of Gauss and Stoke's theorem (without proofs).

TEXTBOOKS

1. Erwin Kreyszig : Advanced Engineering Mathematics, Eighth Edition, Wiley, India.

2. Frank Ayres JR : Matrices, Schaum's Outline Series, TMH Edition.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.

[2] Muray R Spiegel, Vector Analysis, Schaum's Outline series, Asian Student Edition.

[3] Shanthi Narayanan & P.K. Mittal, A Text Book of Matrices, S. Chand

[4] Harry F. Davis & Arthur David Snider, Introduction to Vector Analysis, 6th ed., Universal Book Stall, New Delhi.

OBJECTIVES

- To understand the concepts in ordinary differential equations
- To learn about matrices and its properties
- To learn about Cayley Hamilton theorem
- To understand vectors
- To study in detail Vector Calculus

LESSON PLAN

Unit/Session (hours required)	Topics to be taught (input)	Procedure(process) Student centric method of teaching	Activity	Learning Outcome (output)	Assessment
MODULE I (20 hours)	Modeling of differential equations, methods to solve first order differential equations.	• Discussion • Participative learning • Problem solving	Discussions Lectures and Quizzes	Geometrical meaning of ODE, solving I order ODEs	Evaluation through test paper.
MODULE II (20 hours)	Rank of a matrix, solution of system of linear equations, Cayley- Hamilton theorem	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about Eigen values and vectors	Normal and Echoleon form of matrices, Solution of linear system of equations, Eigen values and vectors	Evaluation through test paper.
MODULE III (25 hours)	Introduction to vectors and vector differential calculus	• Lecture • Discussion • Participative learning • Problem solving	Discussion on derivatives of vector functions	Know gradient, divergence, curl of a vector function	Evaluation through MCQ.
MODULE IV (25 hours)	Vector integral calculus	• Lecture • Discussion • Participative learning • Problem solving	Discussion on surface integrals	Greens theorem, Stoke's theorem, Gauss divergence theorem	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about I order ordinary differential equations
CO2	To learn solution of system of linear equations To study about eigen values and eigen vectors.
CO3	To know about vector differential calculus To learn about vector integral calculus

Faculty in Charge

Sr Mercy Mathew

MT 3C 12: COMPLEX ANALYSIS
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the ideas and concepts of analytic functions and singularities..

MODULE I

Conformality, Linear Transformations, Fundamental Theorems, Cauchy's Integral Formula.

MODULE II

Local Properties of Analytical Functions, The General Form of Cauchy's Theorem, The Calculus of Residues, Harmonic Functions.

MODULE III

Power Series Expansions, Simply Periodic Functions, Doubly Periodic Functions, The Weierstrass Theory.

TEXT: LARS V. AHLFORS : Complex Analysis, 3rd edn. Mc Graw Hill (1979)

REFERENCES :

1. Cartan, H. : Elementary Theory of Analytic Functions of one or Several . Variables, Addison - Wesley Pub. Co. (1973)
2. Conway, J.B. : Functions of One Complex Variable, Narosa Pub. Co., New Delhi. . (1973)
3. Moore T.O. &Hadlock E.H. : Complex Analysis, Series in Pure Mathematics - Vol. 9. World Scientific . (1991)
4. Pennisi, L. : Elements of Complex Variables, Holf, Rinehart & Winston, 2nd Edn. . (1976)
5. Rudin, W. : Real and Complex Analysis, 3rd Edn. McGraw - Hill International . Edn. (1987)
6. Silverman, H. : Compex Variables, Houghton Mifflin Co. Boston (1975)
7. Remmert, R. : Theory of Complex Functions, UTM, Springer- Verlag, NY, (1991)

OBJECTIVES

a) **To understand the basic concepts of** Power series, Analytic functions, Analytic functions as mappings and Mobius transformations.

b) **To get familiarize with** Conformal mappings, Weistrass theory

c) **To understand the** Power series representation of analytic functions, Zeros of an analytic function, The index of a closed curve, Cauchy's Theorem and Integral Formula and the classification of singularities.

LESSON PLAN

Unit/ session / hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Conformal mappings, Cauchy Integral formula	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Power series and Analytic functions	To understand: • Conformal mappings • Fundamental theorems	Evaluation through MCQ
Module I1 (30 hours)	Analytic functions, Harmonic funcions	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about Power series representation of analytic functions	To understand: • Residue theorem • Calculus of residue.	Evaluation through test paper
Module III (30 hours)	Entire functions Wiestrass Theory	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on classification of singularities	To understand: • Simply periodic doubly periodic functions	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of Power series and Analytic functions
CO2	To understand the concept of Cauchy's Theorem and Integral Formula, Open Mapping Theorem and Goursat's Theorem.
CO3	To understand the Argument Principle, the Maximum Principle and Schwarz's Lemma.

Faculty in charge:
Ms.Nikita P B

MT3C14 – ADVANCED FUNCTIONAL ANALYSIS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn about metric spaces, normed spaces, Banach spaces and Inner product spaces.

MODULE I

Metric spaces and Continuous Functions, Lp spaces , Fourier series and Integrals, Normed spaces Continuity of linear maps

MODULE II

Hahn-Banach Theorems, Banach spaces, Uniform Boundedness Principle

MODULE III

Closed Graph and Open Mapping Theorems, Bounded Inverse Theorem, Inner product spaces, Orthonormal sets

TEXTBOOK

LIMAYE , B.V, FUNCTIONAL ANALYSIS, (2nd Edn.) New Age International Ltd, Publishers, New Delhi, Bangalore (1996)

REFERENCES

[1]R. Bhatia, Notes on Functional Analysis TRIM series, Hindustan Book Agency

[2]KesavanS, Functional Analysis TRIM series, Hindustan Book Agency

[3] S David Promislow, A First Course in Functional Analysis Wiley Interscience, John wiley & Sons, INC., (2008)

[4]E.Kreyszig, Introductory Functional Analysis with Applications John Wiley & Sons (1978)

OBJECTIVES

- To define Metric spaces along with examples.
- To study normed spaces and its continuity.
- To learn Hahn Banach theorems.
- To understand Banach spaces.
- To study about Inner product spaces and orthonormality.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Metric spaces.L_p spaces. Normed spaces. Continuity of linear maps	• Discussion • Participative learning • Problem solving • Lecture	Assignments on examples of metric spaces and normed spaces.	To study about metric spaces and its properties. To learn normed spaces.	Evaluation through test paper.
MODULE II	Hahn Banach Theorems. Banach spaces.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on corollaries of Hahn Banach theorems.	To learn Hahn Banach theorem and study about Banach spaces	Evaluation through test paper.
MODULE III	Closed graph theorem. Open mapping theorem. Inner products. Orthonormality.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students	To study important theorems. To learn about Inner products and orthonormal space.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about metric space and normed space along with its continuity
CO2	To study Hahn Banach theorem and Uniform Boundedness principle
CO3	To learn about inner products and orthonormal spaces.

Faculty in charge:
Krishnamol Ravindran

MTH3C11 – MULTIVARIABLE CALCULUS AND GEOMETRY

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To understand concepts in Differential Geometry

MODULE I

Functions of Several Variables Linear Transformations, Differentiation, The Contraction Principle, The Inverse Function Theorem, the Implicit Function Theorem.

MODULE II

What is a curve? Arc-length, Reparametrization, Closed curves, Level curves versus parametrized curves. Curvature, Plane curves, Space curves What is a surface, Smooth surfaces, Smooth maps, Tangents and derivatives, Normals and orientability.

MODULE III

Level surfaces, Ruled surfaces and surfaces of revolution, Applications of the inverse function theorem, Lengths of curves on surfaces, Equiareal maps and a theorem of Archimedes, The second fundamental form, The Gauss and Weingarten maps, Normal and geodesic curvatures. Gaussian and mean curvatures, Principal curvatures of a surface.

TEXTBOOKS

TEXT 1 : RUDIN W., PRINCIPLES OF MATHEMATICAL ANALYSIS, (3rd Edn.), Mc. Graw Hill, 1986.

TEXT 2: ANDREW PRESSLEY, ELEMENTARY DIFFERENTIAL GEOMETRY(2nd Edn.), Springer-Verlag, 2010.

REFERENCES

[1] M. P. do Carmo: Differential Geometry of Curves and Surfaces;

[2] W. Klingenberg: A course in Differential Geometry;

[3] J. R. Munkres: Analysis on Manifolds; Westview Press; 1997

[4] C. C. Pugh: Real Mathematical Analysis, Springer; 2010

[5] M. Spivak: A Comprehensive Introduction to Differential Geometry-Vol. I; Publish

or Perish, Boston; 1970

[6] M. Spivak: Calculus on Manifolds; Westview Press; 1971

[7] V.A. Zorich: Mathematical Analysis-I; Springer; 2008

OBJECTIVES

- To understand functions of several variables and its differentiation
- To study curves, level curves and curvature.
- To learn about surfaces and its properties as normal, orientablity and tangents.
- To understand the definition Guass Weingarten maps
- To study about Guassian, mean curvatures

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	The Contraction Principle, The Inverse Function Theorem, the Implicit Function Theorem.	• Discussion • Participative learning • Problem solving	Seminars by students	To study about Functions of Several Variables Linear Transformations and its properties	Evaluation through test paper.
MODULE II	Arc-length, Reparametrization, Level curves versus parametrized curves. Curvature, Tangents and derivatives, Normals and orientability.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on Tangents and derivatives. Discussion about various definitions.	To learn basics about Curves, Level curves, curvature, Smooth maps,Tangents, Normals.	Evaluation through MCQ
MODULE III	Level surfaces, Applications of the inverse function theorem, Normal and geodesic curvatures. Gaussian and mean curvatures, Principal curvatures of a surface.	• Lecture • Discussion • Participative learning • Problem solving	Discussion on Surfaces and its properties.	To know the about Level, ruled surfaces, Guassian, mean, principal curvatures. The Gauss and Weingarten maps,	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about functions of several variables
CO2	To learn about the analytical and geometric concepts of curves and its variations To study about cuvature and sufaces
CO3	To know The Gauss and Weingarten maps, To learn Guassian and mean curvature.

Faculty in Charge

Ms. Sruthy V

MT3C15: PDE and Integral Equations
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic theory of PDE and Integral Equations.

MODULE I

First Order PDE .

MODULE II

Second Order PDE .

MODULE III

Integral Equations

TEXTS : 1. AMARNATH, M., : PARTIAL DIFFERENTIAL EQUATIONS, Narosa , New Delhi (1997)

2. HILDEBRAND, F.B.: METHODS OF APPLIED MATHEMATICS, (2 nd Edn.) Prentice-Hall of India, New Delhi, 1972

REFERENCES :

1. G. Birkhoff & G.C. Rota : Ordinary Differential Equations, Edn. Wiley & Sons 3rd Edn (1978)
2. E.A. Coddington : An Introduction to Ordinary Differential Equations, Printice Hall of India, New Delhi (1974)
3. P. Hartman : Ordinary Differential Equations, John Wiley & Sons (1964)
4. L.S. Pontriyagin : A Course in Ordinary Differential Equations, Hindustan Pub. Corporation, Delhi (1967)
5. F. John : Partial Differential Equations, Narosa Pub. House New Delhi (1986)
6. Phoolan Prasad & : Partial Differential Equations, Renuka Ravindran Wiley Eastern Ltd New Delhi (1985)
7. R. Courant and D.Hilbert : Methods of Mathematical Physics , Vol I, Wiley Eastern Reprint (1975) 8. W.E. Boyce & R.C. Deprima : Elementary Differential Equations, and Boundary Value Problems John Wiley & Sons, NY, 9th Edition

OBJECTIVES

a) **To study the basic methods of solving partial differential equations.**

b) **To study different methods for solving second order linear and nonlinear pde.**

c) **To study the classification of PDE and to obtain the canonical forms.**

d) **To understand the relation between integral equations and differential equations and to study different methods to solve integral equations.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (35 hours)	Linear equations of first order,Quasilinear equations, method of characteristics, the Lagrange method, Charpit method, Jacobi method, Cauchy problem	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on different methods of solving first order pde	To understand: • Different types of PDE • methods to solve pde • solving non linear problem	Evaluation through test paper and interaction with students

Module I1 (30 hours)	Classification of second order pde, solving wave, heat and Laplace equations, Separation of variables, canonical form, Cauchy problem for second order pde	• Lecture • Discussion • Participative learning • Problem solving	Student seminars to understand the method of solving wave, heat and Laplace equations	To understand: • Methods to solve second order PDE • Solutions of heat, wave and Laplace equations	Evaluation through test paper
Module III (25 Hours)	Integral equations, Fredholm and Volterra equations, Resolvent kernel,Neumann series, Fredholm Schmidt theory	• Lecture • Discussion • Participative learning • Problem solving	• Assignment and problem solving sessions on Integral equations	To understand: • Relation between integral equation and differential equation • Methods to solve integral equations of different kinds	Evaluation through test paper

Course Outcomes

CO1	To study different types of PDE and methods for solving them.
CO2	To study methods of solving second order PDE, heat, wave and Laplace equation, Cauchy problem
CO3	To understand the relation between differential equation and integral equations, also different methods to solve integral equations.

Faculty in charge:
Ms Rossflower

MTH4E06: Algebraic Number Theory
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the concepts of Algebraic Number Theory.

MODULE I

Symmetric polynomials, Modules, Free abelian groups, Algebraic Numbers, Conjugates and Discriminants, Algebraic Integers, Integral Bases, Norms and Traces, Rings of Integers, Quadratic Fields, Cyclotomic Fields

MODULE II

Historical background, Trivial Factorizations, Factorization into Irreducibles, Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals Historical background, Prime Factorization of Ideals, The norm of an ideal

MODULE III

Lattices, The Quotient Torus, Minkowski theorem, The Space Lst, The Class-Group An Existence Theorem, Finiteness of the Class-Group, Factorization of a Rational Prime, Fermats Last Theorem Some history, Elementary Considerations, Kummers Lemma, Kummers Theorem.

TEXT : I. N. STEWART & D.O. TALL, ALGEBRAIC NUMBER THEORY, (2nd Edn.), Chapman &

Hall, (1987)

REFERENCES :

[1] P. Samuel : Theory of Algebraic Numbers, Herman Paris Houghton Mifflin, NY, (1975)
[2] S. Lang : Algebraic Number Theory, Addison Wesley Pub Co., Reading, Mass, (1970)
[3] bf D. Marcus : Number Fields, Universitext, Springer Verlag, NY, (1976)
[4] 4T.I.FR. Pamphlet No: 4 : Algebraic Number Theory (Bombay, 1966)
[5] Harvey Cohn : Advanced Number Theory, Dover Publications Inc., NY, (1980)
[6] Andre Weil : Basic Number Theory, (3rd Edn.), Springer Verlag, NY, (1974)
[7] G.H. Hardy and E.M. Wright : An Introduction to the Theory of Numbers, Oxford University

Press.
[8] Z.I. Borevich & I.R.Shafarevich : Number Theory, Academic Press, NY 1966.
[9] Esmonde & Ram Murthy : Problems in Algebraic Number Theory, Springer Verlag 2000

OBJECTIVES

a) **To study the basic concepts of numberfield, quadratic field, Guassian field and their properties.**

b) **To study how factorization into irreducibles hold in different fields.**

c) **To understand the concepts of lattices, the quotient torus and geometric representation of algebraic numbers.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Factorization into Irreducibles, Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals, Prime Factorization of Ideals,	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on numberfields and its properties	To understand: • the factorization into irreducibles • different types of numberfields • the factorization of ideals • properties of ideals	Evaluation through test paper and interaction with students

Module I1 (30 hours)	Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals Historical background, Prime Factorization of Ideals, The norm of an ideal	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to understand prime factorization and quadratic fields	To understand: • Nonunique Factorization into Irreducibles • Factorization of Ideals and norm of an ideal	Evaluation Through test paper
Module III (25 Hours)	Lattices, The Quotient Torus, Minkowski theorem, The Space Lst, The Class-Group An Existence Theorem, Finiteness of the Class-Group, Factorization of a Rational Prime, Kummers Lemma, Kummers Theorem	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion and assignments to understand geometric representation of algebraic numbers	To understand: • The Quotient Torus • The class group	Evaluation through test paper

Course Outcomes

CO1	Awareness about different types of numberfield and their properties
CO2	Able to check unique factorization in fields and also can provide examples of nonunique factorizations
CO3	To understand the geometric representation of algebraic numbers

Faculty in charge:
Ms. Nikita P B

MT4E11 – ADVANCED FUNCTIONAL ANALYSIS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn about duality, compactness and boundedness of spaces.

MODULE I

Duals and Transposes, Duals of Lp [a,b] and C[a,b], weak and weak* convergence, Reflexivity

MODULE II

Definition of Compact Linear Map, spectrum of a compact operator, Riesz Representation Theorems

MODULE III

Bounded Operators and Adjoints , Normal, Unitary and Self Adjoint Operators , Spectrum and Numerical Range , Compact self Adjoint Operator

TEXTBOOK

LIMAYE , B.V, FUNCTIONAL ANALYSIS, (2nd Edn.) New Age International Ltd, Publishers, New Delhi, Bangalore (1996)

REFERENCES

[1]R. Bhatia, Notes on Functional Analysis TRIM series, Hindustan Book Agency

[2]KesavanS, Functional Analysis TRIM series, Hindustan Book Agency

[3] S David Promislow, A First Course in Functional Analysis Wiley Interscience, John wiley & Sons, INC., (2008)

[4]E.Kreyszig, Introductory Functional Analysis with Applications John Wiley & Sons (1978)

OBJECTIVES

- To understand the concept of duality and reflexivity.
- To study spectrum of compact operators.
- To understand the concept of Bounded linear operators and its types.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Dual spaces. Weak convergence Reflexivity	• Discussion • Participative learning • Problem solving • Lecture	Assignments on examples of dual spaces	To study about duality and weak convergence. To learn reflexivity.	Evaluation through test paper.
MODULE II	Compact operators and its spectrum. Riesz Representation theorems.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on compact operators and examples	To learn about spectrum of compact operators	Evaluation through test paper.
MODULE III	Bounded operators. Adjoint, normal, unitary and self adjoint operators. Compact self adjoint operator.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students	To study Self adjoint operators and compactness.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about duality and the concept of reflexivity
CO2	To learn about compact operators
CO3	To learn about Bounded linear operators and self adjoint operators

Faculty in charge: Ms. Krishnamol Ravindran

MTH4C11: GRAPH THEORY
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the basic concepts of Graph theory.

Module 1

Basic concepts of Graph. Trees, Cut edges and Bonds, Cut vertices, Cayleys Formula, The Connector Problem, Connectivity, Blocks, Construction of Reliable Communication Networks, Euler Tours, Hamilton Cycles, The Chineese Postman Problem, The Travelling Salesman Problem.

Module 2

Matchings, Matchings and Coverings in Bipartite Graphs, Perfect Matchings, The Personnel Assignment Problem, Edge Chromatic Number, Vizings Theorem, The Timetabling Problem, Independent Sets, Ramseys Theorem

Module 3

Vertex Colouring-Chromatic Number, Brooks Theorem, Chromatic Polynomial, Girth and Chromatic Number, A Storage Problem, Plane and Planar Graphs, Dual Graphs, Eulers Formula, Bridges, Kuratowskis Theorem, The Five-Colour Theorem, Directed Graphs, Directed Paths, Directed Cycles.

TEXT : J.A. Bondy and U.S.R.Murty : Graph Theory with applications. Macmillan

References

[1] F. Harary : Graph Theory, Narosa publishers, Reprint 2013.
[2] Geir Agnarsson, Raymond Greenlaw: Graph Theory Modelling, Applications and Algorithms, Pearson Printice Hall, 2007.
[3] John Clark and Derek Allan Holton : A First look at Graph Theory, World Scientific (Singapore) in 1991 and Allied Publishers (India) in 1995
[4] R. Balakrishnan & K. Ranganathan : A Text Book of Graph Theory, Springer Verlag, 2nd edition 2012.

OBJECTIVES

a) **To understand the basic concepts of graphs, Trees, Cut edges and Bonds, Cut vertices, Euler Tours, Hamilton Cycles**

b) **To get familiarize with Matchings and Coverings in Bipartite Graphs, Perfect Matching, Independent Sets, Ramseys Theorem**

c) **To understand the concept of Vertex Colouring-Chromatic Number, Edge Chromatic Number , The Five-Colour Theorem, Directed Graphs.**

d) **To study more about Chromatic Polynomial, Girth and Chromatic Number**

e) **To understand The Five-Colour Theorem, Directed Graphs, Directed Paths, Directed Cycles.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Basic concepts of graph, Trees, Cut edges and Bonds, Cut vertices, Connectivity, Blocks, Euler Tours, Hamilton Cycles	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic concepts of graph	To understand: • the basics of graph, trees • Concepts of cut edges, cut vertices, Euler tour and Hamilton cycles	Evaluation Through MCQ
Module I1 (30 hours)	Matchings and Coverings, Perfect Matchings, Edge Chromatic Number, Vizings Theorem, Independent Sets, Edge colouring,Ramseys Theorem	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the Personnel Assignment Problem and The Timetabling Problem	To understand: • differentiation of matchings and covering • Concepts of edge colouring and Ramseys theorem	Evaluation Through test paper
Module III (30 Hours)	Vertex Colouring-Chromatic Number, Brooks Theorem, , Plane and Planar Graphs, Dual Graphs, Eulers Formula, Bridges, Kuratowskis Theorem, The Five-Colour Theorem, Directed Graphs,	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on Storage Problem	To understand: • Vertex colouring and it's important results • Planar graphs, dual graphs and it's important result	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of basic graph theory, trees, cut vertices and cut edges, Euler tour and Hamilton cycles
CO2	To understand the concept of matchings and covering, Edge colouring.
CO3	To understand the concepts of vertex colouring and it's important results. Planar graphs and dual graphs.

Faculty in charge:
Ms Mariya Jose

MTH4E09: DIFFERENTIAL GEOMETRY
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the basic concepts of differential geometry.

MODULE I

Graphs and Level Set, Vector fields, The Tangent Space, Surfaces, Vector Fields on Surfaces, Orientation. The Gauss Map .

MODULE II

Geodesics, Parallel Transport, The Weingarten Map, Curvature of Plane Curves, Arc Length and Line Integrals.

MODULE III

Curvature of Surfaces, Parametrized Surfaces, Local Equivalence of Surfaces and Parametrized Surfaces.

TEXT:

J.A.THORPE : ELEMENTARY TOPICS IN DIFFERENTIAL GEOMETRY

REFERENCES :

1) M. de Carmo : Differential Geometry of Curves and Surfaces, Prentice Hall Inc Englewood Cliffs NJ (1976).
2) V. Grilleman and A. Pollack : Differential Topology, Prentice Hall Inc Englewood Cliffs NJ (1974)
3) B. O'Neil : Elementary Differential Geometry, Academic Press NY (1966)
4) M. Spivak : A Comprehensive Introduction to Differential, Geometry, (Volumes 1 to 5), Publish or Perish, Boston (1970, 75)
5) R. Millmen and G. Parker : Elements of Differential Geometry, Prentice Hall Inc Englewood Cliffs NJ (1977)
6) I. Singer and J.A. Thorpe : Lecture Notes on Elementary Topology and Geometry, UTM, Springer Verlag, NY (1967)
7) W.L.Burke: Applied Differential Geometry , Cambridge University Press (1985).

OBJECTIVES

a) **To understand the basic concepts of level sets, surfaces and its curvature, geodesics,and parametrized surfaces .**

b) **To get familiarize with covariant derivatives and its properties.**

c) **To understand the concept of local and global parametrization.**

d) **To study more about parametrized surfaces and local equivalence of surface and parametrized surfaces.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I (30 hours)	Level sets,vector fields, the tangent space, surfaces and the gauss map.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on vector fields and level sets.	To understand: • the basics of surfaces • notion of tangent space and the gauss map	Evaluation Through MCQ
Module II (30 hours)	Geodesics, Parallel transport, The Weingarten map, Arc length and line integrals.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of derivatives of smooth vector field and covariant derivative.	To understand: • Local and global parametrization. • Concept of parallel transport.	Evaluation Through test paper
Module III	Curvature of surfaces, First and second fundamental	• Lecture • Discussion • Participative	• Seminar and assignment on local	To understand: • Principal, Gaussian, Gauss	Evaluation through test paper

(30 Hours)	forms,Parametrized surfaces and its local equivalence with surfaces.	learning • Problem solving	equivalence of surfaces and parametrized surfaces.	Kronecker and Mean curvature • Inverse function theorems.	

Course Outcomes

CO1	To introduce the concept of graphs and level sets, basics of surfaces and notion of tangent space anf gauss map.
CO2	To understand the concept of parallel transport, local and global parametrization, arc length and line integral.
CO3	To understand the principal ,Gaussian ,Gauss Kronecker and Mean curvature, and parametrized surfaces.

Faculty in charge:
Ms. Rossflower

MAT1B01: FOUNDATIONS OF MATHEMATICS

Lecture Hours per week: 4, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

To get introduced to many mathematical terms.

Module I (16 hrs)

Set operations: Difference and Symmetric difference, Algebra of sets, Duality, Classes of sets, Powersets Relations: Product set, Relations, Composition of relations, Types of relations, Partitions, Equivalence relations with example of congruence modulo relation, Partial ordering relations, n- ary relations.

Module II (16 hrs)

Functions : Identity function, constant functions, product (composition) of functions, theorems on one-one and onto functions, Mathematical functions, Recursively defined functions, Indexed collection of sets, Operations on indexed collection of sets, Equipotent sets, Denumerable and countable sets, Cardinal numbers.

Module III (20 hrs)

Function quick review, Shifting graphs , Limit and continuity , The Sandwich theorem, Target values and formal definition of limits, Extensions of limit concept, Continuity.

Module IV (20 hrs)

Basic Logic: Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators, Propositional equivalence, Logical equivalences, Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Textbooks:

1) **S. Lipschutz**: Set Theory and related topics (Second Edition), Schaum Outline Series, TataMcGraw- Hill Publishing Company, New Delhi.

2) **Thomas /Finney** : Calculus, 9th ed., LPE, Pearson Education.
3) **K.H. Rosen**: Discrete Mathematics and its Applications (sixth edition), Tata McGraw Hill Publishing Company.

Reference Books:

1) P.R. Halmos: Naive Set Theory, Springer.
2) E. Kamke, Theory of Sets, Dover Publishers.
3) Anton : Calculus, Wiley.
4) R.P. Grimaldi: Discrete and Combinatorial Mathematics, Pearson Education.

OBJECTIVES

1) To get familiarized with different set operations.
2) To learn about different kind of functions and sets.
3) To understand concepts like limit and continuity.
4) To introduce basic logic.

LESSON PLAN

Unit/ Hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **16 Hours**	Set operations, Relations.	• Lecture • Discussion • Participative learning • Problem solving	Seminar on Set Operations.	To master in Set Operations.	Evaluation through test paper

Module II **16 Hours**	Functions, Different kinds of Sets.	• Lecture • Discussion • Participative learning • Problem solving	Assignment on One-one and Onto functions.	To understand different kinds of functions and sets.	Evaluation through test paper
Module III **20 Hours**	Shifting Graphs, Limit and Continuity.	• Lecture • Discussion • Participative learning • Problem solving	Peer discussion on Limits.	To get introduced to Limit and Continuity.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Logical equivalences, Quantifiers.	• Lecture • Discussions • Problem solving	Assignment on Logical equivalences.	To understand Logical equivalences.	Evaluation through testpaper

Course Outcomes

CO1	Get introduced to new mathematical terms.
CO2	Understand set properties and set functions.
CO3	Learn about functions and know about limit and continuity
CO4	To appreciate the beauty of logical arguments.

Teacher in Charge:

Geethu Simon

MAT2B02: CALCULUS

Lecture Hours per week: 4, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce students to the fundamental ideas of differentiability and integrability and also to some basic theorems of differential calculus.

Module I (20 hrs)

Extreme value of functions, The mean value theorem, The first derivative test for local extremum values , Graphing with y' and y'', Limit as x, Assymptotes and dominant terms.

Module II (20 hrs)

Optimization, Linearization and differentials, Riemann sums and definite – integrals, Properties, area and the mean value theorem, The fundamental theorem, Substitution in Definite Integrals.

Module III (20 hrs)

Areas between curves, Finding volumes by slicing ,Volumes of solids of revolution, Lengths of plane curves, Areas of surface of revolution.

Module IV (12 hrs)

Moments and centres of mass, Work

Textbooks:

1) **Thomas / Finney**: Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1) Anton : Calculus, Wiley.
2) S.K. Stein : Calculus with Analytic Geometry, McGraw Hill.

OBJECTIVES

1) To get an idea of sketching of curves.
2) To see different applications of derivatives and integrals.
3) To solve some optimization problems of interest in real life.
4) To establish the close connection between the two branches of Calculus: Differential and Integral Calculus.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	Extreme value of functions, The mean value theorem, The first derivative test for local extremum values , Graphing with y' and y", Limit as x, Assymptotes and dominant terms.	• Lecture • Discussion • Participative learning • Problem solving	Group discussion on Curve Sketching	To understand several techniques of sketching curves and learning limits.	Evaluation through test paper and group discussion
Module II **20 Hours**	Optimization, Linearization and differentials, Riemann sums and definite – integrals, Properties, area and the mean value	• Lecture • Discussion • Participative learning • Problem solving	Assignment to find integrals of functions	To deal with real life problems in Physics, Chemistry etc.	Evaluation through test paper

	theorem, The fundamental theorem, Substitution in Definite Integrals.				
Module III **20 Hours**	Areas between curves, Finding volumes by slicing, Volumes of solids of revolution, Lengths of plane curves, Areas of surface of revolution	• Lecture • Discussion • Participative learning • Problem solving	Assignment to find volume of some familiar objects	To explore relationship between Surfaces and Curves	Evaluation through testpaper
Module IV **12 Hours**	Moments and centres of mass, Work	• Lecture • Problem solving • Participative learning • Videos	Seminars related to Centre of Mass	To understand concepts like Work and Moment.	Evaluation through test paper and viva

Course Outcomes

CO1	To explore the relationship between moving/changing objects
CO2	To master integrals which is a powerful tool in solving problems in Physics, Chemistry, Biology, Engineering, Economics and other fields.
CO3	To deal with real life optimization problems.
CO4	To learn the practical way of evaluating the definite integral.

Teacher in Charge:
Geethu Simon

MAT3B03 CALCULUS AND ANALYTIC GEOMETRY

Lecture Hours per week: 5, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce fundamentals of calculus and geometry

Module I (15 hrs)

Natural logarithms, The Exponential function, and log , Growth and decay ,
L'Hopital's Rule, Relative rates of growth, Hyperbolic functions

Module II (25 hrs)

Limits of sequence of numbers,Theorems for calculating limits of sequences, Infinite series, Integral test for series of non-
negative terms,Comparison test for series of non negativeterms,Ratio and root test for series of non negati veterms, Alternating series, Absolute and conditional convergence.

Module III (15 hrs)

Power series, Taylor and Maclaurin's series, Convergence of Taylor series ,Error estimate

Module IV (35 hrs)

Conic section and quadratic equations, Classifying conic section by eccentricity ,Quadratic equations and rota tions, Parametrisation of plane curves, Calculus with parametrisedcurves,Polar coordinates, Graphing in polar co- ordinates, Polar equations for conic sections, Integration in polar coordinates.

Textbooks :

1) Thomas / Finney: Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1) Anton : Calculus, Wiley.

2) S.K. Stein : Calculus and Analytic Geometry, McGraw Hill

Department of Mathematics

OBJECTIVES

1) To know transcendental functions such as natural logarithmic and exponential function.
2) To study a related notion of convergence of series
3) To study Power series, Taylor series , Maclaurin's series and their convergence
4) To understand parametrisation of plane curves

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **15 Hours**	Natural logarithms , The Exponential function, and log , Growth and decay ,L'Hopital's Rule, Relative rate of growth, Hyper-bolic functions.	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on Growth and decay functions	To understand transcendental functions	Evaluation through test paper
Module II **25 Hours**	Limits of sequence of numbers, Infinite series, Integral test for series,Comparison test ,Ratio and root test , Alternating series, Absolute and co	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to convergence tests of infinite series	To understand convergence of sequences and series	Evaluation through test paper

	nditional converg ence.				
Module III **15 Hours**	Power series, Tay lor and Maclaurin's series, Convergence of Taylor series , Error estimate	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on power series	To study power series and convergence	Evaluation through test paper and group discussion
Module IV **35 Hours**	Conic section and quadratic equations ,Quadratic equation and rotations, Para metrisation of plane curves,Polar coordinates, Graph ing in polar co-ordinates, Polar eq uations for conic se ctions, Integration in polar coordinate s	• Lecture • Discussions • Problem solving	• Student seminars in connection with polar coordinates	To understand parametrisation of plane curves	Evaluation through test paper

Course Outcomes

CO1	To understand transcendental functions such as natural logarithmic and exponential function
CO2	To handle the convergence of series with different tests.
CO3	To learn Power series, Taylor series , Maclaurin’s series and their convergence
CO4	To understand parametrisation of plane curves

Department of Mathematics

Teacher in Charge:

Krishnamol Ravindran

MAT4B04: THEORY OF EQUATIONS, MATRICES AND VECTOR CALCULUS

Lecture Hours per week: 5, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

Develops a new and fundamental ideas of calculus for the simple, but important case of polynomials. Also uses the matrices to solve system of linear equations.

Module I (30 hrs)

Polynomial Equations and Fundamental Theorem of Algebra(without proof). Applications of the Fundamental theorem to equations having one or more complex roots, Rational roots or multiple roots. Relations between roots and co-efficients of a polynomial equation and computation of symmetric functions of roots.Finding equations whose roots are functions of the roots of a given equation. Reciprocal equation and method of finding its roots. Analytical methods for solving polynomial equations of order up to four - quadratic formula.Cardano's method for solving cubic equations.Ferrari's method (for quadratic equations). Remarks about the insolvability of equations of degree five or more.Finding the nature of roots without solving Descartes' rule of signs.

Module II (16 hrs)

Elementary transformation, reduction to normal form, row reduced echelon form.Computing the inverse of a non singular matrix using elementary row transformation.

Module III (20 hrs)

System of linear homogeneous equations.Null space and nullity of matrix. Sylvester's law of nullity.Range of a matrix.Systems of linear non homogeneous equations. Characteristic roots and characteristic vectors of a square matrix. Some fundamental theorem.Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices.Characteristic equation of a matrix, Cayley- Hamilton theorem

Module IV (24 hrs)

Lines and planes in space. Cylinders and Quadric surfaces, Cylindrical and spherical coordinates, Vector valued functions and space curves, Arc length and Unit tangent vector , Curvature, torsion and TNB frame

Textbooks :

1. Bernard and Child: Higher Algebra, Macmillan

2.Shanti Narayanan &Mittal : A Text Book of Matrices, Revised edn., S. Chand

3. Thomas /Finney : Calculus, 9th ed., LPE, Pearson Education

Reference Books:

1.Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.

2.ManicavachagomPillai, Natarajan, Ganapathy- Algebra

3.Dickson: First Course in Theory of Equation

4. Frank Ayres, Jr. : Matrices, Schaum's Outline Series, Asian Student edition.

5. Devi Prasad : Elementary Linear Algebra, Narosa Pub. House.

6. Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.

7. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,

OBJECTIVE

- Learn to find the roots of polynomial equations up to degree 4, insolvability of equations of degree 5 or more.
- To compute the inverse of a non singular matrix using elementary row transformations.
- To understand about the characteristic equation and characteristic root of a matrix.
- Learn to use matrix to solve system of linear equations.
- Understand the basics of vector algebra
- Learn inner product, vector product and scalar triple product.
- Understand the concept of cylindrical and spherical coordinates.
- Learn about the plane and curves in space.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **30 Hours**	Polynomial Equations and Fundamental Theorem of Algebra. Applications of the Fundamental theorem to equations having one or more complex roots, Rational roots or multiple roots. Relations between roots and co-efficients of a	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to find roots of polynomial equations. • Seminar on the topic Transformat	• Learned to solve polynomials using cardan's method, Ferrari methods etc	Evaluation through test paper.

	polynomial equation and computation of symmetric functions of roots.Finding equations whose roots are functions of the roots of a given equation. Reciprocal equation and method of finding its roots. Analytical methods for solving polynomial equations of order up to four - quadratic formula.Cardano's method for solving cubic equations.Ferrari's method (for quadratic equations). Remarks about the insolvability of equations of degree five or more.Finding the nature of roots without solving Descartes' rule of signs.		ion of equations.		
Module II **16 Hours**	Elementary transformation, reduction to normal form, row reduced echelon form.Computing the inverse of a non singular matrix using elementary row transformation.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to find the inverse of a non singular matrix using elementary row transformation .	• Learn to determine wether a matrix is singular or non singular • Learn to find out the rank of a matrix.	Evaluation through test paper.
Module III **20 Hours**	System of linear homogeneous equations.Null space	• Lecture • Discussion • Participative	• Seminar on the topic related to	• Understand to solve system of equation	Evaluation through Test paper

	and nullity of matrix. Sylvester's law of nullity. Range of a matrix.Systems of linear non homogeneous equations. Characteristic roots and characteristic vectors of a square matrix. Some fundamental theorem. Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices. Characteristic equation of a matrix, Cayley- Hamilton theorem	learning • Problem solving	vector space of n-tuples. • Assignments to solve system of equations.	using matrix • Learn about characteristic roots and vectors.	
Module IV **24 Hours**	Lines and planes in space. Cylinders and Quadric surfaces, Cylindrical and spherical coordinates, Vector valued functions and space curves, Arc length and Unit tangent vector , Curvature, torsion and TNB frame	• Lecture • Discussions • Problem solving	• Group discussion on Cylindrical and spherical coordinates.	• Learn basic results in vector algebra.	Evaluation through test paper

Course Outcomes

CO1	Learned to find out the roots of polynomial equations.
CO2	Computed the inverse of a non singular matrix using elementary row transformations.
CO3	Understand about the characteristic equation and characteristic root of a matrix.
CO4	Understand the method of Gauss-Jordan elimination to find the solutions of systems of simultaneous linear equations and Learned to solve a system of linear equations by row-reduced echelon form.
CO5	Understand the basic concepts in vector algebra.

Teacher in Charge:

Krishnamol Ravindran

ST1CO1 BASIC STATISTICS AND PROBABILITY

Lecture Hours per week: 4, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

Introduce basic concepts of statistics and to understand various approaches to probability and compute probabilities.

Module I (20 hrs)

Population, sample, measures of central tendency - arithmetic mean, weighted arithmetic mean, geometric mean, harmonic mean, median, mode, partition values - quartile, percentile, measures of deviations - variance, standard deviation, mean deviation about mean, quartile deviation, co-efficient of variation

Module II (15 hrs)

Fitting of straight line, parabola, exponential, polynomial, (least square method), correlation, regression, two regression lines, regression coefficients, properties - rank correlation, partial and multiple correlation

Module III (25 hrs)

Random experiment, Sample space, event, classical definition of probability, statistical regularity, relative frequency definition, field, sigma field, axiomatic definition of probability and simple properties, concept of probability measure, addition theorem(two and three events), conditional probability of two events, multiplication theorem, independence of events(pair wise and mutual), Bayes theorem. –numerical problems

Module IV (12 hrs)

Random variable- discrete and continuous, probability mass function (pmf) and probability density function (pdf) properties and examples, Cumulative Distribution function and its properties , change of variable (univariate case)

Reference Books:

1) V. K. Rohatgi, An Introduction to Probability Theory and Mathematical

Statistics, Wiley Eastern.

2) S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chan and Sons

3) A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill

4) John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

OBJECTIVES

1) To understand the basic concepts of population and sample
2) To summarize the data in a diagrammatic and graphical way, obtain descriptive statistics and make possible and appropriate interpretations
3) To understand various approaches to probability and compute probabilities.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	Population, sample, measures of central tendency, measures of deviations	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on methods of sampling	To understand advantages and limitations of sampling	Evaluation through test paper
Module II **15 Hours**	Fitting of straight line , parabola, exponential, polynomial, correlation, regression, two regression lines,	• Lecture • Discussion • Participative learning • Problem solving	• Students seminar related to curve fitting	To solve problems related to curve fitting	Evaluation through test paper

	regression coefficients, properties - rank correlation, partial and multiple correlation				
Module III **25 Hours**	Random experiment, Sample space, event, classical definition of probability, axiomatic definition of probability and simple properties, addition theorem, conditional probability of two events, multiplication theorem, independence of events, Bayes theorem	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to compute probabilities	To understand basic definition and properties of probability	Evaluation through test paper and viva
Module IV **12 Hours**	Random variable- discrete and continuous, probability mass function and	• Lecture • Discussions • Problem solving	• Student seminars on probability mass function , probability	To understand discrete and continuous random variables	Evaluation through test paper

	probability density function , Cumulative Distribution Function and its properties change of variable		density function and their properties		

Course Outcomes

CO1	To understand advantages and limitations of sampling
CO2	To summarize the data in a diagrammatic and graphical way, obtain descriptive statistics and make possible and appropriate interpretations
CO3	To understand various approaches to probability and compute probabilities
CO4	To understand discrete and continuous random variables and their probability functions

Teacher in Charge:

Ms. Ross Flower

ST2CO2 : PROBABILITY DISTRIBUTIONS

Lecture Hours per week: 4, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce the idea about mathematical expectation and conditional probability of univariate, Bivariate random variable, Also the standard distribution and its properties.

Module I (15 hrs)

Mathematical expectations (univariate): Definition, raw and central moments (definition and relationships), moment generating function and properties, characteristic function (definition and use only), Skewness and kurtosis (using moments)

Module II (15 hrs)

Bivariate random variable: joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.

Module III (30 hrs)

Standard distributions: Discrete type Bernoulli, Binomial, Poisson, Geometric, negative binomial (definition, properties and applications), Uniform (mean, variance and mgf), Continuous typeUniform, exponential, gamma, Beta, Normal (definition, properties and applications), Lognormal, Pareto and Cauchy (Definition only).

Module IV (12 hrs)

Chebyshev's inequality, variables, Convergence in probability weak law of large numbers (iid case), Bernoulli law of large numbers, example only), Central limit theorem (Lindberg Levyiid case).

Reference Books:

1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill
4. John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

OBJECTIVES

1. Discribe the moments, mgf, expectations, characteristic function, Skewness , kurtosis of univariate and bivariate random variable.
2. Give the knowledge of important discrete and continuous distributions such as Binomial, Poisson,

   Geometric, Negative Binomial and Hyper-geometric, normal, uniform, exponential, beta and gamma distributions
3. Understand the Concept of law large numbers and their uses.
4. Understand the Concept of central limit theorem and its uses.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **15 Hours**	Mathematical expectations (univariate): Definition, raw and central moments (definition and relationships), moment generating function and properties, characteristic function (definition and use only), Skewness and kurtosis (using moments)	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to mathematical expectation, raw and cenral moments, mgf	• Understand the definition of moments, mgf , characteristic function, Skewness and kurtosis	Evaluation through test paper
Module II **15 Hours**	Bivariate random variable: joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars on the topic bivariate Expectations, conditional mean variance, and covariance.	• Give knowledge related to the concept of Bivariate random variable including expectation moments and mgf.	Evaluation through test paper

Module III 30 Hours	Standard distributions: Discrete type Bernoulli, Binomial, Poisson, Geometric, negative binomial, Uniform, Continuous typeUniform, exponential, gamma, Beta, Normal, Lognormal, Pareto and Cauchy.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on discrete and Continuous distribution.	• Enable to understand different type of distribution.	Evaluation through test paper
Module IV 12 Hours	Chebyshev's inequality, variables, Convergence in probability weak law of large numbers (iid case), Bernoulli law of large numbers, example only), Central limit theorem (Lindberg Levyiid case).	• Lecture • Discussion • Participative learning • Problem solving	• Assignment on the topic sample mean and variance.	• Understand the weak law of large numbers, Bernoulli law of large numbers, Central limit theorem and its applications	Evaluation through test paper and viva

Course Outcomes

CO1	Understand the concept of uni variate, Bivariate Discrete and continuous random variable including expectation, moments and mgf.
CO2	Enable one to identify and classify different type of standard distribution.
CO3	Understand the weak law of large numbers, Bernoulli law of large numbers, Central limit theorem and its applications.

Teacher in Charge:

Ms Mariya

ST3CO3: STATISTICAL INFERENCE
Lecture Hours per week: 5, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

Introduce different type of sampling distributions and the concept of testing hypotheses.

Module I (25 hrs)

Sampling distributions: Statistic, Sampling distribution of a statistic, Standard error, Sampling from normal distribution, distribution of sample mean, sample variance, chisquare distribution, t distribution, and F distribution (definition, derivations and relationships only).

Module II (20 hrs)

Theory of Estimation: Point Estimation, desirable properties of a good estimator, unbiasedness, consistency, sufficiency, Fisher Neyman factorization theorem, efficiency. Methods of Estimation: Method of maximum likelihood, method of moments

Module III (15 hrs)

Interval Estimation: Interval estimates of mean, difference of means, variance, proportions and difference of proportions. Derivation of exact confidence intervals for means, variance and ratio of variances based on normal, t, chi square and F distributions

Module IV (30 hrs)

Testing of Hypotheses: concept of testing hypotheses, simple and composite hypotheses, null and alternative hypotheses, type I and II errors, critical region, level of significance and power of a test. Neyman Pearson approach: Large sample tests concerning mean equality of means, proportions, equality of proportions, Small sample tests based on t distribution for mean, equality of means and paired t test. Tests based on Fdistribution for ratio of variances. Tests based on Chi square distribution for variance, goodness of fit and for independence of attributes.

Reference Books:

1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill
4. John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

OBJECTIVES

- Introduce different type of sampling distributions.

- Introduce the concept of random sample from a distribution, sampling distribution of a statistic, standard error of important estimates such as mean and proportions
- knowledge about important inferential aspects such as point estimation, test of hypotheses and associated concepts
- Introduce Neyman Pearson approach in testing of hypotheses.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **25 Hours**	Statistic, Sampling distribution of a statistic, Standard error, Sampling from normal distribution, distribution of sample mean, sample variance, chisquare distribution, t distribution, and F distribution	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on chisquare distribution, t distribution, and F distribution.	• Understand different type of sampling distributions.	Evaluation through test paper
Module II **20 Hours**	Point Estimation, desirable properties of a good estimator, unbiasedness, consistency, sufficiency, Fisher Neyman factorization theorem, Method of maximum likelihood,	• Lecture • Discussion • Participative learning • Problem solving	• Seminar on the topic Method of maximum likelihood and method of moments.	• Understand point estimation methods.	Evaluation through test paper.

	method of moments.				
Module III **15 Hours**	Interval estimates of mean, difference of means, variance, proportions and difference of proportions. Derivation of exact confidence intervals for means, variance and ratio of variances based on normal, t, chi square and F distributions	• Lecture • Discussion • Participative learning • Problem solving	• Seminar related to the topic difference of means, variance, and difference of proportions.	• Understand Interval estimation methods	Evaluation through Group Discussion.
Module IV **30 Hours**	concept of testing hypotheses, simple and composite hypotheses, null and alternative hypotheses, type I and II errors, critical region, level of significance and power of a test. Large sample tests, proportions, equality of proportions, Small sample tests based on t distribution for mean, equality of means and paired t test. Tests based on Fdistribution for ratio	• Lecture • Discussions • Problem solving	• Student seminars in connection with type I and II errors.	• Become familiar with the concept of testing hypotheses and different sample tests.	Evaluation through test paper

	of variances. Tests based on Chi square distribution for variance, goodness of fit and for independence of attributes.				

Course Outcomes

CO1	Understnd different sampling distribution and its properties.
CO2	Understand the tecniques of estimation and testing hypotheses for mean, variance, proportions, correlation coefficient, association and goodness of fit.
CO3	Knowledge of point and interval estimation proceduers and different method of point estimation.

Teacher in Charge:

Ms Sruthy V

ST4CO4 APPLIED STATISTICS

Lecture Hours per week: 5, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce sampling techniques and statistical quality control

Module I (20 hrs)

Census and Sampling, Principal steps in a sample survey, different types of sampling, Organisation and execution of large scale sample surveys, errors in sampling(sampling and non sampling errors), preparation of questionnaire, simple random sampling with and without replacement, Systematic, stratified and cluster sampling

Module II (15 hrs)

Analysis of variance; one way, two way classifications. Null hypothesis, total, between and within sum of squares. Assumptions - ANOVA table..

Module III (30 hrs)

Time series : Components of time series additive and multiplicative models , measurement of trend , moving averages, seasonal indicessimple averageratio to moving average., Index numbers: meaning and definition uses and types - problems in the construction of index numbers -different types of simple and weighted index numbers. Test for an ideal index number - time and factor reversal test.

Module IV (25 hrs)

Statistical Quality Control: Concept of statistical quality control, assignable causes and chance causes, process control, Construction of control charts, 3sigma limits, Control chart for variables -Mean chart and Range chart, Control chart for attributes - pchart, d or np chart and c chart

Reference Books:

1) S.C.Gupta and V. K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand and Sons

2) Grant E L, Statistical quality control, McGraw Hill

3) Duncan A J, Quality Control and Industrial Statistics, Taraporewala and sons

4) Montegomery D C, Introduction to Statistical Quality Control, John Wiley and sons

5) S.P.Gupta: statistical methods

OBJECTIVES

1) To equip students with sampling techniques used in conducting sample surveys.
2) To understand the concepts of ANOVA model
3) To expose the area of time series and index numbers.
4) To provide an insight into quality assessment techniques.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	Census and Sampling, Principal steps in a sample survey, different types of sampling, Organisation and execution of large scale sample surveys, sampling and non sampling errors, simple random sampling with and without replacement, Systematic,	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on sampling and sample survey	To understand sampling techniques used in conducting sample surveys	Evaluation through test paper

	stratified and cluster sampling				
Module II **15 Hours**	Analysis of variance; one way, two way classifications, Null hypothesis, Assumptions - ANOVA table..	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding variance between the samples	To understand the concepts of ANOVA model	Evaluation through test paper and viva
Module III **30 Hours**	Time series, Components of time series, measurement of trend, moving averages, seasonal indices, Index numbers, different types of simple and weighted index numbers, time and factor reversal test.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars related to components of time series	To understand time series, seasonal indices and index numbers	Evaluation through MCQ and Group Discussion
Module IV **25 Hours**	Statistical Quality Control, assignable causes and chance causes, process control, Construction of	• Lecture • Discussions • Problem solving	• Assignment to construct control charts	To understand statistical quality control and its uses	Evaluation through test paper

	control charts, 3sigma limits, Control chart for variables- Mean chart and Range chart,Control chart for attributes- pchart, d or np chart and c chart				

Course Outcomes

CO1	To understand sampling techniques used in conducting sample surveys
CO2	To understand the concepts of ANOVA model
CO3	To learn the concepts of time series and index numbers
CO4	To provide an insight into quality assessment techniques.

Teacher in Charge:

Ms. Rossflower

MAT5B06 : ABSTRACT ALGEBRA

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To introduce the basic concept of the nature of abstract algebra also gives the idea of group and ring.

Module I (20 hrs)

Binary operations, Isomorphic binary structures, Groups, Sub groups

Module II (25 hrs)

Cyclic groups, Groups and permutations, Orbits, cycles and Alternating groups

Module III (15 hrs)

Cosets and Theorem of Lagrange, Homomorphisms

Module IV (30hrs)

Rings and Fields, Integral Domains, The Field of Quotients of an Integral Domain

Textbooks :

John B. Fraleigh : A First Course in Abstract Algebra, 7th Ed., Pearson.

Reference Books:

1. Joseph A. Gallian : Contemporary Abstract Algebra. Narosa Pub. House.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: Basic Abstract Algebra, 2nded., Cambridge University
3. Artin : Algebra, PHI.
4. Durbin : Modern Algebra : An Introduction, 5th ed., Wiley.

OBJECTIVES

1) To enable one to determine whether the given binary operation on a given set forms a group.
2) To understand the concept of subgroups.
3) To describe all elements of a cyclic group using generators.
4) To enable one to understand the homomorphism and Theorem of Lagrange.
5) To understand the concept of rings, fields and integral domains.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	Binary operations, Isomorphic binary structures, Groups; Sub groups	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Binary operation.	• Enable to understand the concept of Groups.	Evaluation through test paper
Module II **25 Hours**	Cyclic groups, Groups and permutations, Orbits, cycles and Alternating groups	• Lecture • Discussion • Participative learning • Problem solving	• Assignments on permutation and orbits.	• enable one to compute the expression of permutation and permutation multiplication • Enable to understand different type of groups.	Evaluation through test paper
Module III **15 Hours**	Cosets and Theorem of Lagrange, Homomorphism	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of homomorphism • Peer group discussion on	• Understand the theorem Lagrange and homomorphism.	Evaluation through test paper

			Cosets.		
Module IV **30 Hours**	Rings and Fields, Integral Domains, The Field of Quotients of an Integral Domain	• Lecture • Discussion • Participative learning • Problem solving	• Seminar on the topic Rings and fields.	• To understand the concept of rings and fields • Learn the concept of Integral domain.	Evaluation through test paper and viva

Course Outcomes

CO1	Understand the concept of binary operation on a given set.
CO2	To get the idea of groups, rings, fields and integral domain.
CO3	Understand different type of groups like cyclic and alternating groups
CO4	Understand the homomorphism and Theorem of Lagrange

Teacher in Charge:

Geethu simon

MAT5B07: BASIC MATHEMATICAL ANALYSIS

Lecture Hours per week: 6, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To develop ability to analyze and prove statements of mathematics using logical arguments.

Module I (20 hrs)

A quick review of sets and functions, Mathematical induction, Finite and infinite sets, Real Numbers, The algebraic property of real numbers.

Module II (24 hrs)

Absolute value and real line, The completeness property of R, Applications of supremum property, Intervals, Nested interval property and uncountability of R.

Module III (30 hrs)

Sequence of real numbers, Sequence and their limits, Limit theorems, Monotone sequences, Subsequence and Bolzano – Weirstrass theorem, Cauchy criterio,Properly divergent sequences, Open and closed sets.

Module IV (34 hrs)

COMPLEX NUMBERS: Sums and Products, Basic Algebraic properties, Further properties, Vectors and Moduli, Complex Conjugates, Exponential form, Product and powers in exponential form, Arguments of products and quotients, Roots of complex numbers, Regions in the complex plane, Functions of complex variable, Limits, Theorems on limits, Limits involving the points at infinity, Continuity.

Textbooks:

1) **Robert G. Bartle & Donald R. Sherbert**: Introduction to Real Analysis, 3rded., Wiley.
2) **J.W. Brown and Ruel V. Churchill**: Complex Variables and Applications, 8th Ed., McGraw Hill.

Reference Books:

1) J.M. Howie : Real Analysis, Springer 2007.

2) Ghorpade and Limaye : A Course in Calculus and Real Analysis, Springer, 2006.
3) K.A. Ross : Elementary Real Analysis : The Theory of Calculus, Springer Indian Reprint.
4) J.V. Deshpande : Mathematical Analysis and Applications, Narosh Pub. House.
5) M.R. Spiegel : Complex Variables, Schaum's Outline Series.

OBJECTIVES

1) To learn to prove Archimedean property, density theorem, existence of a positive square root for positive numbers and so on and the learning will help them to appreciate the beauty of logical arguments.
2) To learn how monotone convergence theorem can be used in establishing the divergence of the harmonic series, how it helps in the calculation of square root of positive numbers and how it establishes the existence of the transcendental number e.
3) To understand the concept of open and closed sets, their properties, their characterization and so on.
4) To familiarize the use of geometry, comparison between real and complex calculus-areas

LESSON PLAN

Unit/ Hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	A quick review of sets and functions ,Mathematical induction, Finite and infinite sets Real Numbers, The algebraic property of	• Lecture • Discussion • Participative learning • Problem solving	Group discussion on Algebraic properties of R.	To generate the ability to analyze and prove statements of Mathematics.	Evaluation through test paper

	real numbers.				
Module II **24 Hours**	Absolute value and real line, The completeness property of R, Applications of supremum property Intervals, Nested interval property and uncountability of R.	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Completeness Property of R.	To master different techniques of finding limits.	Evaluation through test paper
Module III **30 Hours**	Sequence of real numbers, Sequence and their limits, Limit theorems, Monotone sequences, Subsequence and Bolzano – Weirstrass theorem, Cauchy criterio, Properly divergent sequences, Open and closed sets.	• Lecture • Discussion • Participative learning • Problem solving	• Assignment in Limit Theorems. • Discussion on Open and Closed Sets.	To familiarize with different kinds of sequences.	Evaluation through testpaper and Viva
Module IV **34 Hours**	Sums and Products, Basic Algebraic properties, Further properties, Vectors and Moduli, Complex Conjugates, Exponential form, Product and powers in exponential form, Arguments of products and quotients, Roots of	• Lecture • Discussions • Problem solving	Student seminars to familiarize properties of Complex Numbers.	To understand areas where real and complex calculus agree and where they differ.	Evaluation through testpaper

	complex numbers, Regions in the complex plane, Functions of complex variable, Limits, Theorems on limits, Limits involving the points at infinity, Continuity.				

Course Outcomes

CO1	To appreciate the beauty of logical arguments and embolden them to apply it in similar and unknown problems.
CO2	To establish the divergence and convergence of different sequences and series.
CO3	To understand some basic topological properties of real number system.
CO4	To demystify student's belief that complex variable theory is incomprehensible.

Teacher in Charge:

M D Varghese

MAT5B08: DIFFERENTIAL EQUATIONS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To find out ways and means for solving differential equations.

Module I (24 hrs)

Some Basic Mathematical Models: Direction Fields, Solutions of some Differential equations, Classification of Differential Equations, Historical Remarks, First order differential equations: Linear equations with variable coefficients, Separable equations, Modeling with first order equations, Differences between linear and non linear equations, Exact equations and integrating factors, The existence and uniqueness theorem.

Module II (29 hrs)

Second Order Linear Differential Equations: Homogeneous equation with constant coefficients, Fundamental solutions of Linear Homogeneous equations, Linear independence and Wronskian, Complex roots of characteristic equations, Repeated roots Reduction of order, Non homogeneous equations, Method of Undetermined coefficients, Variation of parameters, Mechanical and Electrical vibrations, Systems of First Order Linear equations: Introduction, Basic theory of systems of first order Linear Equations.

Module III (17 hrs)

Definition of Laplace Transforms , Solution of Initial Value Problem , Step functions , Impulse functions, The Convolution Integral.

Module IV (20 hrs)

Two point Boundary value problems , Fourier Series, The Fourier Convergence Theorem, Even and odd functions , Separation of variables; Heat conduction in a rod , The Wave equation, Vibrations of an elastic string.

Textbooks:

1) Thomas / Finney : Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1) Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.
2) H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,Universal Book Stall, New Delhi.

OBJECTIVES

1) To learn to solve DEs that are in linear, separable and in exact forms and also to analyze the solution.
2) To be familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.
3) To acquire the knowledge of solving a differential equation using Laplace method.
4) To get familiarized with Fourier series and its applications.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **24 Hours**	Some Basic Mathematical Models, First order differential equations	• Lecture • Discussion • Participative learning • Problem solving	Assignment on solving first order differential equations.	To learn to solve DEs that are in linear, separable and in exact forms and also to analyze the solution.	Evaluation through test paper

Module II **29 Hours**	Second Order Linear Differential Equations, Systems of First Order Linear equations	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Completeness Property of R.	To be familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.	Evaluation through test paper
Module III **17 Hours**	Laplace Transforms	• Lecture • Discussion • Participative learning • Problem solving	Assignment in solving Differential equations using Laplace transforms.	To acquire the knowledge of solving a differential equation using Laplace method.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Partial Differential Equations and Fourier Series	• Lecture • Discussions • Problem solving	Student seminars in applications of Fourier Series.	To get familiarized with Fourier series and its applications.	Evaluation through testpaper

Course Outcomes

CO1	Students could identify a number of areas where the modelling process results in a differential equation.
CO2	They will realize the basic differences between linear and non linear DEs and also basic results that guarantees a solution in each case.
CO3	They will become familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.
CO4	Students acquire the knowledge of solving a differential equation using Laplace method which is especially suitable to deal with problems arising in engineering field.

Teacher in Charge:

Sruthy V

MAT5D02: MATHEMATICS FOR NATURAL SCIENCES

Lecture Hours per week: 2 Credits: 2

Internal: 10, External: 40, Examination 2 Hours

Objectives

To get introduced to statistical measures and analysis.

Module I (20 hrs)

The idea of sets, Operation on sets, Relations and functions, Variables and graphs, Frequency distributions, The Mean, Median, Mode and other measures of central tendency, Dispersion or variation, The Range, The Mean deviation, The Semi- inter quartile range, The 10- 90 Percentile range.

Module II (16 hrs)

The standard deviation, Properties of Standard Deviation, The variance, Short methods of computing standard deviation, Moments, Moments for grouped data, relation between moments, Computation of moment for grouped data. Skewness and Kurtosis.

Textbooks :

Murray R. Spiegel : Statistics, 2nd Edn., Schaum's Outline Series.

Reference Books:

1) Hogg & Craig: Introduction to Mathematical Statistics.
2) Freund & Walpole: Mathematical Statistics

OBJECTIVES

1) To understand different measures of tendency.
2) To analyse data using measures like SD, Skewness and Kurtosis.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **18 Hours**	Sets, Frequency Distribution, Measures of Tendency	• Lecture • Discussion • Participative learning • Problem solving	Assignment on different measures of tendency.	To understand which measure is better for different kinds of data.	Evaluation through test paper and viva
Module II **12 Hours**	Standard Deviation, Moments, Skewness and Kurtosis.	• Lecture • Discussion • Participative learning • Problem solving	Student seminars on Skewness and Kurtosis on different datas.	To visualize how the data behaves.	Evaluation through test paper

Course Outcomes

CO1	Students get an understanding about the use of some statistical tools.
CO2	They learn to analyze data using different measures.

Teacher in Charge:

Rossflower

MAT5B05: VECTOR CALCULUS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To Provide skils to visualize and manipulate multivariable and vector values functions. Also enable students to evaluate multiple integrals.

Module I (15 hrs)

Functions of several variables, Limits and Continuity, Partial derivatives, Differentiability linearization and differentials, Chain rule, Partial derivatives with constrained variables.

Module II (20 hrs)

Directional derivatives, gradient vectors and tangent planes, Extreme value and saddle points, Lagrange multipliers, Taylor's formula, Double Integrals, Double integrals in polar form.

Module III (25 hrs)

Triple integrals in Rectangular Coordinates, Triple integrals in cylindrical and spherical coordinates, Substitutions in multiple integrals, Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields.

Module IV (30hrs)

Green's theorem in the plane, Surface area and surface integrals, Parametrized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).

Textbooks :

Thomas / Finney : Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1. Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.
2. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,

OBJECTIVES

1) To enable one to apply the basic concepts of partial derivatives.
2) To learn to find multiple integrals.
3) To understand concept of the integrals of the functions and vector fields over parametrized surfaces and compute them in simple examples.
4) To calculate directional derivatives and gradients.
5) To learn application of greens theorem and stokes theorem.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **15 Hours**	Functions of several variables, Limits and Continuity, Partial derivatives, Differentiability linearization and differentials, Chain rule, Partial derivatives with constrained variables.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Partial derivatives.	• Enable to find partial derivatives.	Evaluation through test paper
Module II **20 Hours**	Directional derivatives, gradient vectors and tangent planes, Extreme value and saddle points, Lagrange multipliers, Taylor's formula, Double Integrals, Double integrals in polar	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding Directional derivatives and double integrals.	• Enable to evaluate double integrals.	Evaluation through test paper

	form.				
Module III **25 Hours**	Triple integrals in Rectangular Coordinates, Triple integrals in cylindrical and spherical coordinates, Substitutions in multiple integrals, Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain vector fields, work and circulation	Understand triple integrals and vector fields.	Evaluation through MCQ and Group Discussion
Module IV **30 Hours**	Green's theorem in the plane, Surface area and surface integrals, Parametrized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to Surface integrals.	Learn the application of greens theorem and stokes theorem in multiple integrals.	Evaluation through test paper

Course Outcomes

CO1	Understand the basic concept of partial derivatives.
CO2	Enable to calculate multiple integrals.
CO3	Understand the concept of a conservative vector field
CO4	Learn the application of greens theorem and stokes theorem in multiple integrals and understand how they are generalizations of the Fundamental theorem of calculus.

Teacher in Charge:

Ms. Mariya

MAT6B10 : COMPLEX ANALYSIS

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To learn basic concepts of complex analysis and its applications.

Module I : Analytic Functions (15 hrs)

Derivatives, Differentiation formula, Cauchy-
Riemann Equations, Polar coordinates, Analytic functions, Harmonic functions , Elementary functions , The exponential function, Logarithmic function, Complex exponents, Trigonometric functions, Hyperbolic f unctions, Inverse Trigonometric and Hyperbolic functions.

Module II : Integrals (25 hrs)

Derivatives of functions $\omega(t)$; Indefinite integral of $\omega(t)$; Contours, Contour integrals, Antiderivatives, Cauchy -
Goursat theorem (without proof), Simply and multiply connected domains, Cauchy's integral formula and its e xtension, Liouville's theorem and fundamental theorem of algebra, Maximum modulus principle.

Module III : Series (25 hrs)

A quick review of convergence of sequence and series of complex numbers,Taylor series, Laurents series (wi thoutproof), Applications,Power series: Absolute and uniform convergence,Continuity of sum of powerseries, Differentiation and integration of power series, Multiplication and division of power series.

Module IV : Residues (25 hrs)

Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, Three types of isolated

singular points, Residues at poles, Zeroes of analytic functions, Zeroes and poles,Applications of residues, E valuation of improper integrals, Jordan's Lemma (statement only), Definite integrals involving sines and cosi nes.

Textbooks :

1) **James Ward Brown and Ruel V. Churchill** : Complex Variables and Applications (8th Edn.), McGraw Hill.

Reference Books:

1) Mark J.Ablowitz and Anthanassios S. Fokas: Complex Variables, Cambridge Text, 2nd Edn

2) S. Ponnusamy : Foundation of Complex Analysis : Narosa.

3) Murray R. Spiegel: Complex Variables, Schaum's Outline series.

4) J.M. Howie: Complex Analysis: Springer India Reprint

5) Stewart & Tall: Complex Analysis, CUP

OBJECTIVES

1) To develop differentiability and analyticity of complex valued functions
2) To develop complex integration
3) To represent an analytic function as power series.
4) To classify the singular points using Laurent series and develop the concept of residues and its applications.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **15 Hours**	Derivatives, Cauchy- Riemann Equations,Analytic functions,Harmonic functions ,	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding harmonic conjugates	To understand the difference between differentiability and analyticity	Evaluation through test paper

	Exponential , Logarithmic, Trigonometric , Hyperbolic , Inverse Trigonometric and Hyperbolic functions				
Module II **25 Hours**	Derivatives ofω(t), Indefinite integral of ω(t); Contours, Contour integrals, Antiderivatives, Cauchy-Goursat theorem , Simplyandmultiply connected domains, Cauchy's integralformula and its extension, Liouville's theorem and fundamental theorem of algebra, Maximum modulus principle.	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on contour integrals	To understand integration of complex functions and related theorems	Evaluation through test paper and viva
Module III **25 Hours**	Convergence of sequence and series of complex numbers ,Taylor series, Laurents series , Absolute and Uniform convergence,	• Lecture • Discussion • Participative learning • Problem solving	• Student seminar to explain absolute and uniform convergence of power series	To understand Taylor series and Laurent series	Evaluation through Test paper and Group Discussion

	Continuity of sum of powerseries, Differentiation and integration of power series, Multiplication and division of power series.				
Module IV **25 Hours**	Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, Three types of isolated singular points, Residues at poles, Zeroes of analytic functions, Zeroes and poles, Applications of residues, Evaluation of improper integrals, Jordan's Lemma , Definite integral involving sines and cosines.	• Lecture • Discussions • Problem solving	• Assignments in finding isolated singular points and residues	To understand isolated singular points, residues and applications of residues	Evaluation through test paper

Course Outcomes

CO1	To understand difference between differentiability and analyticity of complex valued functions.
CO2	To learn indefinite integrals of complex valued functions.
CO3	Learn to express an analytic function as a power series.
CO4	To understand the concepts of singular points, residues, and applications of residues.

Teacher in Charge:

Geethu Simon

MAT6B13(E02) : LINEAR PROGRAMMING

Lecture Hours per week: 3, Credits: 2

Internal: 20, External: 80, Examination 3 Hours

Objectives

Formulate our real life problem into a mathematical model also different techniques to solve LPP are introduced.

Module I (16 hrs)

Formulation, Convex sets, General LLP

Module II (14 hrs)

Simplex Method, Duality

Module III (18 hrs)

The transportation problem, The assignment Problems

Textbooks :

Gupta and Manmohan - Linear Programming And Theory of Games

Reference Books:

1. . K. V. Mital&Manmohan: Optimization methods in Operations Research and Systems Analysis, 3rdEdn., New Age International publishers.
2. DipakChatterjee: Linear Programming and Game Theory, Prentice Hall of India.

OBJECTIVE

1. Enable to formulate LPP from real life problem
2. Conceptulize the feasible region, feasible solution, optimal solution etc.
3. Solve the LPP with two variables using graphical method
4. Solve the LPP using simplex method
5. Formulate the dual problem from primal
6. Solve transportation problem and the assignment Problems which are relevent in daily life.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **16 Hours**	Formulation, Convex sets, General LLP	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on formulation of lpp. • Seminar on the topic convex sets.	• Understand to formulate lpp.	Evaluation through test paper
Module II **14 Hours**	Simplex Method, Duality	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in solving LPP using simplex method.	• Understand to solve lpp in finite number of steps using simplex method.	Evaluation through test paper and viva
Module III **18 Hours**	The transportation problem, The assignment Problems	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to solve transportation problems and assignment problems	• Enable one to solve transportation problem and the assignment Problems which are relevent in daily life.	Evaluation through Test paper and Group Discussion

Course Outcomes

Course Outcomes

CO1	Enable one to formulate LPP from real life problem.

CO2	Solve the LPP with two variables using graphical method
CO3	Solve the LPP using simplex method
CO4	Solve transportation problem and the assignment Problems which are relevent in daily life.

Teacher in Charge:

Ms Nikita PB

MAT6B12 : NUMBER THEORY AND LINEAR ALGEBRA

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To study about the integers and integer valued functions. Also introduce the concept of vector fields and linear transformations.

Module I (30 hrs)

Divisibility theory in the integers – the division algorithm, the greatest common divisor, the Euclidean algorithm, the Diophantine equation ax + by = c. Primes and their distribution. The fundamental theorem of arithmetic.The sieve of Eratosthenes. The theory of congruences.Basic properties of congruence.Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem

Module II (25 hrs)

Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors.The greatest integer function.Euler's phi-function.Euler's generalization of Fermat's theorem.Properties of the phi-function.

Module III (15 hrs)

Vectorspaces-examples, linearcombinations, spanning, linearindependence, base, finite dimensional vector spaces.

Module IV (20 hrs)

Linear mappings- Linear transformations, examples, nullspace, rank –nullity theorem, linear isomorphism

Textbooks :

1. David M. Burton : Elementary Number Theory, Sixth Edn., TMH.

2. T. S. Blynth and E.F. Robertson: Basic Linear Algebra, second Edn springer under graduate mathematics series 2009

Reference Books:

1. C.Y. Hsiung : Elementary Theory of Numbers. Allied Publishers.

2. Neville Robbins : Beginning Number Theory, Second Ed. Narosa.
3. George E. Andrews : Number Theory, HPC.
4. Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.
5. Frank Ayres, Jr. : Matrices, Schaum's Outline Series, Asian Student edition.
6. Devi Prasad : Elementary Linear Algebra, Narosa Pub. House

OBJECTIVE

1. Enable to find gcd using Euclidean algorithm.
2. To understand the solution of diophantine equations.
3. Enable to solve system of congruence using chinese remainder theorem.
4. To learn Wilson's theorem, Fermat's little theorem and Euler's theorem
5. Understand the concept of vector space and its basis.
6. Understand the concept of linear transformation and application of rank nullity theorem.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I 30 Hours	The division algorithm, Gcd, the Euclidean algorithm, the Diophantine equation. Primes and their distribution. The fundamental theorem of arithmetic. The sieve of Eratosthenes. The theory of congruences. Basic	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on gcd and euclidean algorithm. • Assignment in finding solution of system of congruence using chinese remainder theorem	• Understand the linear congruence and the method for finding its solutions.	Evaluation through test paper

	properties of congruence. Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem.				
Module II **25 Hours**	Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors. The greatest integer function. Euler's phi-function. Euler's generalization of Fermat's theorem. Properties of the phi-function.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding sum and number of divisors • Seminar on the topic Euler's phi-function and Properties of the phi-function.	• Understand fermat's theorem, wilson's theorem, euler's theorem and its applications.	Evaluation through test paper and viva
Module III **15 Hours**	Vectorspaces- examples, linearcombinations, spanning, linearindependence, base, finite dimensional vector spaces.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to vector space and its example.	• Understand the definition of vector space and its basis.	Evaluation through MCQ and Group Discussion
Module IV **20 Hours**	Linear mappings- Linear transformations, examples, nullspace, ranknullity theorem, linear isomorphism.	• Lecture • Discussions • Problem solving	• Student seminars inconnection with Linear transformation and its example.	• Become familiar with the concept of Linear transformations and rank nullity theorem.	Evaluation through test paper

Course Outcomes

CO1	To prove results involving divisibility, greatest common divisor, least commonmultiple and a few applications.
CO2	Enable to solve system of congruence and diophantine equation
CO3	To learn the theorems viz. Wilson's theorem, Fermat's little theorem and Euler's theorem and its applications.
CO4	To Lean if a set of vectors is a vector space or a basis for a vetor space.
CO5	Understand the concept of linear transformation and application of rank nullity theorem.

Teacher in Charge:

Ms. Mariya

MAT6B11 : NUMERICAL METHODS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To provide techniques and algorithms to find approximate numerical solution to problems in several areas of mathematics.

Module I : Solution of Algebraic and Transcendental Equation (23 hrs)

Introduction, Bisection Method, Method of false position, Iteration method, Newton- Raphson Method, Ramanujan's method, The Secant Method, Finite Differences, Forward differences, Backward differences, Central differences, Symbolic relations and separation of symbols, Differences of a Polynomial.

Module II : Interpolation (23 hrs)

Newton's formulae for intrapolation, Central difference interpolation formulae, Gauss' Central Difference Formulae, Interpolation with unevenly spaced points, Langrange's interpolation formula, Divided differences and their properties, Newton's General interpolation formula, Inverse interpolation, Numerical Differentiation and Integration, Introduction, Numerical differentiation (using Newton's forward and backward formulae), Numerical Integration, Trapizoidal Rule, Simpson's 1/3- Rule , Simpson's 3/8- Rule.

Module III : Matrices and Linear Systems of equations (22 hrs)

Solution of Linear Systems – Direct Methods, Gauss elimination, Gauss- Jordan Method, Modification of Gauss method to compute the inverse, LU Decomposition, LU Decomposition from Gauss elimination, Solution of Linear Systems – Iterative methods, The eigen value problem, Eigen values of Symmetric Tridiazonal matrix.

Module IV : Numerical Solutions of Ordinary Differential Equations (22 hrs)

Introduction, Solution by Taylor's series, Picard's method of successive approximations, Euler's method, Modified Euler's Method, Runge- Kutta method, Predictor- Corrector Methods, Adams- Moulton Method, Milne's method.

Textbooks:

1) **S.S. Sastry** : Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

Reference Books:

1) S. SankaraRao : Numerical Methods of Scientists and Engineer, 3rd ed., PHI.
2) F.B. Hidebrand : Introduction to Numerical Analysis, TMH.
3) J.B. Scarborough : Numerical Mathematical Analysis, Oxford and IBH

OBJECTIVES

1) To understand several methods such as bisection method, fixed point iteration method, regula falsi method etc.
2) To understand the concept of interpolation.
3) To solve system of linear equations using matrices.
4) To learn to find numerical approximations to solutions of initial value problems.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **23 Hours**	Solution of Algebraic and Transcendental Equation, Finite differences	• Lecture • Discussion • Participative learning • Problem solving	• Assignment in different methods to solve equations	To learn to solve equations using different techniques.	Evaluation through test paper

			• Seminars in Finite differences		
Module II **23 Hours**	Interpolation, Numerical Differentiation, Numerical Integration	• Lecture • Discussion • Participative learning • Problem solving	Assignments in different techniques.	To find derivatives and integrals at a point using numerical techniques.	Evaluation through test paper
Module III **22 Hours**	Matrices and Linear Systems of equations	• Lecture • Discussion • Participative learning • Problem solving	Seminar on which technique is better and easier.	To learn to use matrices to solve system of linear equations.	Evaluation through testpaper and Viva
Module IV **22 Hours**	Numerical Solutions of Ordinary Differential Equations	• Lecture • Discussions • Problem solving	Assignment related to IVP	To find out numerical approximations to solutions of initial value problems.	Evaluation through testpaper

Course Outcomes

CO1	Understand several methods such as bisection method, fixed point iteration method, regula falsi method etc. to find out the approximate numerical solutions of algebraic and transcendental equations with desired accuracy.
CO2	Understand the concept of interpolation and also learn some well known interpolation techniques.
CO3	Understand a few techniques for numerical differentiation and integration and also realize their merits and demerits.
CO4	Find out numerical approximations to solutions of initial value problems and also to understand the efficiency of various methods.
CO5	Learn to solve system of linear equations using matrices.

Teacher in Charge:

Ms. Sruthy V

MAT6B09: REAL ANALYSIS

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To teach one how to combine different definitions, theorems and techniques to solve problems.

Module I : Continuous Functions (25 hrs)

Continuous functions, Continuous functions on intervals, Uniform continuity

Module II : Riemann Integral (25 hrs)

Riemann Integral, Riemann Integrable Functions, The fundamental theorem, Substitution theorem and application, Approximate Integration

Module III : Sequence and series of functions (20 hrs)

A quick review of series of real numbers, Pointwise and uniform convergence, Interchange of limit and continuity, Series of functions .

Module IV (20 hrs)

Improper Integrals : Improper integrals of the first kind, Improper integrals of the second kind,Cauchy Principal value, Improper Integrals of the third kind.

Beta and Gamma functions : Beta Functions, Gamma Functions, Relation between Beta and Gamma Functions

Textbooks:

1) **G. Bartle, Donald R. Sherbert** : Introduction to Real Analysis (3rd Edn.)
2) **R.R. Goldberg** : Methods of Real Analysis.
3) **Narayanan & Manicavachagom Pillay** : Calculus, Vol. II

Reference Books:

1) J.V. Deshpande: Mathematical Analysis and Applications, Narosa Pub. House.
2) Torence Tao : Analysis I, TRIM 37, Hindustan Book Agency.
3) K.A. Ross: Elementary Real Analysis : Theory of Calculus, Springer.
4) K.G. Binmore: Mathematical Analysis, CUP

OBJECTIVES

1) To state the definition of continuous functions, formulate sequential criteria for continuity and prove or disprove continuity of functions using this criteria.
2) To develop the notion of Riemann integrability of a function using the idea of tagged partitions and calculate the integral value of some simple functions using the definition.
3) To prove convergence and divergence of sequences of functions and series.
4) To learn the properties of and relationship among two important improper integrals.

LESSON PLAN

Unit/ Hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **25 Hours**	Continuous Functions, Uniform Continuity	• Lecture • Discussion • Participative learning • Problem solving	Assignment regarding difference in Continuity and Uniform Continuity.	To understand several deep and fundamental results of continuous functions on intervals.	Evaluation through test paper

Module II **25 Hours**	Riemann Integral	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Riemann Intregrability.	To understand a few basic and fundamental results of integration theory.	Evaluation through test paper
Module III **20 Hours**	Sequence and series of functions	• Lecture • Discussion • Participative learning • Problem solving	Assignment on convergence of series and sequences of functions.	To understand the difference between pointwise and uniform convergence of sequences and series of functions.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Improper Integrals, Beta and Gamma functions	• Lecture • Discussions • Problem solving	Seminars related to Improper Integrals and Principal Value.	To understand the notion of improper integrals, their convergence, principal value and evaluation.	Evaluation through testpaper

Course Outcomes

CO1	To understand several deep and fundamental results of continuous functions on intervals such as boundedness theorem, maximum-minimum theorem, intermediate value theorem, preservation of interval theorem and so on.
CO2	To develop the notion of Riemann integrability of a function using the idea of tagged partitions and calculate the integral value of some simple functions using the definition.
CO3	To learn and find out examples/counter examples to prove or disprove the validity of several mathematical statements that arise naturally in the process/context of learning.
CO4	To learn the properties of and relationship among two important improper integrals namely beta and gamma functions that frequently appear in mathematics, statistics, science and engineering.

Teacher in Charge:

M D Varghese

MAT 1C01 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 4 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of limit, Continuity, derivatives and integration.

MODULE I

Limits and Continuity: Rules for finding limits. Target values and formal definitions of limits. Extensions of limit concept, Continuity, Tangent lines

.

MODULE II

Derivatives: The derivative of a function, a quick review of differentiation rules, rate of Change.

MODULE III

Application of derivatives: Extreme values of a function. The mean value theorem, First derivative test, Graphing with y' and y''. Limits as x approaches infinity. Asymptotes and dominant terms, Linearization and differentials. The L'Hopital's Rule.

MODULE IV

Integration: Riemann sums and Definite integrals; properties, areas and the Mean value theorem. The Fundamental theorem. Application of Integrals: Areas between curves, Finding Volumes by slicing.

TEXTBOOKS

George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.

[2] Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

OBJECTIVES

- To understand the basics of limits and continuity.
- To learn derivatives and differentiation rules
- To learn about applications of derivatives
- To understand L'Hospital's rule.
- To study in detail Riemann sums and integration.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I (20 hours)	Limits and Continuity Epsilon – delta definitions	• Discussion • Participative learning • Problem solving	Discussions Lectures and Quizzes	Limits, Sandwich theorem,	Evaluation through test paper.
MODULE II (12 hours)	Derivatives and differentiation rukes	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about differentiation rules.	Derivatives and rate of Change.	Evaluation through test paper.
MODULE III (24 hours)	Applications of derivatives, Graphing of functions	• Lecture • Discussion • Participative learning • Problem solving	Discussion Maximum minimum points	Plot graphs of a function by finding maximum and minimum points using derivatives	Evaluation through MCQ.
MODULE IV (16 hours)	Riemann Sums and integration and applications of integration	• Lecture • Discussion • Participative learning • Problem solving	Discussion on integration concepts	Integration concept using Riemann sums, area of surfaces	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about limit continuity and derivatives
CO2	To learn application of derivatives To study about plotting function graphs
CO3	To know about integration and its origin To learn about applications of integration

Faculty in Charge

Ms. Meera V

MAT 2C02 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 4 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of hyperbolic functions, improper integrals, partial differentiation, infinite series and polar coordinates.

MODULE I

Hyperbolic Functions - Definitions and Identities, Derivatives and Integrals, Inverse Hyperbolic , functions - Derivatives and Integrals, Application of Integrals :, Volumes of Solids of Revolution (Disk method only), Lengths of plane curves. Areas of surfaces of revolution Improper Integrals, Convergence and Divergence, Tests for Convergence and Divergence, Direct Comparison Test and Limit Comparison Test

.

MODULE II

Limit of Sequences of Number, Theorems for calculating limits of sequences (Excluding Picard's Method), Infinite series, The ratio and root test for series of non negative terms, alternating series, Absolute and conditional convergence, Power Series, Taylor and Maclaurin Series.

MODULE III

Polar coordinates, Graphing in Polar Coordinates, Polar equations for conic sections, integration in Polar coordinates, Cylindrical and Spherical Coordinates.

MODULE IV

Functions of Several Variables, Limits and Continuity, Partial Derivatives, differentiability, Chain rule

.

TEXTBOOKS

George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.

[2] Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

OBJECTIVES

- To understand the Hyperbolic functions and improper integrals.
- To learn about sequences and series.
- To learn about polar coordinates and is graphing.
- To understand functions of several variables.
- To study partial differntiaition .

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I (20 hours)	Hyperbolic functions, Applications of integrals, improper integrals.	• Discussion • Participative learning • Problem solving	Discussions Lectures and Quizzes	Integrats and derivatives of Hyperbolic functions, Improper integrals, Volume and area of integrals	Evaluation through test paper.
MODULE II (28 hours)	Sequences and series of real numbers	• Lecture • Discussion • Participative learning • Problem solving	.Discussion about convergence of various series.	Convergence and divergence of series. Taylor and Maclaurin series.	Evaluation through test paper.
MODULE III (10 hours)	Polar Coordinates, Graphing, Cylindrical and Spherical coordinates.	• Lecture • Discussion • Participative learning • Problem solving	Discussion on cylindrical and spherical coordinates	Plot graphs of polar coordinates	Evaluation through MCQ.
MODULE IV (14 hours)	Functions of several variables, partial derivatives	• Lecture • Discussion • Participative learning • Problem solving	Discussion on partial derivatives	Partial differentiation	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about Infinite series and its convergence.
CO2	To learn hyperbolic functions and improper integrals. To study about Taylor series and Maclaurain series.
CO3	To know about polar coordinates and its plotting. To learn about partial differentiation.

Faculty in Charge

Ms. Smitha Davis

Ms. Amala Mary George

MAT 3C03 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 5 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of Ordinary differential equations, matrices and vector calculus.

MODULE I

Basic concepts and ideas, Geometrical meaning of y' = f(x,y). Direction Fields, Separable Differential Equations. Exact Differential Equations; Integrating Factors, Linear Differential Equations; Bernoulli Equation, Orthogonal Trajectories of Curves.

MODULE II

Rank of a Matrix, Non-Singular and Singular matrices, Elementary Transformations, Inverse of an elementary Transformations, Row Canonical form, Normal form. Systems of Linear equations: Homogeneous and Non Homogenoeus Equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton Theorem (statement only) and simple applications.

MODULE III

A quick Review of vector algebra, Inner product and vector product in R^2 and R^3 . Vector and scalar functions and Fields, Derivatives, Curves, Tangents, Arc Length, Velocity and acceleration, Gradient of a scalar field; Directional Derivative, Divergence of a vector field, Curl of a Vector Field.

MODULE IV

Line Integrals, Independence of path, Green's Theorem in the Plane (without proof), surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Divergence theorem of Gauss and Stoke's theorem (without proofs).

TEXTBOOKS

1. Erwin Kreyszig : Advanced Engineering Mathematics, Eighth Edition, Wiley, India.

2. Frank Ayres JR : Matrices, Schaum's Outline Series, TMH Edition.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.

[2] Muray R Spiegel, Vector Analysis, Schaum's Outline series, Asian Student Edition.

[3] Shanthi Narayanan & P.K. Mittal, A Text Book of Matrices, S. Chand

[4] Harry F. Davis & Arthur David Snider, Introduction to Vector Analysis, 6th ed., Universal Book Stall, New Delhi.

OBJECTIVES

- To understand the concepts in ordinary differential equations
- To learn about matrices and its properties
- To learn about Cayley Hamilton theorem
- To understand vectors
- To study in detail Vector Calculus

LESSON PLAN

Unit/Session (hours required)	Topics to be taught (input)	Procedure(process) Student centric method of teaching	Activity	Learning Outcome (output)	Assessment
MODULE I (20 hours)	Modeling of differential equations, methods to solve first order differential equations.	• Discussion • Participative learning • Problem solving	Discussions Lectures and Quizzes	Geometrical meaning of ODE, solving I order ODEs	Evaluation through test paper.
MODULE II (20 hours)	Rank of a matrix, solution of system of linear equations, Cayley- Hamilton theorem	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about Eigen values and vectors	Normal and Echoleon form of matrices, Solution of linear system of equations, Eigen values and vectors	Evaluation through test paper.
MODULE III (25 hours)	Introduction to vectors and vector differential calculus	• Lecture • Discussion • Participative learning • Problem solving	Discussion on derivatives of vector functions	Know gradient, divergence, curl of a vector function	Evaluation through MCQ.
MODULE IV (25 hours)	Vector integral calculus	• Lecture • Discussion • Participative learning • Problem solving	Discussion on surface integrals	Greens theorem, Stoke's theorem, Gauss divergence theorem	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about I order ordinary differential equations
CO2	To learn solution of system of linear equations To study about eigen values and eigen vectors.
CO3	To know about vector differential calculus To learn about vector integral calculus

Faculty in Charge

Ms. Rossflower

MAT 4C04 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 5 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of Second order differential equations, Laplace tranforms, Fourier series, Numerical methods

MODULE I

Linear Differential equations of Second and Higher order: Differential Operators, Euler-Cauchy Equation, Wronskian, Nonhomogeneous Equations, Solutions by Undetermined Coefficients, Solution by variation of Parameters.

MODULE II

Laplace Transforms: Laplace Transform, Inverse Transform, Linearity, Shifting, Transforms of Derivatives of Integrals, Differential Equations. Unit step Function, Second Shifting Theorem, Dirac Delta Function, Differentiation and integration of Transforms, Convolution, Integral Equations, Partial Fractions, Differential Equations.

.

MODULE III

Fourier Series : Periodic Functions, Trigonometric Series, Fourier Series, Even and Odd functions, Half-range Expansions, Partial differential Equations: Basic Concepts, Vibrating String, Wave Equation, Separation of Variables, Use of Fourier Series

MODULE IV

Numerical Methods: Methods of First-order Differential Equations, Picard's iteration for initial Value Problems. Numerical Integration: Trapezoidal Rule, Simpson's Rule.

TEXTBOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.
[2] Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

[3] Murray R. Spiegel, Laplace Transforms, Schaum's Outline Series.

OBJECTIVES

- To understand the methods to solve II and higher order derivatives
- To learn Laplace and inverse Laplace equations
- To learn about Fourier series and Half range expansions
- To understand classical partial differential equations
- To study in detail some numerical methods for integration and ODEs.

LESSON PLAN

Unit/Session (hours required)	Topics to be taught (input)	Procedure(process) Student centric method of teaching	Activity	Learning Outcome (output)	Assessment
MODULE I (20 hours)	Solution of II and higher order differential equations	• Discussion • Participative learning • Problem solving	Discussions Lectures on wronskian	Euler-Cauchy equations, various methods for solving II order DEs	Evaluation through test paper.
MODULE II (20 hours)	Laplace transforms, Inverse Laplace transforms, Shifting theorems	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about laplace and inverse Laplace transforms	Solution of differential equations using Laplace transforms	Evaluation through test paper.
MODULE III (30 hours)	Fourier series and its half range expansions	• Lecture • Discussion • Participative learning • Problem solving	Discussion on Fourier series expansions of periodic functions	Solution of heat and wave equations using Fourier series	Evaluation through test paper.
MODULE IV (20 hours)	Numerical methods for integration and solving differential equations	• Lecture • Discussion • Participative learning • Problem solving	Discussion on various numerical methods	Runge – Kutta, Euler methods, Trapeziodal, Simpson’s rule.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about Euler- Cauchy equations, method of undetermined coefficients and method of variation of parameters
CO2	To learn Solving differential equations using Laplace transforms To study about Fourier series
CO3	To know about solution of Heat and Wave Equations To learn about various numerical methods.

Faculty in Charge

Ms. Smitha Davis

Ms. Linet Roslin Antony

Dr. Nidhin T J

MAT1B01: FOUNDATIONS OF MATHEMATICS

Lecture Hours per week: 4, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

To get introduced to many mathematical terms.

Module I (16 hrs)

Set operations: Difference and Symmetric difference, Algebra of sets, Duality, Classes of sets, Powersets Relations: Product set, Relations, Composition of relations, Types of relations, Partitions, Equivalence relations with example of congruence modulo relation, Partial ordering relations, n-ary relations.

Module II (16 hrs)

Functions : Identity function, constant functions, product (composition) of functions, theorems on one-one and onto functions, Mathematical functions, Recursively defined functions, Indexed collection of sets, Operations on indexed collection of sets, Equipotent sets, Denumerable and countable sets, Cardinal numbers.

Module III (20 hrs)

Function quick review, Shifting graphs , Limit and continuity , The Sandwich theorem, Target values and formal definition of limits, Extensions of limit concept, Continuity.

Module IV (20 hrs)

Basic Logic: Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators, Propositional equivalence, Logical equivalences, Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Textbooks:

1) **S. Lipschutz**: Set Theory and related topics (Second Edition), Schaum Outline Series, TataMcGraw-Hill Publishing Company, New Delhi.

2) **Thomas /Finney** : Calculus, 9th ed., LPE, Pearson Education.
3) **K.H. Rosen**: Discrete Mathematics and its Applications (sixth edition), Tata McGraw Hill Publishing Company.

Reference Books:

1) P.R. Halmos: Naive Set Theory, Springer.
2) E. Kamke, Theory of Sets, Dover Publishers.
3) Anton : Calculus, Wiley.
4) R.P. Grimaldi: Discrete and Combinatorial Mathematics, Pearson Education.

OBJECTIVES

1) To get familiarized with different set operations.
2) To learn about different kind of functions and sets.
3) To understand concepts like limit and continuity.
4) To introduce basic logic.

LESSON PLAN

Unit/ Hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **16 Hours**	Set operations, Relations.	• Lecture • Discussion • Participative learning • Problem solving	Seminar on Set Operations.	To master in Set Operations.	Evaluation through test paper

Module II **16 Hours**	Functions, Different kinds of Sets.	• Lecture • Discussion • Participative learning • Problem solving	Assignment on One-one and Onto functions.	To understand different kinds of functions and sets.	Evaluation through test paper
Module III **20 Hours**	Shifting Graphs, Limit and Continuity.	• Lecture • Discussion • Participative learning • Problem solving	Peer discussion on Limits.	To get introduced to Limit and Continuity.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Logical equivalences, Quantifiers.	• Lecture • Discussions • Problem solving	Assignment on Logical equivalences.	To understand Logical equivalences.	Evaluation through testpaper

Course Outcomes

CO1	Get introduced to new mathematical terms.
CO2	Understand set properties and set functions.
CO3	Learn about functions and know about limit and continuity
CO4	To appreciate the beauty of logical arguments.

Teacher in Charge:

Geethu Simon

MAT2B02: CALCULUS

Lecture Hours per week: 4, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce students to the fundamental ideas of differentiability and integrability and also to some basic theorems of differential calculus.

Module I (20 hrs)

Extreme value of functions, The mean value theorem, The first derivative test for local extremum values , Graphing with y' and y'', Limit as x, Assymptotes and dominant terms.

Module II (20 hrs)

Optimization, Linearization and differentials, Riemann sums and definite – integrals, Properties, area and the mean value theorem, The fundamental theorem, Substitution in Definite Integrals.

Module III (20 hrs)

Areas between curves, Finding volumes by slicing ,Volumes of solids of revolution, Lengths of plane curves, Areas of surface of revolution.

Module IV (12 hrs)

Moments and centres of mass, Work

Textbooks:

1) **Thomas / Finney**: Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1) Anton : Calculus, Wiley.
2) S.K. Stein : Calculus with Analytic Geometry, McGraw Hill.

OBJECTIVES

1) To get an idea of sketching of curves.
2) To see different applications of derivatives and integrals.
3) To solve some optimization problems of interest in real life.
4) To establish the close connection between the two branches of Calculus: Differential and Integral Calculus.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	Extreme value of functions, The mean value theorem, The first derivative test for local extremum values , Graphing with y' and y'', Limit as x, Assymptotes and dominant terms.	• Lecture • Discussion • Participative learning • Problem solving	Group discussion on Curve Sketching	To understand several techniques of sketching curves and learning limits.	Evaluation through test paper and group discussion
Module II **20 Hours**	Optimization, Linearization and differentials, Riemann sums and definite – integrals, Properties, area and the mean value	• Lecture • Discussion • Participative learning • Problem solving	Assignment to find integrals of functions	To deal with real life problems in Physics, Chemistry etc.	Evaluation through test paper

	theorem, The fundamental theorem, Substitution in Definite Integrals.				
Module III **20 Hours**	Areas between curves, Finding volumes by slicing, Volumes of solids of revolution, Lengths of plane curves, Areas of surface of revolution	• Lecture • Discussion • Participative learning • Problem solving	Assignment to find volume of some familiar objects	To explore relationship between Surfaces and Curves	Evaluation through testpaper
Module IV **12 Hours**	Moments and centres of mass, Work	• Lecture • Problem solving • Participative learning • Videos	Seminars related to Centre of Mass	To understand concepts like Work and Moment.	Evaluation through test paper and viva

Course Outcomes

CO1	To explore the relationship between moving/changing objects
CO2	To master integrals which is a powerful tool in solving problems in Physics, Chemistry, Biology, Engineering, Economics and other fields.
CO3	To deal with real life optimization problems.
CO4	To learn the practical way of evaluating the definite integral.

Teacher in Charge:
Prof. M D Vargehese

MAT3B03 CALCULUS AND ANALYTIC GEOMETRY

Lecture Hours per week: 5, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce fundamentals of calculus and geometry

Module I (15 hrs)

Natural logarithms, The Exponential function, and log , Growth and decay ,
L'Hopital's Rule, Relative rates of growth, Hyperbolic functions

Module II (25 hrs)

Limits of sequence of numbers,Theorems for calculating limits of sequences, Infinite series, Integral test for series of non-
negative terms,Comparison test for series of non negativeterms,Ratio and root test for series of non negati veterms, Alternating series, Absolute and conditional convergence.

Module III (15 hrs)

Power series, Taylor and Maclaurin's series, Convergence of Taylor series ,Error estimate

Module IV (35 hrs)

Conic section and quadratic equations, Classifying conic section by eccentricity ,Quadratic equations and rota tions, Parametrisation of plane curves, Calculus with parametrisedcurves,Polar coordinates, Graphing in polar co-ordinates, Polar equations for conic sections, Integration in polar coordinates.

Textbooks :

1) Thomas / Finney: Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1) Anton : Calculus, Wiley.

2) S.K. Stein : Calculus and Analytic Geometry, McGraw Hill

OBJECTIVES

1) To know transcendental functions such as natural logarithmic and exponential function.
2) To study a related notion of convergence of series
3) To study Power series, Taylor series , Maclaurin's series and their convergence
4) To understand parametrisation of plane curves

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **15 Hours**	Natural logarithms , The Exponential function, and log , Growth and decay ,L'Hopital's Rule, Relative rate of growth, Hyper-bolic functions.	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on Growth and decay functions	To understand transcendental functions	Evaluation through test paper
Module II **25 Hours**	Limits of sequence of numbers, Infinite series, Integral test for series,Comparison test ,Ratio and root test , Alternating series, Absolute and co	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to convergence tests of infinite series	To understand convergence of sequences and series	Evaluation through test paper

	nditional converg ence.				
Module III **15 Hours**	Power series, Tay lor and Maclaurin's series, Convergence of Taylor series , Error estimate	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on power series	To study power series and convergence	Evaluation through test paper and group discussion
Module IV **35 Hours**	Conic section and quadratic equations ,Quadratic equation and rotations, Para metrisation of plane curves,Polar coordinates, Graph ing in polar co-ordinates, Polar eq uations for conic se ctions, Integration in polar coordinate s	• Lecture • Discussions • Problem solving	• Student seminars in connection with polar coordinates	To understand parametrisation of plane curves	Evaluation through test paper

Course Outcomes

CO1	To understand transcendental functions such as natural logarithmic and exponential function
CO2	To handle the convergence of series with different tests.
CO3	To learn Power series, Taylor series , Maclaurin's series and their convergence
CO4	To understand parametrisation of plane curves

Department of Mathematics

Teacher in Charge:

Krishnamol Ravindran

MAT4B04: THEORY OF EQUATIONS, MATRICES AND VECTOR CALCULUS

Lecture Hours per week: 5, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

Develops a new and fundamental ideas of calculus for the simple, but important case of polynomials. Also uses the matrices to solve system of linear equations.

Module I (30 hrs)

Polynomial Equations and Fundamental Theorem of Algebra(without proof). Applications of the Fundamental theorem to equations having one or more complex roots, Rational roots or multiple roots. Relations between roots and co-efficients of a polynomial equation and computation of symmetric functions of roots.Finding equations whose roots are functions of the roots of a given equation. Reciprocal equation and method of finding its roots. Analytical methods for solving polynomial equations of order up to four - quadratic formula.Cardano's method for solving cubic equations.Ferrari's method (for quadratic equations). Remarks about the insolvability of equations of degree five or more.Finding the nature of roots without solving Descartes' rule of signs.

Module II (16 hrs)

Elementary transformation, reduction to normal form, row reduced echelon form.Computing the inverse of a non singular matrix using elementary row transformation.

Module III (20 hrs)

System of linear homogeneous equations.Null space and nullity of matrix. Sylvester's law of nullity.Range of a matrix.Systems of linear non homogeneous equations. Characteristic roots and characteristic vectors of a square matrix. Some fundamental theorem.Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices.Characteristic equation of a matrix, Cayley- Hamilton theorem

Module IV (24 hrs)

Lines and planes in space. Cylinders and Quadric surfaces, Cylindrical and spherical coordinates, Vector valued functions and space curves, Arc length and Unit tangent vector , Curvature, torsion and TNB frame

Textbooks :

1. Bernard and Child: Higher Algebra, Macmillan

2.Shanti Narayanan &Mittal : A Text Book of Matrices, Revised edn., S. Chand

3. Thomas /Finney : Calculus, 9th ed., LPE, Pearson Education

Reference Books:

1.Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.

2.ManicavachagomPillai, Natarajan, Ganapathy- Algebra

3. Dickson: First Course in Theory of Equation

4. Frank Ayres, Jr. : Matrices, Schaum's Outline Series, Asian Student edition.

5. Devi Prasad : Elementary Linear Algebra, Narosa Pub. House.

6. Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.

7. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,

OBJECTIVE

- Learn to find the roots of polynomial equations up to degree 4, insolvability of equations of degree 5 or more.
- To compute the inverse of a non singular matrix using elementary row transformations.
- To understand about the characteristic equation and characteristic root of a matrix.
- Learn to use matrix to solve system of linear equations.
- Understand the basics of vector algebra
- Learn inner product, vector product and scalar triple product.
- Understand the concept of cylindrical and spherical coordinates.
- Learn about the plane and curves in space.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **30 Hours**	Polynomial Equations and Fundamental Theorem of Algebra. Applications of the Fundamental theorem to equations having one or more complex roots, Rational roots or multiple roots. Relations between roots and co-efficients of a polynomial equation	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to find roots of polynomial equations. • Seminar on the topic Transformation of	• Learned to solve polynomials using cardan's method, Ferrari methods etc	Evaluation through test paper.

	and computation of symmetric functions of roots.Finding equations whose roots are functions of the roots of a given equation. Reciprocal equation and method of finding its roots. Analytical methods for solving polynomial equations of order up to four - quadratic formula.Cardano's method for solving cubic equations.Ferrari's method (for quadratic equations). Remarks about the insolvability of equations of degree five or more.Finding the nature of roots without solving Descartes' rule of signs.		equations.		
Module II **16 Hours**	Elementary transformation, reduction to normal form, row reduced echelon form.Computing the inverse of a non singular matrix using elementary row transformation.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to find the inverse of a non singular matrix using elementary row transformation .	• Learn to determine wether a matrix is singular or non singular • Learn to find out the rank of a matrix.	Evaluation through test paper.
Module III **20 Hours**	System of linear homogeneous equations.Null space and nullity of matrix.	• Lecture • Discussion • Participative learning	• Seminar on the topic related to vector space	• Understand to solve system of equation using matrix	Evaluation through Test paper

	Sylvester's law of nullity. Range of a matrix.Systems of linear non homogeneous equations. Characteristic roots and characteristic vectors of a square matrix. Some fundamental theorem. Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices. Characteristic equation of a matrix, Cayley- Hamilton Theorem	• Problem solving	of n-tuples. • Assignments to solve system of equations.	• Learn about characteristic roots and vectors.	
Module IV **24 Hours**	Lines and planes in space. Cylinders and Quadric surfaces, Cylindrical and spherical coordinates, Vector valued functions and space curves, Arc length and Unit tangent vector , Curvature, torsion and TNB Frame	• Lecture • Discussions • Problem solving	• Group discussion on Cylindrical and spherical coordinates.	• Learn basic results in vector algebra.	Evaluation through test paper

Course Outcomes

CO1	Learned to find out the roots of polynomial equations.
CO2	Computed the inverse of a non singular matrix using elementary row transformations.
CO3	Understand about the characteristic equation and characteristic root of a matrix.
CO4	Understand the method of Gauss-Jordan elimination to find the solutions of systems of simultaneous linear equations and Learned to solve a system of linear equations by row-reduced echelon form.
CO5	Understand the basic concepts in vector algebra.

Teacher in Charge:

Dr Vijitha Mukundan

Prof. M D Varghese

MAT5B06 : ABSTRACT ALGEBRA

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To introduce the basic concept of the nature of abstract algebra also gives the idea of group and ring.

Module I (20 hrs)

Binary operations, Isomorphic binary structures, Groups, Sub groups

Module II (25 hrs)

Cyclic groups, Groups and permutations, Orbits, cycles and Alternating groups

Module III (15 hrs)

Cosets and Theorem of Lagrange, Homomorphisms

Module IV (30hrs)

Rings and Fields, Integral Domains, The Field of Quotients of an Integral Domain

Textbooks :

John B. Fraleigh : A First Course in Abstract Algebra, 7th Ed., Pearson.

Reference Books:

1. Joseph A. Gallian : Contemporary Abstract Algebra. Narosa Pub. House.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: Basic Abstract Algebra, 2nded., Cambridge University
3. Artin : Algebra, PHI.
4. Durbin : Modern Algebra : An Introduction, 5th ed., Wiley.

OBJECTIVES

1) To enable one to determine whether the given binary operation on a given set forms a group.
2) To understand the concept of subgroups.
3) To describe all elements of a cyclic group using generators.
4) To enable one to understand the homomorphism and Theorem of Lagrange.
5) To understand the concept of rings, fields and integral domains.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	Binary operations, Isomorphic binary structures, Groups; Sub groups	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Binary operation.	• Enable to understand the concept of Groups.	Evaluation through test paper
Module II **25 Hours**	Cyclic groups, Groups and permutations, Orbits, cycles and Alternating groups	• Lecture • Discussion • Participative learning • Problem solving	• Assignments on permutation and orbits.	• enable one to compute the expression of permutation and permutation multiplication • Enable to understand different type of groups.	Evaluation through test paper
Module III **15 Hours**	Cosets and Theorem of Lagrange, Homomorphism	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of homomorphism • Peer group discussion on	• Understand the theorem Lagrange and homomorphism.	Evaluation through test paper

			Cosets.		
Module IV **30 Hours**	Rings and Fields, Integral Domains, The Field of Quotients of an Integral Domain	• Lecture • Discussion • Participative learning • Problem solving	• Seminar on the topic Rings and fields.	• To understand the concept of rings and fields • Learn the concept of Integral domain.	Evaluation through test paper and viva

Course Outcomes

CO1	Understand the concept of binary operation on a given set.
CO2	To get the idea of groups, rings, fields and integral domain.
CO3	Understand different type of groups like cyclic and alternating groups
CO4	Understand the homomorphism and Theorem of Lagrange

Teacher in Charge:

Geethu simon

MAT5B07: BASIC MATHEMATICAL ANALYSIS

Lecture Hours per week: 6, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To develop ability to analyze and prove statements of mathematics using logical arguments.

Module I (20 hrs)

A quick review of sets and functions, Mathematical induction, Finite and infinite sets, Real Numbers, The algebraic property of real numbers.

Module II (24 hrs)

Absolute value and real line, The completeness property of R, Applications of supremum property, Intervals, Nested interval property and uncountability of R.

Module III (30 hrs)

Sequence of real numbers, Sequence and their limits, Limit theorems, Monotone sequences, Subsequence and Bolzano – Weirstrass theorem, Cauchy criterio,Properly divergent sequences, Open and closed sets.

Module IV (34 hrs)

COMPLEX NUMBERS: Sums and Products, Basic Algebraic properties, Further properties, Vectors and Moduli, Complex Conjugates, Exponential form, Product and powers in exponential form, Arguments of products and quotients, Roots of complex numbers, Regions in the complex plane, Functions of complex variable, Limits, Theorems on limits, Limits involving the points at infinity, Continuity.

Textbooks:

1) **Robert G. Bartle & Donald R. Sherbert**: Introduction to Real Analysis, 3rded., Wiley.
2) **J.W. Brown and Ruel V. Churchill**: Complex Variables and Applications, 8th Ed., McGraw Hill.

Reference Books:

1) J.M. Howie : Real Analysis, Springer 2007.

2) Ghorpade and Limaye : A Course in Calculus and Real Analysis, Springer, 2006.
3) K.A. Ross : Elementary Real Analysis : The Theory of Calculus, Springer Indian Reprint.
4) J.V. Deshpande : Mathematical Analysis and Applications, Narosh Pub. House.
5) M.R. Spiegel : Complex Variables, Schaum's Outline Series.

OBJECTIVES

1) To learn to prove Archimedean property, density theorem, existence of a positive square root for positive numbers and so on and the learning will help them to appreciate the beauty of logical arguments.
2) To learn how monotone convergence theorem can be used in establishing the divergence of the harmonic series, how it helps in the calculation of square root of positive numbers and how it establishes the existence of the transcendental number e.
3) To understand the concept of open and closed sets, their properties, their characterization and so on.
4) To familiarize the use of geometry, comparison between real and complex calculus-areas

LESSON PLAN

Unit/ Hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	A quick review of sets and functions ,Mathematical induction, Finite and infinite sets Real Numbers, The algebraic property of	• Lecture • Discussion • Participative learning • Problem solving	Group discussion on Algebraic properties of R.	To generate the ability to analyze and prove statements of Mathematics.	Evaluation through test paper

	real numbers.				
Module II **24 Hours**	Absolute value and real line, The completeness property of R, Applications of supremum property Intervals, Nested interval property and uncountability of R.	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Completeness Property of R.	To master different techniques of finding limits.	Evaluation through test paper
Module III **30 Hours**	Sequence of real numbers, Sequence and their limits, Limit theorems, Monotone sequences, Subsequence and Bolzano – Weirstrass theorem, Cauchy criterio, Properly divergent sequences, Open and closed sets.	• Lecture • Discussion • Participative learning • Problem solving	• Assignment in Limit Theorems. • Discussion on Open and Closed Sets.	To familiarize with different kinds of sequences.	Evaluation through testpaper and Viva
Module IV **34 Hours**	Sums and Products, Basic Algebraic properties, Further properties, Vectors and Moduli, Complex Conjugates, Exponential form, Product and powers in exponential form, Arguments of products and quotients, Roots of	• Lecture • Discussions • Problem solving	Student seminars to familiarize properties of Complex Numbers.	To understand areas where real and complex calculus agree and where they differ.	Evaluation through testpaper

	complex numbers, Regions in the complex plane, Functions of complex variable, Limits, Theorems on limits, Limits involving the points at infinity, Continuity.				

Course Outcomes

CO1	To appreciate the beauty of logical arguments and embolden them to apply it in similar and unknown problems.
CO2	To establish the divergence and convergence of different sequences and series.
CO3	To understand some basic topological properties of real number system.
CO4	To demystify student's belief that complex variable theory is incomprehensible.

Teacher in Charge:

M D Varghese

MAT5B08: DIFFERENTIAL EQUATIONS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To find out ways and means for solving differential equations.

Module I (24 hrs)

Some Basic Mathematical Models: Direction Fields, Solutions of some Differential equations, Classification of Differential Equations, Historical Remarks, First order differential equations: Linear equations with variable coefficients, Separable equations, Modeling with first order equations, Differences between linear and non linear equations, Exact equations and integrating factors, The existence and uniqueness theorem.

Module II (29 hrs)

Second Order Linear Differential Equations: Homogeneous equation with constant coefficients, Fundamental solutions of Linear Homogeneous equations, Linear independence and Wronskian, Complex roots of characteristic equations, Repeated roots Reduction of order, Non homogeneous equations, Method of Undetermined coefficients, Variation of parameters, Mechanical and Electrical vibrations, Systems of First Order Linear equations: Introduction, Basic theory of systems of first order Linear Equations.

Module III (17 hrs)

Definition of Laplace Transforms , Solution of Initial Value Problem , Step functions , Impulse functions, The Convolution Integral.

Module IV (20 hrs)

Two point Boundary value problems , Fourier Series, The Fourier Convergence Theorem, Even and odd functions , Separation of variables; Heat conduction in a rod , The Wave equation, Vibrations of an elastic string.

Textbooks:

1) Thomas / Finney : Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1) Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.
2) H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,Universal Book Stall, New Delhi.

OBJECTIVES

1) To learn to solve DEs that are in linear, separable and in exact forms and also to analyze the solution.
2) To be familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.
3) To acquire the knowledge of solving a differential equation using Laplace method.
4) To get familiarized with Fourier series and its applications.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **24 Hours**	Some Basic Mathematical Models, First order differential equations	• Lecture • Discussion • Participative learning • Problem solving	Assignment on solving first order differential equations.	To learn to solve DEs that are in linear, separable and in exact forms and also to analyze the solution.	Evaluation through test paper

Module II **29 Hours**	Second Order Linear Differential Equations, Systems of First Order Linear equations	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Completeness Property of R.	To be familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.	Evaluation through test paper
Module III **17 Hours**	Laplace Transforms	• Lecture • Discussion • Participative learning • Problem solving	Assignment in solving Differential equations using Laplace transforms.	To acquire the knowledge of solving a differential equation using Laplace method.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Partial Differential Equations and Fourier Series	• Lecture • Discussions • Problem solving	Student seminars in applications of Fourier Series.	To get familiarized with Fourier series and its applications.	Evaluation through testpaper

Course Outcomes

CO1	Students could identify a number of areas where the modelling process results in a differential equation.
CO2	They will realize the basic differences between linear and non linear DEs and also basic results that guarantees a solution in each case.
CO3	They will become familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.
CO4	Students acquire the knowledge of solving a differential equation using Laplace method which is especially suitable to deal with problems arising in engineering field.

Teacher in Charge:

Ms. Krishnamol Ravindran

MAT5D02: MATHEMATICS FOR NATURAL SCIENCES

Lecture Hours per week: 2 Credits: 2

Internal: 10, External: 40, Examination 2 Hours

Objectives

To get introduced to statistical measures and analysis.

Module I (20 hrs)

The idea of sets, Operation on sets, Relations and functions, Variables and graphs, Frequency distributions, The Mean, Median, Mode and other measures of central tendency, Dispersion or variation, The Range, The Mean deviation, The Semi-inter quartile range, The 10-90 Percentile range.

Module II (16 hrs)

The standard deviation, Properties of Standard Deviation, The variance, Short methods of computing standard deviation, Moments, Moments for grouped data, relation between moments, Computation of moment for grouped data. Skewness and Kurtosis.

Textbooks :

Murray R. Spiegel : Statistics, 2nd Edn., Schaum's Outline Series.

Reference Books:

1) Hogg & Craig: Introduction to Mathematical Statistics.
2) Freund & Walpole: Mathematical Statistics

OBJECTIVES

1) To understand different measures of tendency.
2) To analyse data using measures like SD, Skewness and Kurtosis.

LESSON PLAN

Module I **18 Hours**	Sets, Frequency Distribution, Measures of Tendency	• Lecture • Discussion • Participative learning • Problem solving	Assignment on different measures of tendency.	To understand which measure is better for different kinds of data.	Evaluation through test paper and viva
Module II **12 Hours**	Standard Deviation, Moments, Skewness and Kurtosis.	• Lecture • Discussion • Participative learning • Problem solving	Student seminars on Skewness and Kurtosis on different datas.	To visualize how the data behaves.	Evaluation through test paper

Course Outcomes

CO1	Students get an understanding about the use of some statistical tools.
CO2	They learn to analyze data using different measures.

Teacher in Charge:

Ms. Rossflower

MAT5B05: VECTOR CALCULUS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To Provide skils to visualize and manipulate multivariable and vector values functions. Also enable students to evaluate multiple integrals.

Module I (15 hrs)

Functions of several variables, Limits and Continuity, Partial derivatives, Differentiability linearization and differentials, Chain rule, Partial derivatives with constrained variables.

Module II (20 hrs)

Directional derivatives, gradient vectors and tangent planes, Extreme value and saddle points, Lagrange multipliers, Taylor's formula, Double Integrals, Double integrals in polar form.

Module III (25 hrs)

Triple integrals in Rectangular Coordinates, Triple integrals in cylindrical and spherical coordinates, Substitutions in multiple integrals, Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields.

Module IV (30hrs)

Green's theorem in the plane, Surface area and surface integrals, Parametrized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).

Textbooks :

Thomas / Finney : Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1. Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.
2. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,

OBJECTIVES

1) To enable one to apply the basic concepts of partial derivatives.
2) To learn to find multiple integrals.
3) To understand concept of the integrals of the functions and vector fields over parametrized surfaces and compute them in simple examples.
4) To calculate directional derivatives and gradients.
5) To learn application of greens theorem and stokes theorem.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **15 Hours**	Functions of several variables, Limits and Continuity, Partial derivatives, Differentiability linearization and differentials, Chain rule, Partial derivatives with constrained variables.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Partial derivatives.	• Enable to find partial derivatives.	Evaluation through test paper
Module II **20 Hours**	Directional derivatives, gradient vectors and tangent planes, Extreme value and saddle points, Lagrange multipliers, Taylor's formula, Double Integrals, Double integrals in polar	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding Directional derivatives and double integrals.	• Enable to evaluate double integrals.	Evaluation through test paper

	form.				
Module III **25 Hours**	Triple integrals in Rectangular Coordinates, Triple integrals in cylindrical and spherical coordinates, Substitutions in multiple integrals, Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain vector fields, work and circulation	Understand triple integrals and vector fields.	Evaluation through MCQ and Group Discussion
Module IV **30 Hours**	Green's theorem in the plane, Surface area and surface integrals, Parametrized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to Surface integrals.	Learn the application of greens theorem and stokes theorem in multiple integrals.	Evaluation through test paper

Course Outcomes

CO1	Understand the basic concept of partial derivatives.
CO2	Enable to calculate multiple integrals.
CO3	Understand the concept of a conservative vector field
CO4	Learn the application of greens theorem and stokes theorem in multiple integrals and understand how they are generalizations of the Fundamental theorem of calculus.

Teacher in Charge:

Ms. Meera V

MAT6B10 : COMPLEX ANALYSIS

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To learn basic concepts of complex analysis and its applications.

Module I : Analytic Functions (15 hrs)

Derivatives, Differentiation formula, Cauchy-
Riemann Equations, Polar coordinates, Analytic functions, Harmonic functions , Elementary functions , The exponential function, Logarithmic function, Complex exponents, Trigonometric functions, Hyperbolic f unctions, Inverse Trigonometric and Hyperbolic functions.

Module II : Integrals (25 hrs)

Derivatives of functions ω(t); Indefinite integral of ω(t); Contours, Contour integrals, Antiderivatives, Cauchy -
Goursat theorem (without proof), Simply and multiply connected domains, Cauchy's integral formula and its e xtension, Liouville's theorem and fundamental theorem of algebra, Maximum modulus principle.

Module III : Series (25 hrs)

A quick review of convergence of sequence and series of complex numbers,Taylor series, Laurents series (wi thoutproof), Applications,Power series: Absolute and uniform convergence,Continuity of sum of powerseries, Differentiation and integration of power series, Multiplication and division of power series.

Module IV : Residues (25 hrs)

Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, Three types of isolated

singular points, Residues at poles, Zeroes of analytic functions, Zeroes and poles,Applications of residues, E valuation of improper integrals, Jordan's Lemma (statement only), Definite integrals involving sines and cosi nes.

Textbooks :

1) **James Ward Brown and Ruel V. Churchill** : Complex Variables and Applications (8th Edn.), McGraw Hill.

Reference Books:

1) Mark J.Ablowitz and Anthanassios S. Fokas: Complex Variables, Cambridge Text, 2nd Edn

2) S. Ponnusamy : Foundation of Complex Analysis : Narosa.

3) Murray R. Spiegel: Complex Variables, Schaum's Outline series.

4) J.M. Howie: Complex Analysis: Springer India Reprint

5) Stewart & Tall: Complex Analysis, CUP

OBJECTIVES

1) To develop differentiability and analyticity of complex valued functions
2) To develop complex integration
3) To represent an analytic function as power series.
4) To classify the singular points using Laurent series and develop the concept of residues and its applications.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **15 Hours**	Derivatives, Cauchy-Riemann Equations,Analytic functions,Harmonic functions , Exponential ,	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding harmonic conjugates	To understand the difference between differentiability and analyticity	Evaluation through test paper

	Logarithmic, Trigonometric , Hyperbolic , Inverse Trigonometric and Hyperbolic functions				
Module II **25 Hours**	Derivatives ofω(t), Indefinite integral of ω(t); Contours, Contour integrals, Antiderivatives, Cauchy-Goursat theorem , Simplyand multiply connected domains, Cauchy's integralformula and its extension, Liouville's theorem and fundamental theorem of algebra, Maximum modulus principle.	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on contour integrals	To understand integration of complex functions and related theorems	Evaluation through test paper and viva
Module III **25 Hours**	Convergence of sequence and series of complex numbers ,Taylor series, Laurents series , Absolute and Uniform convergence, Continuity of sum of powerseries,	• Lecture • Discussion • Participative learning • Problem solving	• Student seminar to explain absolute and uniform convergence of power series	To understand Taylor series and Laurent series	Evaluation through Test paper and Group Discussion

	Differentiation and integration of power series, Multiplication and division of power series.				
Module IV **25 Hours**	Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, Three types of isolated singular points, Residues at poles, Zeroes of analytic functions, Zeroes and poles, Applications of residues, Evaluation of improper integrals, Jordan's Lemma , Definite integral involving sines and cosines.	• Lecture • Discussions • Problem solving	• Assignments in finding isolated singular points and residues	To understand isolated singular points, residues and applications of residues	Evaluation through test paper

Course Outcomes

CO1	To understand difference between differentiability and analyticity of complex valued functions.

CO2	To learn indefinite integrals of complex valued functions.
CO3	Learn to express an analytic function as a power series.
CO4	To understand the concepts of singular points, residues, and applications of residues.

Teacher in Charge:

Ms. Nikita P B

MAT6B13(E02) : LINEAR PROGRAMMING

Lecture Hours per week: 3, Credits: 2

Internal: 20, External: 80, Examination 3 Hours

Objectives

Formulate our real life problem into a mathematical model also different techniques to solve LPP are introduced.

Module I (16 hrs)

Formulation, Convex sets, General LLP

Module II (14 hrs)

Simplex Method, Duality

Module III (18 hrs)

The transportation problem, The assignment Problems

Textbooks :

Gupta and Manmohan - Linear Programming And Theory of Games

Reference Books:

1. . K. V. Mital&Manmohan: Optimization methods in Operations Research and Systems Analysis, 3rdEdn., New Age International publishers.
2. DipakChatterjee: Linear Programming and Game Theory, Prentice Hall of India.

OBJECTIVE

1. Enable to formulate LPP from real life problem
2. Conceptulize the feasible region, feasible solution, optimal solution etc.
3. Solve the LPP with two variables using graphical method
4. Solve the LPP using simplex method
5. Formulate the dual problem from primal
6. Solve transportation problem and the assignment Problems which are relevent in daily life.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **16 Hours**	Formulation, Convex sets, General LLP	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on formulation of lpp. • Seminar on the topic convex sets.	• Understand to formulate lpp.	Evaluation through test paper
Module II **14 Hours**	Simplex Method, Duality	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in solving LPP using simplex method.	• Understand to solve lpp in finite number of steps using simplex method.	Evaluation through test paper and viva
Module III **18 Hours**	The transportation problem, The assignment Problems	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to solve transportation problems and assignment problems	• Enable one to solve transportation problem and the assignment Problems which are relevent in daily life.	Evaluation through Test paper and Group Discussion

Course Outcomes

Course Outcomes

CO1	Enable one to formulate LPP from real life problem.

CO2	Solve the LPP with two variables using graphical method
CO3	Solve the LPP using simplex method
CO4	Solve transportation problem and the assignment Problems which are relevent in daily life.

Teacher in Charge:

Ms Nikita PB

MAT6B12 : NUMBER THEORY AND LINEAR ALGEBRA

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To study about the integers and integer valued functions. Also introduce the concept of vector fields and linear transformations.

Module I (30 hrs)

Divisibility theory in the integers – the division algorithm, the greatest common divisor, the Euclidean algorithm, the Diophantine equation ax + by = c. Primes and their distribution. The fundamental theorem of arithmetic.The sieve of Eratosthenes. The theory of congruences.Basic properties of congruence.Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem

Module II (25 hrs)

Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors.The greatest integer function.Euler's phi-function.Euler's generalization of Fermat's theorem.Properties of the phi-function.

Module III (15 hrs)

Vectorspaces-examples, linearcombinations, spanning, linearindependence, base, finite dimensional vector spaces.

Module IV (20 hrs)

Linear mappings- Linear transformations, examples, nullspace, rank –nullity theorem, linear isomorphism

Textbooks :

1. David M. Burton : Elementary Number Theory, Sixth Edn., TMH.

2. T. S. Blynth and E.F. Robertson: Basic Linear Algebra, second Edn springer under graduate mathematics series 2009

Reference Books:

1. C.Y. Hsiung : Elementary Theory of Numbers. Allied Publishers.

2. Neville Robbins : Beginning Number Theory, Second Ed. Narosa.
3. George E. Andrews : Number Theory, HPC.
4. Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.
5. Frank Ayres, Jr. : Matrices, Schaum's Outline Series, Asian Student edition.
6. Devi Prasad : Elementary Linear Algebra, Narosa Pub. House

OBJECTIVE

1. Enable to find gcd using Euclidean algorithm.
2. To understand the solution of diophantine equations.
3. Enable to solve system of congruence using chinese remainder theorem.
4. To learn Wilson's theorem, Fermat's little theorem and Euler's theorem
5. Understand the concept of vector space and its basis.
6. Understand the concept of linear transformation and application of rank nullity theorem.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I 30 Hours	The division algorithm, Gcd, the Euclidean algorithm, the Diophantine equation. Primes and their distribution. The fundamental theorem of arithmetic. The sieve of Eratosthenes. The theory of congruences. Basic	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on gcd and euclidean algorithm. • Assignment in finding solution of system of congruence using chinese remainder theorem	• Understand the linear congruence and the method for finding its solutions.	Evaluation through test paper

	properties of congruence. Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem.				
Module II **25 Hours**	Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors. The greatest integer function. Euler's phi-function. Euler's generalization of Fermat's theorem. Properties of the phi-function.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding sum and number of divisors • Seminar on the topic Euler's phi-function and Properties of the phi-function.	• Understand fermat's theorem, wilson's theorem, euler's theorem and its applications.	Evaluation through test paper and viva
Module III **15 Hours**	Vectorspaces-examples, linearcombinations, spanning, linearindependence, base, finite dimensional vector spaces.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to vector space and its example.	• Understand the definition of vector space and its basis.	Evaluation through MCQ and Group Discussion
Module IV **20 Hours**	Linear mappings-Linear transformations, examples, nullspace, ranknullity theorem, linear isomorphism.	• Lecture • Discussions • Problem solving	• Student seminars inconnection with Linear transformation and its example.	• Become familiar with the concept of Linear transformations and rank nullity theorem.	Evaluation through test paper

Course Outcomes

CO1	To prove results involving divisibility, greatest common divisor, least commonmultiple and a few applications.
CO2	Enable to solve system of congruence and diophantine equation
CO3	To learn the theorems viz. Wilson's theorem, Fermat's little theorem and Euler's theorem and its applications.
CO4	To Lean if a set of vectors is a vector space or a basis for a vetor space.
CO5	Understand the concept of linear transformation and application of rank nullity theorem.

Teacher in Charge:

Ms. Geethu Simon

MAT6B11 : NUMERICAL METHODS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To provide techniques and algorithms to find approximate numerical solution to problems in several areas of mathematics.

Module I : Solution of Algebraic and Transcendental Equation (23 hrs)

Introduction, Bisection Method, Method of false position, Iteration method, Newton-Raphson Method, Ramanujan's method, The Secant Method, Finite Differences, Forward differences, Backward differences, Central differences, Symbolic relations and separation of symbols, Differences of a Polynomial.

Module II : Interpolation (23 hrs)

Newton's formulae for intrapolation, Central difference interpolation formulae, Gauss' Central Difference Formulae, Interpolation with unevenly spaced points, Langrange's interpolation formula, Divided differences and their properties, Newton's General interpolation formula, Inverse interpolation, Numerical Differentiation and Integration, Introduction, Numerical differentiation (using Newton's forward and backward formulae), Numerical Integration, Trapizoidal Rule, Simpson's 1/3-Rule , Simpson's 3/8-Rule.

Module III : Matrices and Linear Systems of equations (22 hrs)

Solution of Linear Systems – Direct Methods, Gauss elimination, Gauss-Jordan Method, Modification of Gauss method to compute the inverse, LU Decomposition, LU Decomposition from Gauss elimination, Solution of Linear Systems – Iterative methods, The eigen value problem, Eigen values of Symmetric Tridiazonal matrix.

Module IV : Numerical Solutions of Ordinary Differential Equations (22 hrs)

Introduction, Solution by Taylor's series, Picard's method of successive approximations, Euler's method, Modified Euler's Method, Runge-Kutta method, Predictor-Corrector Methods, Adams-Moulton Method, Milne's method.

Textbooks:

1) **S.S. Sastry** : Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

Reference Books:

1) S. SankaraRao : Numerical Methods of Scientists and Engineer, 3rd ed., PHI.
2) F.B. Hidebrand : Introduction to Numerical Analysis, TMH.
3) J.B. Scarborough : Numerical Mathematical Analysis, Oxford and IBH

OBJECTIVES

1) To understand several methods such as bisection method, fixed point iteration method, regula falsi method etc.
2) To understand the concept of interpolation.
3) To solve system of linear equations using matrices.
4) To learn to find numerical approximations to solutions of initial value problems.

LESSON PLAN

Unit/ Hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **23 Hours**	Solution of Algebraic and Transcendental Equation, Finite differences	• Lecture • Discussion • Participative learning • Problem solving	• Assignment in different methods to solve equations	To learn to solve equations using different techniques.	Evaluation through test paper

			• Seminars in Finite differences		
Module II **23 Hours**	Interpolation, Numerical Differentiation, Numerical Integration	• Lecture • Discussion • Participative learning • Problem solving	Assignments in different techniques.	To find derivatives and integrals at a point using numerical techniques.	Evaluation through test paper
Module III **22 Hours**	Matrices and Linear Systems of equations	• Lecture • Discussion • Participative learning • Problem solving	Seminar on which technique is better and easier.	To learn to use matrices to solve system of linear equations.	Evaluation through testpaper and Viva
Module IV **22 Hours**	Numerical Solutions of Ordinary Differential Equations	• Lecture • Discussions • Problem solving	Assignment related to IVP	To find out numerical approximations to solutions of initial value problems.	Evaluation through testpaper

Course Outcomes

CO1	Understand several methods such as bisection method, fixed point iteration method, regula falsi method etc. to find out the approximate numerical solutions of algebraic and transcendental equations with desired accuracy.
CO2	Understand the concept of interpolation and also learn some well known interpolation techniques.
CO3	Understand a few techniques for numerical differentiation and integration and also realize their merits and demerits.
CO4	Find out numerical approximations to solutions of initial value problems and also to understand the efficiency of various methods.
CO5	Learn to solve system of linear equations using matrices.

Teacher in Charge:

Ms. Geethu Simon

MAT6B09: REAL ANALYSIS

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To teach one how to combine different definitions, theorems and techniques to solve problems.

Module I : Continuous Functions (25 hrs)

Continuous functions, Continuous functions on intervals, Uniform continuity

Module II : Riemann Integral (25 hrs)

Riemann Integral, Riemann Integrable Functions, The fundamental theorem, Substitution theorem and application, Approximate Integration

Module III : Sequence and series of functions (20 hrs)

A quick review of series of real numbers, Pointwise and uniform convergence, Interchange of limit and continuity, Series of functions .

Module IV (20 hrs)

Improper Integrals : Improper integrals of the first kind, Improper integrals of the second kind,Cauchy Principal value, Improper Integrals of the third kind.

Beta and Gamma functions : Beta Functions, Gamma Functions, Relation between Beta and Gamma Functions

Textbooks:

1) **G. Bartle, Donald R. Sherbert** : Introduction to Real Analysis (3rd Edn.)
2) **R.R. Goldberg** : Methods of Real Analysis.
3) **Narayanan & Manicavachagom Pillay** : Calculus, Vol. II

Reference Books:

1) J.V. Deshpande: Mathematical Analysis and Applications, Narosa Pub. House.
2) Torence Tao : Analysis I, TRIM 37, Hindustan Book Agency.
3) K.A. Ross: Elementary Real Analysis : Theory of Calculus, Springer.
4) K.G. Binmore: Mathematical Analysis, CUP

OBJECTIVES

1) To state the definition of continuous functions, formulate sequential criteria for continuity and prove or disprove continuity of functions using this criteria.
2) To develop the notion of Riemann integrability of a function using the idea of tagged partitions and calculate the integral value of some simple functions using the definition.
3) To prove convergence and divergence of sequences of functions and series.
4) To learn the properties of and relationship among two important improper integrals.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **25 Hours**	Continuous Functions, Uniform Continuity	• Lecture • Discussion • Participative learning • Problem solving	Assignment regarding difference in Continuity and Uniform Continuity.	To understand several deep and fundamental results of continuous functions on intervals.	Evaluation through test paper

Module II **25 Hours**	Riemann Integral	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Riemann Intregrability.	To understand a few basic and fundamental results of integration theory.	Evaluation through test paper
Module III **20 Hours**	Sequence and series of functions	• Lecture • Discussion • Participative learning • Problem solving	Assignment on convergence of series and sequences of functions.	To understand the difference between pointwise and uniform convergence of sequences and series of functions.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Improper Integrals, Beta and Gamma functions	• Lecture • Discussions • Problem solving	Seminars related to Improper Integrals and Principal Value.	To understand the notion of improper integrals, their convergence, principal value and evaluation.	Evaluation through testpaper

Course Outcomes

CO1	To understand several deep and fundamental results of continuous functions on intervals such as boundedness theorem, maximum-minimum theorem, intermediate value theorem, preservation of interval theorem and so on.
CO2	To develop the notion of Riemann integrability of a function using the idea of tagged partitions and calculate the integral value of some simple functions using the definition.
CO3	To learn and find out examples/counter examples to prove or disprove the validity of several mathematical statements that arise naturally in the process/context of learning.
CO4	To learn the properties of and relationship among two important improper integrals namely beta and gamma functions that frequently appear in mathematics, statistics, science and engineering.

Teacher in Charge:

Prof. M D Varghese

MTH1C01: ALGEBRA I
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of abstract algebra.

MODULE I

Plane Isometries, Direct products & finitely generated Abelian Groups, Factor Groups, Factor- Group Computations and Simple Groups, Group action on a set, Applications of G-set to counting

MODULE II

Isomorphism theorems, Series of groups, (Omit Butterfly Lemma and proof of the SchreierTheorem), Sylow theorems, Applications of the Sylow theory, Free Groups

MODULE III

Group Presentations, Rings of polynomials, Factorization of polynomials over a field, NonCommutative examples, Homomorphism and factor rings

TEXT:

JOHN B. FRALEIGH, A FIRST COURSE IN ABSTRACT ALGEBRA(7th Edn.), Pearson Education Inc., 2003.

REFERENCES :

[1] N. Bourbaki: Elements of Mathematics: Algebra I, Springer; 1998.

[2] Dummit and Foote: Abstract algebra(3rd edn.); Wiley India; 2011.

[3] P.A. Grillet: Abstract algebra(2nd edn.); Springer; 2007

[4] I.N. Herstein: Topics in Algebra(2nd Edn); John Wiley & Sons, 2006.

[5] T.W. Hungerford: Algebra; Springer Verlag GTM 73(4th Printing); 1987.

[6] N. Jacobson: Basic Algebra-Vol. I; Hindustan Publishing Corporation(India), Delhi; 1991.

[7] T.Y. Lam: Exercises in classical ring theory(2nd edn); Springer; 2003.

[8] C. Lanski: Concepts in Abstract Algebra; American Mathematical Society; 2010.

[9] N.H. Mc Coy: Introduction to modern algebra, Literary Licensing, LLC; 2012.

[10] S. M. Ross: Topics in Finite and Discrete Mathematics; Cambridge; 2000.

[11] J. Rotman: An Introduction to the Theory of Groups(4th edn.); Springer, 1999.

OBJECTIVES

a) **To understand the basic concepts of groups, factor groups, simple groups and group action on a set.**

b) **To get familiarize with Isomorphism theorems and its properties.**

c) **To understand the concept of sylow theorems and its applications.**

d) **To study more about rings of polynomials and factorization of polynomials over a field.**

e) **To understand homomorphism and factor ring.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Plane Isometries, Abelian groups, Factor groups, Simple groups, group action on a set	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on groups and its properties	To understand: • the basics of different types of groups • notion of group action on a set	Evaluation Through MCQ
Module I1 (30 hours)	Isomorphism theorems, Sylow theorems and its applications	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of Isomprhism • Peer group discussion on Sylow theorems	To understand: • Isomorphism theorems and their significance • Sylow theorems and its applications	Evaluation Through test paper
Module III (30 Hours)	Ring of polynomials, factorization of a polynomial over a field, homomorphism and factor rings	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of homomorphism and factor rings	To understand: • homomorphism and factor rings • factorization of a polynomial over a field convergence	Evaluation through test paper

Course Outcomes

CO1	To get the idea of different types of groups and group action on a set
CO2	To understand the concept of isomorphism theorems and their significance, Sylow theorems and its applications
CO3	To understand factorization of a polynomial over a field, homomorphism and factor rings

Faculty in charge:
Ms. Geethu Simon

MTH1C05 – DISCRETE MATHEMATICS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To understand concepts in graph theory, lattices and automata.

MODULE I

Order Relations, Lattices; Boolean Algebra Definition and Properties, Boolean Functions.

MODULE II

Basic concepts, Subgraphs, Degree of vertices, Paths and connectedness, Automorphism of a simple graph, Operations on graphs, Vertex cuts and Edge cuts, Connectivity and Edge connectivity, Trees-Definition, Characterization and Simple properties, Eulerian graphs, Planar and Non planar graphs, Euler formula and its consequences, K5 and K3,3 are non planar graphs, Dual of a plane graph.

MODULE III

Automata and Formal Languages: Introduction to the theory of Computation, Finite Automata.

TEXTBOOKS

TEXT 1: R. BALAKRISHNAN and K. RANGANATHAN, A TEXT BOOK OF GRAPH THEORY, Springer-Verlag New York, Inc., 2000.

TEXT 2: K. D JOSHI, FOUNDATIONS OF DISCRETE MATHEMATICS, New Age International(P) Limited, New Delhi, 1989.

TEXT 3: PETER LINZ, AN INTRODUCTION TO FORMAL LANGUAGES AND AUTOMATA (2nd Edn.), Narosa Publishing House, New Delhi, 1997.

REFERENCES

[1] J. C. Abbot: Sets, lattices and Boolean Algebras; Allyn and Bacon, Boston; 1969.

[2] J. A. Bondy, U.S.R. Murty: Graph Theory; Springer; 2000.

[3] S. M. Cioaba and M.R. Murty: A First Course in Graph Theory and Combinatorics; Hindustan Book Agency; 2009.

[4] J. A. Clalrk: A first look at Graph Theory; World Scientific; 1991.

OBJECTIVES

- To understand the definition of Boolean algebra and Boolean functions along with various properties.
- To study graph and its types with suitable examples.
- To learn about connectivity of graphs.
- To understand the definition of trees and learn various theorems related to it.
- To study about language, grammar and types of acceptors.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Lattices; Boolean Algebra Definition and Properties, Boolean Functions	• Discussion • Participative learning • Problem solving	Seminars by students	To study about Boolean algebra and Boolean functions.	Evaluation through test paper.
MODULE II	Graph definition with examples, isomorphism, connected graphs, planar graphs, trees and eulerian graphs	• Lecture • Discussion • Participative learning • Problem solving	Assignments on isomorphism of graphs. Discussion about various definitions.	To learn basics about graphs and trees. To study about planarity and connectivity.	Evaluation through test paper.
MODULE III	Definition of automata. Languages and Grammars. DFA and NFA	• Lecture • Discussion • Participative learning • Problem solving	Discussion on applications of automata. Working out exercise problems on DFA and NFA	To know the basic about automata. To learn about DFA and NFA	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about Boolean algebra and Boolean functions.
CO2	To learn basics about graphs and trees. To study about planarity and connectivity.
CO3	To know the basic about automata. To learn about DFA and NFA

Faculty in Charge
Ms Meera V

MTH1C02: LINEAR ALGEBRA
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of Linear Algebra.

MODULE I

Vector Spaces & Linear Transformations

MODULE II

Linear Transformations (continued) and Elementary Canonical Forms

MODULE III

Elementary Canonical Forms (continued), Inner Product Spaces

TEXT:

HOFFMAN K. and KUNZE R., LINEAR ALGEBRA (2nd Edn.), Prentice Hall of India, 199

REFERENCES :

[1] P. R. Halmos: Finite Dimensional Vector spaces; Narosa Pub House, New Delhi; 1980.

[2] A. K. Hazra: Matrix: Algebra, Calculus and generalised inverse- Part I; Cambridge International Science Publishing; 2007.

[3] I. N. Herstein: Topics in Algebra; Wiley Eastern Ltd Reprint; 1991.

[4] S. Kumaresan: Linear Algebra-A Geometric Approach; Prentice Hall of India; 2000.

[5] S. Lang: Linear Algebra; Addison Wesley Pub.Co.Reading, Mass; 1972.

[6] S. Maclane and G. Bikhrkhoff: Algebra; Macmillan Pub Co NY; 1967.

[7] N. H. McCoy and R. Thomas: Algebra; Allyn Bacon Inc NY; 1977.

[8] R. R. Stoll and E.T.Wong: Linear Algebra; Academic Press International Edn; 1968.

[9] G. Strang: linear algebra and its applications(4th edn.); Cengage Learning; 2006.

OBJECTIVES

a) **To understand the concept of vector spaces, basis and dimension.**

b) **To study about linear transformations and its properties.**

c) **To understand the concept of functionals and dual space**

d) **To study the relation between linear transformations and corresponding matrices.**

e) **To study about inner product spaces.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Vector spaces, subspace, basis, dimension, properties, linear transformations	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on properties of vector spaces	To understand: • the basics of vector spaces, basis • notion of linear transformation • properties of linear transformation	Evaluation through test papers and interaction with students
Module I1 (35 hours)	linear transformations, functionals, dual space and elementary canonical transformations	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of linear transformations	To understand: • More about linear transformation • Significance of dual space	Evaluation through test paper
Module III (25 Hours)	canonical transformations inner product spaces,	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on inner product spaces	To understand: • Inner product spaces and their relevance • Orthogonal compliment and direct sums of vector spaces	Evaluation through test paper

Course Outcomes

CO1	To understand the concept of vector spaces, their basis, dimension and linear transformations
CO2	To understand more about linear transformations and some of its important properties, elementary canonical forms
CO3	To introduce the concept of Inner product spaces, orthogonal compliment and direct sums of vector spaces

Faculty in charge:
Ms Nikita P B

MT1C05: NUMBER THEORY

Number of hours of Lectures per week: 5

Number of Credits: 4

Objectives

To understand the basic concepts of Number Theory.

Module 1

Arithmetical functions and Dirichlet multiplication; Averages of arithmetical functions

Module 2

Some elementary theorems on the distribution of prime numbers

Module 3

Quadratic residues and quadratic reciprocity law ,Cryptography, Public key.

TEXT 1 : APOSTOL T.M., INTRODUCTION TO ANALYTIC NUMBER THEORY, Narosa Publishing House, New Delhi, 1990.

TEXT 2: KOBLITZ NEAL A., COURSE IN NUMBER THEROY AND CRYPTOGRAPHY, SpringerVerlag, NewYork, 1987.

References

[1] A. Beautelspacher: Cryptology; Mathematical Association of America (Incorporated); 1994

[2] H. Davenport: The higher arithmetic(6th Edn.); Cambridge Univ.Press; 1992

[3] G. H. Hardy and E.M. Wright: Introduction to the theory of numbers; Oxford International Edn; 1985

[4] A. Hurwitz & N. Kritiko: Lectures on Number Theory; Springer Verlag ,Universitext; 1986

[5] T. Koshy: Elementary Number Theory with Applications; Harcourt / Academic Press; 2002

[6] D. Redmond: Number Theory; Monographs & Texts in Mathematics No: 220; Marcel Dekker Inc.; 1994

[7] P. Ribenboim: The little book of Big Primes; Springer-Verlag, New York; 1991

[8] K.H. Rosen: Elementary Number Theory and its applications(3rd Edn.); Addison Wesley Pub Co.; 1993

[9] W. Stallings: Cryptography and Network Security-Principles and Practices; PHI; 2004

[10] D.R. Stinson: Cryptography- Theory and Practice(2nd Edn.); Chapman & Hall / CRC (214. Simon Sing : The Code Book The Fourth Estate London); 1999

[11] J. Stopple: A Primer of Analytic Number Theory-From Pythagorus to Riemann; Cambridge Univ Press; 2003

[12] S.Y. Yan: Number Theroy for Computing(2nd Edn.); Springer-Verlag; 2002

OBJECTIVES

a) **To understand the basic arithmetical functions and its averages.**

b) **To get familiarize with theorems on the distribution of prime numbers.**

c) **To understand quadratic residues, quadratic reciprocity law.**

d) **To study about basics of cryptography .**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Arithmetical functions and Dirichlet multiplication; Averages of arithmetical functions	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on various arithmetic functions.	To understand: • Arithmetical functions • Dirichlet multiplication and derivatives of arithmetical functions • Averages of arithmetical functions.	Evaluation Through Test paper
Module I1	Some elementary theorems on the	• Lecture • Discussion • Participative	• Student seminars to	To understand: • Equivalent	Evaluation Through test paper

(30 hours)	distribution of prime numbers	learning • Problem solving	explain theorems on distribution of prime numbers.	forms of prime number theorem. • Partial sums of Mobius function.	
Module III (30 Hours)	Quadratic residues and quadratic reciprocity law, Cryptography, Public key	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on legendre's symbol, its properties and Gauss lemma.	To understand: • Quadratic Residues and Quadratic reciprocity law,jacobi's symbol. • Basics of cryptography, types of crypto-system and its cryptanalysis.	Evaluation through test paper

Course Outcomes

CO1	To introduce the Arithmetical functions,Dirichlet multiplication and derivatives of arithmetical functions,Averages of arithmetic.
CO2	To understand the Equivalent forms of prime number theorem, Partial sums of Mobius function.
CO3	To understand the quadratic residues and quadratic reciprocity law, jacobi's symbol , basics of cryptography, types of cryptosystem and its cryptanalysis.

Faculty in charge:
Ms. Lipsy Paulose

MT1C03: REAL ANALYSIS I
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of real analysis.

MODULE I

Basic Topololgy, Finite, Countable and Uncountable sets Metric Spaces, Compact Sets, Perfect Sets, Connected Sets. Continuity - Limits of function, Continuous functions, Continuity and compactness, continuity and connectedness, Discontinuities, Monotonic functions, Infinite limits and Limits at Infinity

MODULE II

Differentiation The derivative of a real function, Mean Value theorems, The continuity of Derivatives, L Hospitals Rule, Derivatives of Higher Order, Taylors Theorem, Differentiation of Vector valued functions. The Riemann Stieltjes Integral, - Definition and Existence of the integral, properties of the integral, Integration and Differentiation

MODULE III

The Riemann Stieltjes Integral (Continued) - Integration of Vector vector-valued Functions, Rectifiable curves. Sequences and Series of Functions - Discussion of Main problem, Uniform convergence, Uniform convergence and continuity, Uniform convergence and Integration, Uniform convergence and Differentiation. Equicontinuous Families of Functions, The Stone Weierstrass

TEXT:

RUDIN W., PRINCIPLES OF MATHEMATICAL ANALYSIS (3rd Edn.), Mc. Graw-Hill, 1986.

REFERENCES :

[1] H. Amann and J. Escher: Analysis-I; Birkhuser; 2006.

[2] T. M. Apostol: Mathematical Analysis(2nd Edn.); Narosa; 2002.

[3] R. G. Bartle: Elements of Real Analysis(2nd Edn.); Wiley International Edn.; 1976.

[4] R. G. Bartle and D.R. Sherbert: Introduction to Real Analysis; John Wiley Bros; 1982.

[5] J. V. Deshpande: Mathematical Analysis and Applications- an Introduction; Alpha Science International; 2004.

OBJECTIVES

a) **To understand the basic concepts of Topology: Finite, Countable and Uncountable sets, Metric spaces, Compact sets, Perfect sets, Connected sets.**

b) **To develop the notion of continuity of functions in R^K.**

c) **To understand the concept of differentiation of real valued and complex valued functions.**

d) **To study about Riemann Stieltjes Integral and Rectifiable curves.**

e) **To understand the convergence of sequence and series of functions.**

f) **To understand the relation between uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Basic topology, Continuous functions, continuity and compactness, continuity and connectedness, discontinuities	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic topology and continuity of functions	To understand: • the basics of topology • notion of continuity • difference between continuity and uniform continuity	Evaluation Through MCQ
Module I1 (30 hours)	Differentiation, derivatives of higher order, differentiation of	• Lecture • Discussion • Participative	• Student seminars to explain the	To understand: • differentiation of vector valued	Evaluation Through test paper

	vector valued functions, Riemann Stieltjes Integral	learning • Problem solving	properties of differentiation and integration	functions • integration of vector valued functions	
Module III (25 Hours)	Convergence of sequence and series of functions, uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of convergence of functions	To understand: • Convergence of sequence and series of functions • Differentiate between convergence and uniform convergence	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of basic topology, difference between continuous and uniformly continuous functions and its properties.
CO2	To understand the concept of differentiation of vector valued functions and integration of functions.
CO3	To understand the difference between pointwise convergence and uniform convergence of sequence of functions, convergence of series of functions

Faculty in charge:
M D Varghese

MTH2C06: ALGEBRA II
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the ideas and concepts of insolvability of the quintic.

MODULE I

Prime and Maximal Ideals, Introduction to Extension Fields, Algebraic Extensions (Omit Proof of the Existence of an Algebraic Closure), Geometric Constructions. [27, 29, 31, 32]

MODULE II

Finite Fields, Automorphisms of Fields, the Isomorphism Extension Theorem, Splitting Fields, Separable Extensions. [33, 48, 49, 50, 51]

MODULE III

Galois Theory, Illustration of Galois Theory, Cyclotomic Extensions, Insolvability of the Quintic. [53, 54, 55, 56]

TEXT: John B. Fraleigh: A FIRST COURSE IN ABSTRACT ALGEBRA (7th Edn), Pearson Education Inc., 2003.

REFERENCES :

[1] N. Bourbaki: Elements of Mathematics: Algebra I, Springer; 1998

[2] Dummit and Foote: Abstract algebra (3rd Edn); Wiley India; 2011

[3] M.H. Fenrick: Introduction to the Galois correspondence (2nd Edn); Birkhuser; 1998

[4] P.A. Grillet: Abstract algebra (2nd Edn); Springer; 2007

[5] I.N. Herstein: Topics in Algebra (2nd Edn); John Wiley & Sons, 2006.

[6] T.W. Hungerford: Algebra; Springer Verlag GTM 73 (4th Printing); 1987

[7] C. Lanski: Concepts in Abstract Algebra; American Mathematical Society; 2010

[8] R. Lidl and G. Pilz Applied abstract algebra(2nd edn.); Springer; 1998

[9] N.H. Mc Coy: Introduction to modern algebra, Literary Licensing, LLC; 2012

[10] J. Rotman: An Introduction to the Theory of Groups (4th Edn); Springer; 1999

[11] I. Stewart: Galois theory(3rd edn.); Chapman & Hall/CRC; 2003

OBJECTIVES

a) **To understand the basic concepts of Prime and Maximal Ideals.**

b) **To get familiarize with Algebraic Extensions.**

c) **To understand the Automorphisms of fields, Separable Extensions and Splitting Fields.**

d) **To study about the Galois Theory, Cyclotomic Extensions and the Insolvability of the Quintic.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Prime and Maximal Ideals, Introduction to Extension Fields, Algebraic Extensions, Geometric Constructions.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on prime and maximal ideals and algebraic extensions	To understand: • the basics of extension fields • geometric constructions	Evaluation through MCQ
Module I1 (30 hours)	Finite Fields, Automorphisms of Fields, the Isomorphism Extension Theorem, Splitting Fields, Separable Extensions.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about separable extensions	To understand: • Isomorphism Extension Theorem Splitting and Separable Extensions	Evaluation through test paper
Module III (30 hours)	Galois Theory, Illustration of Galois Theory, Cyclotomic Extensions, Insolvability of the Quintic.	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on Cyclotomic Extensions	To understand: • Galois Theory • Insolvability of the Quintic	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of finite and extension fields, geometric constructions etc.
CO2	To understand the concept of Isomorphism Extension Theorem, Splitting and Separable Extensions.
CO3	To understand Galois theory and the Insolvability of the Quintic

Faculty in charge:
Ms. Smitha Davis

MTH2C07: REAL ANALYSIS II
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the advanced concepts of real analysis.

MODULE I

The Real Numbers: Sets, Sequences and Functions, Sigma Algebra, Borel sets, Lebesgue Measure, Lebesgue Measurable Functions

MODULE II

Lebesgue Integration, Lebesgue Integration: Further topics

MODULE III

Differentiation and Integration, The L^p spaces : Completeness and Approximation

TEXT:

H. L.Royden ,P. M. FitzpatrickH.L. REAL ANAYLSIS (4th Edn.), Prentice Hall of India, 2000.

REFERENCES :

[1] K B. Athreya and S N Lahiri:,Measure theory,Hindustan Book Agency,New Delhi,(2006).

[2] R G Bartle:, The Elements of Integration and Lebsgue Mesure , Wiley(1995).

[3] S K Berberian: ,measure theory and Integration,The Mc Millan Company,New York,(1965).

[4] L M Graves: ,The Theory of Functions of Real Variable Tata McGraw-Hill Book Co(1978)

[5] P R Halmos: , Measure Theory, GTM ,Springer Verlag [6] W Rudin:, Real and Complex Analysis,Tata McGraw Hill,New Delhi,2006

[7] I K Rana:,An Introduction to Measure and Integration,Narosa Publishing Company,New York.

[8] Terence Tao: ,An Introduction to Measure Theory,Graduate Studies in Mathematics,Vol 126 AMS

OBJECTIVES

a) **To understand the basic concepts of Sigma Algebra, Borel sets.**

b) **To understand Lebesgue Measure and Lebesgue Measurable Functions and its properties**

c) **To understand the concept of Lebesgue Integration,**

d) **To perform differentiation and Integration**

e) **To study about the L^p spaces : Completeness and Approximation**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Sets, Sequences and Functions, Sigma Algebra, Borel sets, Lebesgue Measure, Lebesgue Measurable Functions	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Lebesgue measure and Lebesgue measurable functions	To understand: • the basics of sigma algebra • notion of Lebesgue measure and measurable functions	Evaluation through interaction with students and test papers
Module I1 (30 hours)	Lebesgue Integration	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars on some topics of Lebesgue integration	To understand: • Concepts of Lebesgue integration	Evaluation through test paper
Module II1 (30 hours)	Differentiation and Integration, The L^p spaces : Completeness and Approximation	• Lecture • Discussion • Participative learning • Problem solving	• Assignments on Differentiation and Integration	To understand: • Concepts of L^pspaces	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of Sigma Algebra, Borel sets, Lebesgue Measure, Lebesgue Measurable Functions
CO2	To understand the concept of Lebesgue integration, the L^p spaces : Completeness and Approximation
CO3	To understand the concept of differentiation and integration.

Faculty in charge:
Dr. Nidhin TJ

MTH2C08: TOPOLOGY
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the motivation and concepts of topology.

MODULE I

A Quick Revision of Chapter 1,2 and 3. Topological space, basic concepts [Chapter 4 and Chapter5 Section 1, Section 2(excluding 2.11 and 2.12) and Section 3 only]

MODULE II

Making Functions Continuous, quotient spaces, spaces with special properties [Chapter 5 Section4 and Chapter 6]

MODULE III

Separation axioms: Hierarchy of separation axioms, Compactness and separation axioms, The Urysohn characterization of normality, Tietze characterization of normality.[Chapter 7 Section 1 to 3 andSection 4 up to and including 4.6]

TEXT:

JOSHI K D, INTRODUCTION TO GENERAL TOPOLOGY (Revised Edn.), New Age International (P)Ltd., New Delhi, 1983

Inc., 2003.

REFERENCES :

[1] M A Armstrong: Basic Topology, Springer- Verlag New York; 1983.

[2] J Dugundji: Topology; Prentice hall of India; 1975.

[3] M Gemignani: Elementary Topology; Addison Wesley Pub Co Reading Mass, 1971

[4] M G Murdeshwar: General Topology(2nd Edn);Wiley Eastern Ltd, 1990

[5] G F Simmons: Introduction to Topology and modern analysis; McGraw-Hill international student

Edn;1963.

OBJECTIVES

a) **To understand the basic concepts of Topological Spaces.**

b) **To get familiarize with making functions continuous, Quotient Spaces.**

c) **To understand the separation axioms, Hierarchy of separation axioms, compactness and separation axioms.**

d) **To study the Urysohn characterization of normality, Tietze characterization of normality.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Topological Spaces, Basic concepts	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic topology and topological space	To understand: • the basics of topology • topological spaces • different types of topologies	Evaluation Through MCQ
Module I1 (30 hours)	Making functions continuous, quotient spaces, spaces with special properties	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about making functions continuous	To understand: • Compact Lindeloff spaces • Connectedness Local Connectedness Path Connectedness	Evaluation Through test paper

Module III (30 Hours)	Separation axioms: Hierarchy of separation axioms, compactness and separation axioms, The Urysohn characterization of normality, Tietze characterization of normality	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on separation axioms	To understand: • Separation axioms • Urysohn characterization of normality	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of basic topology, topological space, different types of topologies.
CO2	To understand the concept of making functions continuous, quotient spaces
CO3	To understand the separation axioms, the Urysohn characterization of normality, Tietz characterization of normality

Faculty in charge:
Ms. Linet Roslin Antony

MT2C10: ODE AND CALCULUS OF VARIATIONS
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of ordinary differential equations and its applications.

MODULE I

Power Series Solutions and Special functions; Some Special Functions of Mathematical Physics.

MODULE II

Some special functions of Mathematical Physics (continued), Systems of First Order Equations; Non linearEquations

MODULE III

Oscillation Theory of Boundary Value Problems, The Existence and Uniqueness of Solutions, TheCalculus of Variations.

TEXT:

SIMMONS, G.F., DIFFERENTIAL EQUATIONS WITH APPLICATIONS AND HISTORICAL NOTES (3rd Edn.), New Delhi, 1974.

REFERENCES :

[1] G. Birkhoff and G.C. Rota: Ordinary Differential Equations(3rd Edn.); Edn. Wiley & Sons; 1978
[2] W.E. Boyce and R.C. Diprima: Elementary Differential Equations and boundary value problems (2nd Edn.); John Wiley & Sons, NY; 1969
[3] A. Chakrabarti: Elements of ordinary Differential Equations and special functions; Wiley Eastern Ltd., New Delhi; 1990
[4] E.A. Coddington: An Introduction to Ordinary Differential Eqution; Printice Hall of India, New Delhi; 1974
[5] R.Courant and D. Hilbert: Methods of Mathematical Physics- vol I; Wiley Eastern Reprint; 1975
[6] P. Hartman: Ordinary Differential Equations; John Wiley & Sons; 1964 [7] L.S. Pontriyagin : A course in ordinary Differential Equations Hindustan Pub. Corporation, Delhi; 1967

[8] I. Sneddon: Elements of Partial Differential Equations; McGraw-Hill International, Edn.;1957

OBJECTIVES

a) **To study how to compute power series solution of first order ODE.**

b) **To get familiarize with some special functions of Mathematical Physics.**

c) **To study the methods to solve systems of first order equations.**

d) **To study more about qualitative properties of solutions.**

e) **To understand the concept of calculus of variations.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (35 hours)	Power series solutions of first order ODEs, special functions in Mathematical Physics	• Lecture • Discussion • Participative learning • Problem solving	• Problem solving sessions in groups. • Discussing the solutions obtained	To understand: • the basics of solutions of ODE • significance of special functions	Evaluation Through test papers
Module I1 (30 hours)	Solve systems of first order and nonlinear equations	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain nonlinear equations	To understand: • the method to solve systems of first order equations • theory of solutions of nonlinear equations	Evaluation through test paper
Module III (25 Hours)	Existence and uniqueness of solutions, calculus of variations	• Lecture • Discussion • Participative learning • Problem solving	• Assignment on existence and uniqueness of solutions • Discussion in peer groups on Calculus of Variations	To understand: • the applications in Calculus of variations • the qualitative nature of solutions	Evaluation through test paper

Course Outcomes

CO1	To understand the power series solutions of ordinary differential equations and the significance of special functions.
CO2	To know more about special functions, systems of first order equations and nonlinear equations
CO3	To understand the qualitative nature of solutions and calculus of variation.

Faculty in charge:
Dr. Vijitha Mukundan

MTH2C10 – OPERATIONS RESEARCH

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn various methods to solve an LPP and study about game theory and networking.

MODULE I

Convex Functions; Linear Programming

MODULE II

Linear Programming (contd.); Transportation Problem

MODULE III

Integer Programming; Sensitivity Analysis; Flow and Potential in Networks; Theory of Games

TEXTBOOK

K.V. MITAL; C. MOHAN., OPTIMIZATION METHODS IN OPERATIONS RESEARCH AND SYSTEMS ANALYSIS(3rd. Edn.), New Age International(P) Ltd., 1996.

REFERENCES

[1] R.L. Ackoff and M.W. Sasioni: Fundamentals of Operations Research; Wiley Eastern Ltd. New Delhi; 1991

[2] C.S. Beightler, D.T. Philiphs and D.J. Wilde: Foundations of optimization(2nd Edn.); Prentice Hall of India, Delhi; 1979

[3] G. Hadley: Linear Programming; Addison-Wesley Pub Co Reading, Mass; 1975

[4] G. Hadley: Non-linear and Dynamic Programming; Wiley Eastern Pub Co. Reading, Mass; 1964

OBJECTIVES

- To learn about convex function and few theorems related to it.
- To study LPP and simplex method to solve it.
- Understand and solve transportation problems.

- ❖ To study about the sensitivity analysis.
- ❖ To learn flow and networks.
- ❖ To understand the problems related to game theory.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Convex functions. Definition of LPP.	• Discussion • Participative learning • Problem solving • Lecture	Assignments on LPP	To study about convex functions and definition of LPP	Evaluation through test paper.
MODULE II	Simplex method to solve LPP. Transportation problem. VAM and MODI method to solve transportation problem.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on simplex method and solving of transportation method	To learn to solve LPP using simplex method. To solve Transportation problem.	Evaluation through test paper.
MODULE III	Integer programming and sensitivity analysis. Networking. Introduction to Game theory.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students on sensitivity analysis. Methods to solve flow and network. Game theory problem solving.	Discussion on sensitivity analysis. To solve networks and problems on game theory.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about convex functions
CO2	To learn about methods to solve LPP and transportation problems
CO3	To know about sensitivity in LPP and methods to solve networks. To understand game theory.

Faculty in charge: Ms. Amala Mary George

MTH3C11 – MULTIVARIABLE CALCULUS AND GEOMETRY

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To understand concepts in Differential Geometry

MODULE I

Functions of Several Variables Linear Transformations, Differentiation, The Contraction Principle, The Inverse Function Theorem, the Implicit Function Theorem.

MODULE II

What is a curve? Arc-length, Reparametrization, Closed curves, Level curves versus parametrized curves. Curvature, Plane curves, Space curves What is a surface, Smooth surfaces, Smooth maps, Tangents and derivatives, Normals and orientability.

MODULE III

Level surfaces, Ruled surfaces and surfaces of revolution, Applications of the inverse function theorem, Lengths of curves on surfaces, Equiareal maps and a theorem of Archimedes, The second fundamental form, The Gauss and Weingarten maps, Normal and geodesic curvatures. Gaussian and mean curvatures, Principal curvatures of a surface.

TEXTBOOKS

TEXT 1 : RUDIN W., PRINCIPLES OF MATHEMATICAL ANALYSIS, (3rd Edn.), Mc. Graw Hill, 1986.

TEXT 2: ANDREW PRESSLEY, ELEMENTARY DIFFERENTIAL GEOMETRY(2nd Edn.), Springer-Verlag, 2010.

REFERENCES

[1] M. P. do Carmo: Differential Geometry of Curves and Surfaces;

[2] W. Klingenberg: A course in Differential Geometry;

[3] J. R. Munkres: Analysis on Manifolds; Westview Press; 1997

[4] C. C. Pugh: Real Mathematical Analysis, Springer; 2010

[5] M. Spivak: A Comprehensive Introduction to Differential Geometry-Vol. I; Publish

or Perish, Boston; 1970

[6] M. Spivak: Calculus on Manifolds; Westview Press; 1971

[7] V.A. Zorich: Mathematical Analysis-I; Springer; 2008

OBJECTIVES

- To understand functions of several variables and its differentiation
- To study curves, level curves and curvature.
- To learn about surfaces and its properties as normal, orientablity and tangents.
- To understand the definition Guass Weingarten maps
- To study about Guassian, mean curvatures

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	The Contraction Principle, The Inverse Function Theorem, the Implicit Function Theorem.	• Discussion • Participative learning • Problem solving	Seminars by students	To study about Functions of Several Variables Linear Transformations and its properties	Evaluation through test paper.
MODULE II	Arc-length, Reparametrization, Level curves versus parametrized curves. Curvature, Tangents and derivatives, Normals and orientability.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on Tangents and derivatives. Discussion about various definitions.	To learn basics about Curves, Level curves, curvature, Smooth maps,Tangents, Normals.	Evaluation through MCQ
MODULE III	Level surfaces, Applications of the inverse function theorem, Normal and geodesic curvatures. Gaussian and mean curvatures, Principal curvatures of a surface.	• Lecture • Discussion • Participative learning • Problem solving	Discussion on Surfaces and its properties.	To know the about Level, ruled surfaces, Guassian, mean, principal curvatures. The Gauss and Weingarten maps,	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about functions of several variables
CO2	To learn about the analytical and geometric concepts of curves and its variations To study about cuvature and sufaces
CO3	To know The Gauss and Weingarten maps, To learn Guassian and mean curvature.

Faculty in Charge

Ms. Rossflower

MT3C14 – ADVANCED FUNCTIONAL ANALYSIS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn about metric spaces, normed spaces, Banach spaces and Inner product spaces.

MODULE I

Metric spaces and Continuous Functions, Lp spaces , Fourier series and Integrals, Normed spaces Continuity of linear maps

MODULE II

Hahn-Banach Theorems, Banach spaces, Uniform Boundedness Principle

MODULE III

Closed Graph and Open Mapping Theorems, Bounded Inverse Theorem, Inner product spaces, Orthonormal sets

TEXTBOOK

LIMAYE , B.V, FUNCTIONAL ANALYSIS, (2nd Edn.) New Age International Ltd, Publishers, New Delhi, Bangalore (1996)

REFERENCES

[1]R. Bhatia, Notes on Functional Analysis TRIM series, Hindustan Book Agency

[2]KesavanS, Functional Analysis TRIM series, Hindustan Book Agency

[3] S David Promislow, A First Course in Functional Analysis Wiley Interscience, John wiley & Sons, INC., (2008)

[4]E.Kreyszig, Introductory Functional Analysis with Applications John Wiley & Sons (1978)

OBJECTIVES

- To define Metric spaces along with examples.
- To study normed spaces and its continuity.
- To learn Hahn Banach theorems.
- To understand Banach spaces.
- To study about Inner product spaces and orthonormality.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Metric spaces.L_p spaces. Normed spaces. Continuity of linear maps	• Discussion • Participative learning • Problem solving • Lecture	Assignments on examples of metric spaces and normed spaces.	To study about metric spaces and its properties. To learn normed spaces.	Evaluation through test paper.
MODULE II	Hahn Banach Theorems. Banach spaces.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on corollaries of Hahn Banach theorems.	To learn Hahn Banach theorem and study about Banach spaces	Evaluation through test paper.
MODULE III	Closed graph theorem. Open mapping theorem. Inner products. Orthonormality.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students	To study important theorems. To learn about Inner products and orthonormal space.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about metric space and normed space along with its continuity
CO2	To study Hahn Banach theorem and Uniform Boundedness principle
CO3	To learn about inner products and orthonormal spaces.

Faculty in charge:
Krishnamol Ravindran

MT3C15: PDE and Integral Equations
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic theory of PDE and Integral Equations.

MODULE I

First Order PDE .

MODULE II

Second Order PDE .

MODULE III

Integral Equations

TEXTS : 1. AMARNATH, M., : PARTIAL DIFFERENTIAL EQUATIONS, Narosa , New Delhi (1997)

2. HILDEBRAND, F.B.: METHODS OF APPLIED MATHEMATICS, (2 nd Edn.) Prentice-Hall of India, New Delhi, 1972

REFERENCES :

1. G. Birkhoff & G.C. Rota : Ordinary Differential Equations, Edn. Wiley & Sons 3rd Edn (1978)
2. E.A. Coddington : An Introduction to Ordinary Differential Equations, Printice Hall of India, New Delhi (1974)
3. P. Hartman : Ordinary Differential Equations, John Wiley & Sons (1964)
4. L.S. Pontriyagin : A Course in Ordinary Differential Equations, Hindustan Pub. Corporation, Delhi (1967)
5. F. John : Partial Differential Equations, Narosa Pub. House New Delhi (1986)
6. Phoolan Prasad & : Partial Differential Equations, Renuka Ravindran Wiley Eastern Ltd New Delhi (1985)
7. R. Courant and D.Hilbert : Methods of Mathematical Physics , Vol I, Wiley Eastern Reprint (1975) 8. W.E. Boyce & R.C. Deprima : Elementary Differential Equations, and Boundary Value Problems John Wiley & Sons, NY, 9th Edition

OBJECTIVES

a) **To study the basic methods of solving partial differential equations.**

b) **To study different methods for solving second order linear and nonlinear pde.**

c) **To study the classification of PDE and to obtain the canonical forms.**

d) **To understand the relation between integral equations and differential equations and to study different methods to solve integral equations.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (35 hours)	Linear equations of first order,Quasilinear equations, method of characteristics, the Lagrange method, Charpit method, Jacobi method, Cauchy problem	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on different methods of solving first order pde	To understand: • Different types of PDE • methods to solve pde • solving non linear problem	Evaluation through test paper and interaction with students

Module I1 (30 hours)	Classification of second order pde, solving wave, heat and Laplace equations, Separation of variables, canonical form, Cauchy problem for second order pde	• Lecture • Discussion • Participative learning • Problem solving	Student seminars to understand the method of solving wave, heat and Laplace equations	To understand: • Methods to solve second order PDE • Solutions of heat, wave and Laplace equations	Evaluation through test paper
Module III (25 Hours)	Integral equations, Fredholm and Volterra equations, Resolvent kernel,Neumann series, Fredholm Schmidt theory	• Lecture • Discussion • Participative learning • Problem solving	• Assignment and problem solving sessions on Integral equations	To understand: • Relation between integral equation and differential equation • Methods to solve integral equations of different kinds	Evaluation through test paper

Course Outcomes

CO1	To study different types of PDE and methods for solving them.
CO2	To study methods of solving second order PDE, heat, wave and Laplace equation, Cauchy problem
CO3	To understand the relation between differential equation and integral equations, also different methods to solve integral equations.

Faculty in charge:
Ms Lipsy Paulouse

MT 3C 12: COMPLEX ANALYSIS
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the ideas and concepts of analytic functions and singularities..

MODULE I

Conformality, Linear Transformations, Fundamental Theorems, Cauchy's Integral Formula.

MODULE II

Local Properties of Analytical Functions, The General Form of Cauchy's Theorem, The Calculus of Residues, Harmonic Functions.

MODULE III

Power Series Expansions, Simply Periodic Functions, Doubly Periodic Functions, The Weierstrass Theory.

TEXT: LARS V. AHLFORS : Complex Analysis, 3rd edn. Mc Graw Hill (1979)

REFERENCES :

1. Cartan, H. : Elementary Theory of Analytic Functions of one or Several . Variables, Addison - Wesley Pub. Co. (1973)
2. Conway, J.B. : Functions of One Complex Variable, Narosa Pub. Co., New Delhi. . (1973)
3. Moore T.O. &Hadlock E.H. : Complex Analysis, Series in Pure Mathematics - Vol. 9. World Scientific . (1991)
4. Pennisi, L. : Elements of Complex Variables, Holf, Rinehart & Winston, 2nd Edn. . (1976)
5. Rudin, W. : Real and Complex Analysis, 3rd Edn. McGraw - Hill International . Edn. (1987)
6. Silverman, H. : Compex Variables, Houghton Mifflin Co. Boston (1975)
7. Remmert, R. : Theory of Complex Functions, UTM, Springer- Verlag, NY, (1991)

OBJECTIVES

a) **To understand the basic concepts of** Power series, Analytic functions, Analytic functions as mappings and Mobius transformations.

b) **To get familiarize with** Conformal mappings, Weistrass theory

c) **To understand the** Power series representation of analytic functions, Zeros of an analytic function, The index of a closed curve, Cauchy's Theorem and Integral Formula and the classification of singularities.

LESSON PLAN

Unit/ session / hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Conformal mappings, Cauchy Integral formula	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Power series and Analytic functions	To understand: • Conformal mappings • Fundamental theorems	Evaluation through MCQ
Module I1 (30 hours)	Analytic functions, Harmonic funcions	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about Power series representation of analytic functions	To understand: • Residue theorem • Calculus of residue.	Evaluation through test paper
Module III (30 hours)	Entire functions Wiestrass Theory	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on classification of singularities	To understand: • Simply periodic doubly periodic functions	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of Power series and Analytic functions
CO2	To understand the concept of Cauchy's Theorem and Integral Formula, Open Mapping Theorem and Goursat's Theorem.
CO3	To understand the Argument Principle, the Maximum Principle and Schwarz's Lemma.

Faculty in charge:
Ms.Nikita P B

MTH4E06: Algebraic Number Theory
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the concepts of Algebraic Number Theory.

MODULE I

Symmetric polynomials, Modules, Free abelian groups, Algebraic Numbers, Conjugates and Discriminants, Algebraic Integers, Integral Bases, Norms and Traces, Rings of Integers, Quadratic Fields, Cyclotomic Fields

MODULE II

Historical background, Trivial Factorizations, Factorization into Irreducibles, Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals Historical background, Prime Factorization of Ideals, The norm of an ideal

MODULE III

Lattices, The Quotient Torus, Minkowski theorem, The Space Lst, The Class-Group An Existence Theorem, Finiteness of the Class-Group, Factorization of a Rational Prime, Fermats Last Theorem Some history, Elementary Considerations, Kummers Lemma, Kummers Theorem.

TEXT : I. N. STEWART & D.O. TALL, ALGEBRAIC NUMBER THEORY, (2nd Edn.), Chapman &

Hall, (1987)

REFERENCES :

[1] P. Samuel : Theory of Algebraic Numbers, Herman Paris Houghton Mifflin, NY, (1975)
[2] S. Lang : Algebraic Number Theory, Addison Wesley Pub Co., Reading, Mass, (1970)
[3] bf D. Marcus : Number Fields, Universitext, Springer Verlag, NY, (1976)
[4] 4T.I.FR. Pamphlet No: 4 : Algebraic Number Theory (Bombay, 1966)
[5] Harvey Cohn : Advanced Number Theory, Dover Publications Inc., NY, (1980)
[6] Andre Weil : Basic Number Theory, (3rd Edn.), Springer Verlag, NY, (1974)
[7] G.H. Hardy and E.M. Wright : An Introduction to the Theory of Numbers, Oxford University

Press.
[8] Z.I. Borevich & I.R.Shafarevich : Number Theory, Academic Press, NY 1966.
[9] Esmonde & Ram Murthy : Problems in Algebraic Number Theory, Springer Verlag 2000

OBJECTIVES

a) **To study the basic concepts of numberfield, quadratic field, Guassian field and their properties.**

b) **To study how factorization into irreducibles hold in different fields.**

c) **To understand the concepts of lattices, the quotient torus and geometric representation of algebraic numbers.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Factorization into Irreducibles, Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals, Prime Factorization of Ideals,	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on numberfields and its properties	To understand: • the factorization into irreducibles • different types of numberfields • the factorization of ideals • properties of ideals	Evaluation through test paper and interaction with students

Module I1 (30 hours)	Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals Historical background, Prime Factorization of Ideals, The norm of an ideal	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to understand prime factorization and quadratic fields	To understand: • Nonunique Factorization into Irreducibles • Factorization of Ideals and norm of an ideal	Evaluation Through test paper
Module III (25 Hours)	Lattices, The Quotient Torus, Minkowski theorem, The Space Lst, The Class-Group An Existence Theorem, Finiteness of the Class-Group, Factorization of a Rational Prime, Kummers Lemma, Kummers Theorem	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion and assignments to understand geometric representation of algebraic numbers	To understand: • The Quotient Torus • The class group	Evaluation through test paper

Course Outcomes

CO1	Awareness about different types of numberfield and their properties
CO2	Able to check unique factorization in fields and also can provide examples of nonunique factorizations
CO3	To understand the geometric representation of algebraic numbers

Faculty in charge:
Dr. Vijitha Mukundan

MTH4E09: DIFFERENTIAL GEOMETRY
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the basic concepts of differential geometry.

MODULE I

Graphs and Level Set, Vector fields, The Tangent Space, Surfaces, Vector Fields on Surfaces, Orientation. The Gauss Map .

MODULE II

Geodesics, Parallel Transport, The Weingarten Map, Curvature of Plane Curves, Arc Length and Line Integrals.

MODULE III

Curvature of Surfaces, Parametrized Surfaces, Local Equivalence of Surfaces and Parametrized Surfaces.

TEXT:

J.A.THORPE : ELEMENTARY TOPICS IN DIFFERENTIAL GEOMETRY

REFERENCES :

1) M. de Carmo : Differential Geometry of Curves and Surfaces, Prentice Hall Inc Englewood Cliffs NJ (1976).
2) V. Grilleman and A. Pollack : Differential Topology, Prentice Hall Inc Englewood Cliffs NJ (1974)
3) B. O'Neil : Elementary Differential Geometry, Academic Press NY (1966)
4) M. Spivak : A Comprehensive Introduction to Differential, Geometry, (Volumes 1 to 5), Publish or Perish, Boston (1970, 75)
5) R. Millmen and G. Parker : Elements of Differential Geometry, Prentice Hall Inc Englewood Cliffs NJ (1977)
6) I. Singer and J.A. Thorpe : Lecture Notes on Elementary Topology and Geometry, UTM, Springer Verlag, NY (1967)
7) W.L.Burke: Applied Differential Geometry , Cambridge University Press (1985).

OBJECTIVES

a) **To understand the basic concepts of level sets, surfaces and its curvature, geodesics,and parametrized surfaces .**

b) **To get familiarize with covariant derivatives and its properties.**

c) **To understand the concept of local and global parametrization.**

d) **To study more about parametrized surfaces and local equivalence of surface and parametrized surfaces.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I (30 hours)	Level sets,vector fields, the tangent space, surfaces and the gauss map.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on vector fields and level sets.	To understand: • the basics of surfaces • notion of tangent space and the gauss map	Evaluation Through MCQ
Module II (30 hours)	Geodesics, Parallel transport, The Weingarten map, Arc length and line integrals.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of derivatives of smooth vector field and covariant derivative.	To understand: • Local and global parametrization. • Concept of parallel transport.	Evaluation Through test paper
Module III	Curvature of surfaces, First and second fundamental	• Lecture • Discussion • Participative	• Seminar and assignment on local	To understand: • Principal, Gaussian, Gauss	Evaluation through test paper

(30 Hours)	forms,Parametrized surfaces and its local equivalence with surfaces.	learning • Problem solving	equivalence of surfaces and parametrized surfaces.	Kronecker and Mean curvature • Inverse function theorems.	

Course Outcomes

CO1	To introduce the concept of graphs and level sets, basics of surfaces and notion of tangent space anf gauss map.
CO2	To understand the concept of parallel transport, local and global parametrization, arc length and line integral.
CO3	To understand the principal ,Gaussian ,Gauss Kronecker and Mean curvature, and parametrized surfaces.

Faculty in charge:
Dr. Nidhin T J

MT4E11 – ADVANCED FUNCTIONAL ANALYSIS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn about duality, compactness and boundedness of spaces.

MODULE I

Duals and Transposes, Duals of Lp [a,b] and C[a,b], weak and weak* convergence, Reflexivity

MODULE II

Definition of Compact Linear Map, spectrum of a compact operator, Riesz Representation Theorems

MODULE III

Bounded Operators and Adjoints , Normal, Unitary and Self Adjoint Operators , Spectrum and Numerical Range , Compact self Adjoint Operator

TEXTBOOK

LIMAYE , B.V, FUNCTIONAL ANALYSIS, (2nd Edn.) New Age International Ltd, Publishers, New Delhi, Bangalore (1996)

REFERENCES

[1]R. Bhatia, Notes on Functional Analysis TRIM series, Hindustan Book Agency

[2]KesavanS, Functional Analysis TRIM series, Hindustan Book Agency

[3] S David Promislow, A First Course in Functional Analysis Wiley Interscience, John wiley & Sons, INC., (2008)

[4]E.Kreyszig, Introductory Functional Analysis with Applications John Wiley & Sons (1978)

OBJECTIVES

- To understand the concept of duality and reflexivity.
- To study spectrum of compact operators.
- To understand the concept of Bounded linear operators and its types.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Dual spaces. Weak convergence Reflexivity	• Discussion • Participative learning • Problem solving • Lecture	Assignments on examples of dual spaces	To study about duality and weak convergence. To learn reflexivity.	Evaluation through test paper.
MODULE II	Compact operators and its spectrum. Riesz Representation theorems.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on compact operators and examples	To learn about spectrum of compact operators	Evaluation through test paper.
MODULE III	Bounded operators. Adjoint, normal, unitary and self adjoint operators. Compact self adjoint operator.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students	To study Self adjoint operators and compactness.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about duality and the concept of reflexivity
CO2	To learn about compact operators
CO3	To learn about Bounded linear operators and self adjoint operators

Faculty in charge: Ms. Amala Mary George

MTH4C11: GRAPH THEORY
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the basic concepts of Graph theory.

Module 1

Basic concepts of Graph. Trees, Cut edges and Bonds, Cut vertices, Cayleys Formula, The Connector Problem, Connectivity, Blocks, Construction of Reliable Communication Networks, Euler Tours, Hamilton Cycles, The Chineese Postman Problem, The Travelling Salesman Problem.

Module 2

Matchings, Matchings and Coverings in Bipartite Graphs, Perfect Matchings, The Personnel Assignment Problem, Edge Chromatic Number, Vizings Theorem, The Timetabling Problem, Independent Sets, Ramseys Theorem

Module 3

Vertex Colouring-Chromatic Number, Brooks Theorem, Chromatic Polynomial, Girth and Chromatic Number, A Storage Problem, Plane and Planar Graphs, Dual Graphs, Eulers Formula, Bridges, Kuratowskis Theorem, The Five-Colour Theorem, Directed Graphs, Directed Paths, Directed Cycles.

TEXT : J.A. Bondy and U.S.R.Murty : Graph Theory with applications. Macmillan

References

[1] F. Harary : Graph Theory, Narosa publishers, Reprint 2013.
[2] Geir Agnarsson, Raymond Greenlaw: Graph Theory Modelling, Applications and Algorithms, Pearson Printice Hall, 2007.
[3] John Clark and Derek Allan Holton : A First look at Graph Theory, World Scientific (Singapore) in 1991 and Allied Publishers (India) in 1995
[4] R. Balakrishnan & K. Ranganathan : A Text Book of Graph Theory, Springer Verlag, 2nd edition 2012.

OBJECTIVES

a) **To understand the basic concepts of graphs, Trees, Cut edges and Bonds, Cut vertices, Euler Tours, Hamilton Cycles**

b) **To get familiarize with Matchings and Coverings in Bipartite Graphs, Perfect Matching, Independent Sets, Ramseys Theorem**

c) **To understand the concept of Vertex Colouring-Chromatic Number, Edge Chromatic Number , The Five-Colour Theorem, Directed Graphs.**

d) **To study more about Chromatic Polynomial, Girth and Chromatic Number**

e) **To understand The Five-Colour Theorem, Directed Graphs, Directed Paths, Directed Cycles.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Basic concepts of graph, Trees, Cut edges and Bonds, Cut vertices, Connectivity, Blocks, Euler Tours, Hamilton Cycles	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic concepts of graph	To understand: • the basics of graph, trees • Concepts of cut edges, cut vertices, Euler tour and Hamilton cycles	Evaluation Through MCQ
Module I1 (30 hours)	Matchings and Coverings, Perfect Matchings, Edge Chromatic Number, Vizings Theorem, Independent Sets, Edge colouring,Ramseys Theorem	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the Personnel Assignment Problem and The Timetabling Problem	To understand: • differentiation of matchings and covering • Concepts of edge colouring and Ramseys theorem	Evaluation Through test paper
Module III (30 Hours)	Vertex Colouring-Chromatic Number, Brooks Theorem, , Plane and Planar Graphs, Dual Graphs, Eulers Formula, Bridges, Kuratowskis Theorem, The Five-Colour Theorem, Directed Graphs,	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on Storage Problem	To understand: • Vertex colouring and it's important results • Planar graphs, dual graphs and it's important result	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of basic graph theory, trees, cut vertices and cut edges, Euler tour and Hamilton cycles
CO2	To understand the concept of matchings and covering, Edge colouring.
CO3	To understand the concepts of vertex colouring and it's important results. Planar graphs and dual graphs.

Faculty in charge:
Ms Linet Roslin Antony

ST1CO1 BASIC STATISTICS AND PROBABILITY

Lecture Hours per week: 4, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

Introduce basic concepts of statistics and to understand various approaches to probability and compute probabilities.

Module I (20 hrs)

Population, sample, measures of central tendency - arithmetic mean, weighted arithmetic mean, geometric mean, harmonic mean, median, mode, partition values - quartile, percentile, measures of deviations - variance, standard deviation, mean deviation about mean, quartile deviation, co-efficient of variation

Module II (15 hrs)

Fitting of straight line, parabola, exponential, polynomial, (least square method), correlation, regression, two regression lines, regression coefficients, properties - rank correlation, partial and multiple correlation

Module III (25 hrs)

Random experiment, Sample space, event, classical definition of probability, statistical regularity, relative frequency definition, field, sigma field, axiomatic definition of probability and simple properties, concept of probability measure, addition theorem(two and three events), conditional probability of two events, multiplication theorem, independence of events(pair wise and mutual), Bayes theorem. –numerical problems

Module IV (12 hrs)

Random variable- discrete and continuous, probability mass function (pmf) and probability density function (pdf) properties and examples, Cumulative Distribution function and its properties , change of variable (univariate case)

Reference Books:

1) V. K. Rohatgi, An Introduction to Probability Theory and Mathematical

Statistics, Wiley Eastern.

2) S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chan and Sons

3) A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill

4) John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

OBJECTIVES

1) To understand the basic concepts of population and sample
2) To summarize the data in a diagrammatic and graphical way, obtain descriptive statistics and make possible and appropriate interpretations
3) To understand various approaches to probability and compute probabilities.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	Population, sample, measures of central tendency, measures of deviations	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on methods of sampling	To understand advantages and limitations of sampling	Evaluation through test paper
Module II **15 Hours**	Fitting of straight line , parabola, exponential, polynomial, correlation, regression, two regression lines,	• Lecture • Discussion • Participative learning • Problem solving	• Students seminar related to curve fitting	To solve problems related to curve fitting	Evaluation through test paper

	regression coefficients, properties - rank correlation, partial and multiple correlation				
Module III **25 Hours**	Random experiment, Sample space, event, classical definition of probability, axiomatic definition of probability and simple properties, addition theorem, conditional probability of two events, multiplication theorem, independence of events, Bayes theorem	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to compute probabilities	To understand basic definition and properties of probability	Evaluation through test paper and viva
Module IV **12 Hours**	Random variable- discrete and continuous, probability mass function and	• Lecture • Discussions • Problem solving	• Student seminars on probability mass function , probability	To understand discrete and continuous random variables	Evaluation through test paper

	probability density function , Cumulative Distribution Function and its properties change of variable		density function and their properties		

Course Outcomes

CO1	To understand advantages and limitations of sampling
CO2	To summarize the data in a diagrammatic and graphical way, obtain descriptive statistics and make possible and appropriate interpretations
CO3	To understand various approaches to probability and compute probabilities
CO4	To understand discrete and continuous random variables and their probability functions

Teacher in Charge:

Ms. Nikita P B

ST2CO2 : PROBABILITY DISTRIBUTIONS

Lecture Hours per week: 4, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce the idea about mathematical expectation and conditional probability of univariate, Bivariate random variable, Also the standard distribution and its properties.

Module I (15 hrs)

Mathematical expectations (univariate): Definition, raw and central moments (definition and relationships), moment generating function and properties, characteristic function (definition and use only), Skewness and kurtosis (using moments)

Module II (15 hrs)

Bivariate random variable: joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.

Module III (30 hrs)

Standard distributions: Discrete type Bernoulli, Binomial, Poisson, Geometric, negative binomial (definition, properties and applications), Uniform (mean, variance and mgf), Continuous typeUniform, exponential, gamma, Beta, Normal (definition, properties and applications), Lognormal, Pareto and Cauchy (Definition only).

Module IV (12 hrs)

Chebyshev's inequality, variables, Convergence in probability weak law of large numbers (iid case), Bernoulli law of large numbers, example only), Central limit theorem (Lindberg Levyiid case).

Reference Books:

1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill
4. John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

OBJECTIVES

1. Discribe the moments, mgf, expectations, characteristic function, Skewness , kurtosis of univariate and bivariate random variable.
2. Give the knowledge of important discrete and continuous distributions such as Binomial, Poisson,

   Geometric, Negative Binomial and Hyper-geometric, normal, uniform, exponential, beta and gamma distributions
3. Understand the Concept of law large numbers and their uses.
4. Understand the Concept of central limit theorem and its uses.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **15 Hours**	Mathematical expectations (univariate): Definition, raw and central moments (definition and relationships), moment generating function and properties, characteristic function (definition and use only), Skewness and kurtosis (using moments)	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to mathematical expectation, raw and cenral moments, mgf	• Understand the definition of moments, mgf , characteristic function, Skewness and kurtosis	Evaluation through test paper
Module II **15 Hours**	Bivariate random variable: joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars on the topic bivariate Expectations, conditional mean variance, and covariance.	• Give knowledge related to the concept of Bivariate random variable including expectation moments and mgf.	Evaluation through test paper

Module III 30 Hours	Standard distributions: Discrete type Bernoulli, Binomial, Poisson, Geometric, negative binomial, Uniform, Continuous typeUniform, exponential, gamma, Beta, Normal, Lognormal, Pareto and Cauchy.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on discrete and Continuous distribution.	• Enable to understand different type of distribution.	Evaluation through test paper
Module IV 12 Hours	Chebyshev's inequality, variables, Convergence in probability weak law of large numbers (iid case), Bernoulli law of large numbers, example only), Central limit theorem (Lindberg Levyiid case).	• Lecture • Discussion • Participative learning • Problem solving	• Assignment on the topic sample mean and variance.	• Understand the weak law of large numbers, Bernoulli law of large numbers, Central limit theorem and its applications	Evaluation through test paper and viva

Course Outcomes

CO1	Understand the concept of uni variate, Bivariate Discrete and continuous random variable including expectation, moments and mgf.
CO2	Enable one to identify and classify different type of standard distribution.
CO3	Understand the weak law of large numbers, Bernoulli law of large numbers, Central limit theorem and its applications.

Teacher in Charge:

Ms Geethu Simon

ST3CO3: STATISTICAL INFERENCE
Lecture Hours per week: 5, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

Introduce different type of sampling distributions and the concept of testing hypotheses.

Module I (25 hrs)

Sampling distributions: Statistic, Sampling distribution of a statistic, Standard error, Sampling from normal distribution, distribution of sample mean, sample variance, chisquare distribution, t distribution, and F distribution (definition, derivations and relationships only).

Module II (20 hrs)

Theory of Estimation: Point Estimation, desirable properties of a good estimator, unbiasedness, consistency, sufficiency, Fisher Neyman factorization theorem, efficiency. Methods of Estimation: Method of maximum likelihood, method of moments

Module III (15 hrs)

Interval Estimation: Interval estimates of mean, difference of means, variance, proportions and difference of proportions. Derivation of exact confidence intervals for means, variance and ratio of variances based on normal, t, chi square and F distributions

Module IV (30 hrs)

Testing of Hypotheses: concept of testing hypotheses, simple and composite hypotheses, null and alternative hypotheses, type I and II errors, critical region, level of significance and power of a test. Neyman Pearson approach: Large sample tests concerning mean equality of means, proportions, equality of proportions, Small sample tests based on t distribution for mean, equality of means and paired t test. Tests based on Fdistribution for ratio of variances. Tests based on Chi square distribution for variance, goodness of fit and for independence of attributes.

Reference Books:

1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill
4. John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

OBJECTIVES

- Introduce different type of sampling distributions.

- Introduce the concept of random sample from a distribution, sampling distribution of a statistic, standard error of important estimates such as mean and proportions
- knowledge about important inferential aspects such as point estimation, test of hypotheses and associated concepts
- Introduce Neyman Pearson approach in testing of hypotheses.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **25 Hours**	Statistic, Sampling distribution of a statistic, Standard error, Sampling from normal distribution, distribution of sample mean, sample variance, chisquare distribution, t distribution, and F distribution	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on chisquare distribution, t distribution, and F distribution.	• Understand different type of sampling distributions.	Evaluation through test paper
Module II **20 Hours**	Point Estimation, desirable properties of a good estimator, unbiasedness, consistency, sufficiency, Fisher Neyman factorization theorem, Method of maximum likelihood,	• Lecture • Discussion • Participative learning • Problem solving	• Seminar on the topic Method of maximum likelihood and method of moments.	• Understand point estimation methods.	Evaluation through test paper.

	method of moments.				
Module III **15 Hours**	Interval estimates of mean, difference of means, variance, proportions and difference of proportions. Derivation of exact confidence intervals for means, variance and ratio of variances based on normal, t, chi square and F distributions	• Lecture • Discussion • Participative learning • Problem solving	• Seminar related to the topic difference of means, variance, and difference of proportions.	• Understand Interval estimation methods	Evaluation through Group Discussion.
Module IV **30 Hours**	concept of testing hypotheses, simple and composite hypotheses, null and alternative hypotheses, type I and II errors, critical region, level of significance and power of a test. Large sample tests, proportions, equality of proportions, Small sample tests based on t distribution for mean, equality of means and paired t test. Tests based on Fdistribution for ratio	• Lecture • Discussions • Problem solving	• Student seminars in connection with type I and II errors.	• Become familiar with the concept of testing hypotheses and different sample tests.	Evaluation through test paper

	of variances. Tests based on Chi square distribution for variance, goodness of fit and for independence of attributes.				

Course Outcomes

CO1	Understnd different sampling distribution and its properties.
CO2	Understand the tecniques of estimation and testing hypotheses for mean, variance, proportions, correlation coefficient, association and goodness of fit.
CO3	Knowledge of point and interval estimation proceduers and different method of point estimation.

Teacher in Charge:

Ms Lipsy Paulouse

ST4CO4 APPLIED STATISTICS

Lecture Hours per week: 5, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce sampling techniques and statistical quality control

Module I (20 hrs)

Census and Sampling, Principal steps in a sample survey, different types of sampling, Organisation and execution of large scale sample surveys, errors in sampling(sampling and non sampling errors), preparation of questionnaire, simple random sampling with and without replacement, Systematic, stratified and cluster sampling

Module II (15 hrs)

Analysis of variance; one way, two way classifications. Null hypothesis, total, between and within sum of squares. Assumptions - ANOVA table..

Module III (30 hrs)

Time series : Components of time series additive and multiplicative models , measurement of trend , moving averages, seasonal indicessimple averageratio to moving average., Index numbers: meaning and definition uses and types - problems in the construction of index numbers -different types of simple and weighted index numbers. Test for an ideal index number - time and factor reversal test.

Module IV (25 hrs)

Statistical Quality Control: Concept of statistical quality control, assignable causes and chance causes, process control, Construction of control charts, 3sigma limits, Control chart for variables -Mean chart and Range chart, Control chart for attributes - pchart, d or np chart and c chart

Reference Books:

1) S.C.Gupta and V. K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand and Sons
2) Grant E L, Statistical quality control, McGraw Hill
3) Duncan A J, Quality Control and Industrial Statistics, Taraporewala and sons
4) Montegomery D C, Introduction to Statistical Quality Control, John Wiley and sons

5) S.P.Gupta: statistical methods

OBJECTIVES

1) To equip students with sampling techniques used in conducting sample surveys.
2) To understand the concepts of ANOVA model
3) To expose the area of time series and index numbers.
4) To provide an insight into quality assessment techniques.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	Census and Sampling, Principal steps in a sample survey, different types of sampling, Organisation and execution of large scale sample surveys, sampling and non sampling errors, simple random sampling with and without replacement, Systematic,	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on sampling and sample survey	To understand sampling techniques used in conducting sample surveys	Evaluation through test paper

	stratified and cluster sampling				
Module II **15 Hours**	Analysis of variance; one way, two way classifications, Null hypothesis, Assumptions - ANOVA table..	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding variance between the samples	To understand the concepts of ANOVA model	Evaluation through test paper and viva
Module III **30 Hours**	Time series, Components of time series, measurement of trend, moving averages, seasonal indices, Index numbers, different types of simple and weighted index numbers, time and factor reversal test.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars related to components of time series	To understand time series, seasonal indices and index numbers	Evaluation through MCQ and Group Discussion
Module IV **25 Hours**	Statistical Quality Control, assignable causes and chance causes, process control, Construction of	• Lecture • Discussions • Problem solving	• Assignment to construct control charts	To understand statistical quality control and its uses	Evaluation through test paper

	control charts, 3sigma limits, Control chart for variables- Mean chart and Range chart,Control chart for attributes- pchart, d or np chart and c chart				

Course Outcomes

CO1	To understand sampling techniques used in conducting sample surveys
CO2	To understand the concepts of ANOVA model
CO3	To learn the concepts of time series and index numbers
CO4	To provide an insight into quality assessment techniques.

Teacher in Charge:

Ms. Nikita P B

MAT 1C01 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 4 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of limit, Continuity, derivatives and integration.

MODULE I

Limits and Continuity: Rules for finding limits. Target values and formal definitions of limits. Extensions of limit concept, Continuity, Tangent lines

.

MODULE II

Derivatives: The derivative of a function, a quick review of differentiation rules, rate of Change.

MODULE III

Application of derivatives: Extreme values of a function. The mean value theorem, First derivative test, Graphing with y' and y''. Limits as x approaches infinity. Asymptotes and dominant terms, Linearization and differentials. The L'Hopital's Rule.

MODULE IV

Integration: Riemann sums and Definite integrals; properties, areas and the Mean value theorem. The Fundamental theorem. Application of Integrals: Areas between curves, Finding Volumes by slicing.

TEXTBOOKS

George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.

[2] Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

OBJECTIVES

- To understand the basics of limits and continuity.
- To learn derivatives and differentiation rules
- To learn about applications of derivatives
- To understand L'Hospital's rule.
- To study in detail Riemann sums and integration.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I (20 hours)	Limits and Continuity Epsilon – delta definitions	• Discussion • Participative learning • Problem solving	Discussions Lectures and Quizzes	Limits, Sandwich theorem,	Evaluation through test paper.
MODULE II (12 hours)	Derivatives and differentiation rukes	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about differentiation rules.	Derivatives and rate of Change.	Evaluation through test paper.
MODULE III (24 hours)	Applications of derivatives, Graphing of functions	• Lecture • Discussion • Participative learning • Problem solving	Discussion Maximum minimum points	Plot graphs of a function by finding maximum and minimum points using derivatives	Evaluation through MCQ.
MODULE IV (16 hours)	Riemann Sums and integration and applications of integration	• Lecture • Discussion • Participative learning • Problem solving	Discussion on integration concepts	Integration concept using Riemann sums, area of surfaces	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about limit continuity and derivatives
CO2	To learn application of derivatives To study about plotting function graphs
CO3	To know about integration and its origin To learn about applications of integration

Faculty in Charge

Dr. Nidhin T J

Ms. Smitha Davis

MAT 2C02 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 4 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of hyperbolic functions, improper integrals, partial differentiation, infinite series and polar coordinates.

MODULE I

Hyperbolic Functions - Definitions and Identities, Derivatives and Integrals, Inverse Hyperbolic , functions - Derivatives and Integrals, Application of Integrals :, Volumes of Solids of Revolution (Disk method only), Lengths of plane curves. Areas of surfaces of revolution Improper Integrals, Convergence and Divergence, Tests for Convergence and Divergence, Direct Comparison Test and Limit Comparison Test

.

MODULE II

Limit of Sequences of Number, Theorems for calculating limits of sequences (Excluding Picard's Method), Infinite series, The ratio and root test for series of non negative terms, alternating series, Absolute and conditional convergence, Power Series, Taylor and Maclaurin Series.

MODULE III

Polar coordinates, Graphing in Polar Coordinates, Polar equations for conic sections, integration in Polar coordinates, Cylindrical and Spherical Coordinates.

MODULE IV

Functions of Several Variables, Limits and Continuity, Partial Derivatives, differentiability, Chain rule

.

TEXTBOOKS

George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.

[2] Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

OBJECTIVES

- To understand the Hyperbolic functions and improper integrals.
- To learn about sequences and series.
- To learn about polar coordinates and is graphing.
- To understand functions of several variables.
- To study partial differntiaition .

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I (20 hours)	Hyperbolic functions, Applications of integrals, improper integrals.	• Discussion • Participative learning • Problem solving	Discussions Lectures and Quizzes	Integrats and derivatives of Hyperbolic functions, Improper integrals, Volume and area of integrals	Evaluation through test paper.
MODULE II (28 hours)	Sequences and series of real numbers	• Lecture • Discussion • Participative learning • Problem solving	.Discussion about convergence of various series.	Convergence and divergence of series. Taylor and Maclaurin series.	Evaluation through test paper.
MODULE III (10 hours)	Polar Coordinates, Graphing, Cylindrical and Spherical coordinates.	• Lecture • Discussion • Participative learning • Problem solving	Discussion on cylindrical and spherical coordinates	Plot graphs of polar coordinates	Evaluation through MCQ.
MODULE IV (14 hours)	Functions of several variables, partial derivatives	• Lecture • Discussion • Participative learning • Problem solving	Discussion on partial derivatives	Partial differentiation	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about Infinite series and its convergence.
CO2	To learn hyperbolic functions and improper integrals. To study about Taylor series and Maclaurain series.
CO3	To know about polar coordinates and its plotting. To learn about partial differentiation.

Faculty in Charge

Dr. Vijitha Mukundan

Ms. Amala Mary George

MAT 3C03 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 5 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of Ordinary differential equations, matrices and vector calculus.

MODULE I

Basic concepts and ideas, Geometrical meaning of y' = f(x,y). Direction Fields, Separable Differential Equations. Exact Differential Equations; Integrating Factors, Linear Differential Equations; Bernoulli Equation, Orthogonal Trajectories of Curves.

MODULE II

Rank of a Matrix, Non-Singular and Singular matrices, Elementary Transformations, Inverse of an elementary Transformations, Row Canonical form, Normal form. Systems of Linear equations: Homogeneous and Non Homogenoeus Equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton Theorem (statement only) and simple applications.

MODULE III

A quick Review of vector algebra, Inner product and vector product in R^2 and R^3 . Vector and scalar functions and Fields, Derivatives, Curves, Tangents, Arc Length, Velocity and acceleration, Gradient of a scalar field; Directional Derivative, Divergence of a vector field, Curl of a Vector Field.

MODULE IV

Line Integrals, Independence of path, Green's Theorem in the Plane (without proof), surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Divergence theorem of Gauss and Stoke's theorem (without proofs).

TEXTBOOKS

1. Erwin Kreyszig : Advanced Engineering Mathematics, Eighth Edition, Wiley, India.

2. Frank Ayres JR : Matrices, Schaum's Outline Series, TMH Edition.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.

[2] Muray R Spiegel, Vector Analysis, Schaum's Outline series, Asian Student Edition.

[3] Shanthi Narayanan & P.K. Mittal, A Text Book of Matrices, S. Chand

[4] Harry F. Davis & Arthur David Snider, Introduction to Vector Analysis, 6th ed., Universal Book Stall, New Delhi.

OBJECTIVES

- To understand the concepts in ordinary differential equations
- To learn about matrices and its properties
- To learn about Cayley Hamilton theorem
- To understand vectors
- To study in detail Vector Calculus

LESSON PLAN

Unit/Session (hours required)	Topics to be taught (input)	Procedure(process) Student centric method of teaching	Activity	Learning Outcome (output)	Assessment
MODULE I (20 hours)	Modeling of differential equations, methods to solve first order differential equations.	• Discussion • Participative learning • Problem solving	Discussions Lectures and Quizzes	Geometrical meaning of ODE, solving I order ODEs	Evaluation through test paper.
MODULE II (20 hours)	Rank of a matrix, solution of system of linear equations, Cayley- Hamilton theorem	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about Eigen values and vectors	Normal and Echoleon form of matrices, Solution of linear system of equations, Eigen values and vectors	Evaluation through test paper.
MODULE III (25 hours)	Introduction to vectors and vector differential calculus	• Lecture • Discussion • Participative learning • Problem solving	Discussion on derivatives of vector functions	Know gradient, divergence, curl of a vector function	Evaluation through MCQ.
MODULE IV (25 hours)	Vector integral calculus	• Lecture • Discussion • Participative learning • Problem solving	Discussion on surface integrals	Greens theorem, Stoke's theorem, Gauss divergence theorem	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about I order ordinary differential equations
CO2	To learn solution of system of linear equations To study about eigen values and eigen vectors.
CO3	To know about vector differential calculus To learn about vector integral calculus

Faculty in Charge

Dr. Vijitha Mukundan

Ms. Linet Roslin Antony

Ms. Amala Mary George

MAT 4C04 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 5 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of Second order differential equations, Laplace tranforms, Fourier series, Numerical methods

MODULE I

Linear Differential equations of Second and Higher order: Differential Operators, Euler-Cauchy Equation, Wronskian, Nonhomogeneous Equations, Solutions by Undetermined Coefficients, Solution by variation of Parameters.

MODULE II

Laplace Transforms: Laplace Transform, Inverse Transform, Linearity, Shifting, Transforms of Derivatives of Integrals, Differential Equations. Unit step Function, Second Shifting Theorem, Dirac Delta Function, Differentiation and integration of Transforms, Convolution, Integral Equations, Partial Fractions, Differential Equations.

.

MODULE III

Fourier Series : Periodic Functions, Trigonometric Series, Fourier Series, Even and Odd functions, Half-range Expansions, Partial differential Equations: Basic Concepts, Vibrating String, Wave Equation, Separation of Variables, Use of Fourier Series

MODULE IV

Numerical Methods: Methods of First-order Differential Equations, Picard's iteration for initial Value Problems. Numerical Integration: Trapezoidal Rule, Simpson's Rule.

TEXTBOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.
[2] Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

[3] Murray R. Spiegel, Laplace Transforms, Schaum's Outline Series.

OBJECTIVES

- To understand the methods to solve II and higher order derivatives
- To learn Laplace and inverse Laplace equations
- To learn about Fourier series and Half range expansions
- To understand classical partial differential equations
- To study in detail some numerical methods for integration and ODEs.

LESSON PLAN

Unit/Session (hours required)	Topics to be taught (input)	Procedure(process) Student centric method of teaching	Activity	Learning Outcome (output)	Assessment
MODULE I (20 hours)	Solution of II and higher order differential equations	• Discussion • Participative learning • Problem solving	Discussions Lectures on wronskian	Euler-Cauchy equations, various methods for solving II order DEs	Evaluation through test paper.
MODULE II (20 hours)	Laplace transforms, Inverse Laplace transforms, Shifting theorems	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about laplace and inverse Laplace transforms	Solution of differential equations using Laplace transforms	Evaluation through test paper.
MODULE III (30 hours)	Fourier series and its half range expansions	• Lecture • Discussion • Participative learning • Problem solving	Discussion on Fourier series expansions of periodic functions	Solution of heat and wave equations using Fourier series	Evaluation through test paper.
MODULE IV (20 hours)	Numerical methods for integration and solving differential equations	• Lecture • Discussion • Participative learning • Problem solving	Discussion on various numerical methods	Runge – Kutta, Euler methods, Trapeziodal, Simpson’s rule.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about Euler- Cauchy equations, method of undetermined coefficients and method of variation of parameters
CO2	To learn Solving differential equations using Laplace transforms To study about Fourier series
CO3	To know about solution of Heat and Wave Equations To learn about various numerical methods.

Faculty in Charge

Ms. Smitha Davis

Ms. Linet Roslin Antony

Dr. Nidhin T J

MAT1B01: FOUNDATIONS OF MATHEMATICS

Lecture Hours per week: 4, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

To get introduced to many mathematical terms.

Module I (16 hrs)

Set operations: Difference and Symmetric difference, Algebra of sets, Duality, Classes of sets, Powersets Relations: Product set, Relations, Composition of relations, Types of relations, Partitions, Equivalence relations with example of congruence modulo relation, Partial ordering relations, n- ary relations.

Module II (16 hrs)

Functions : Identity function, constant functions, product (composition) of functions, theorems on one-one and onto functions, Mathematical functions, Recursively defined functions, Indexed collection of sets, Operations on indexed collection of sets, Equipotent sets, Denumerable and countable sets, Cardinal numbers.

Module III (20 hrs)

Function quick review, Shifting graphs , Limit and continuity , The Sandwich theorem, Target values and formal definition of limits, Extensions of limit concept, Continuity.

Module IV (20 hrs)

Basic Logic: Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators, Propositional equivalence, Logical equivalences, Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Textbooks:

1) **S. Lipschutz**: Set Theory and related topics (Second Edition), Schaum Outline Series, TataMcGraw-Hill Publishing Company, New Delhi.

2) **Thomas /Finney** : Calculus, 9th ed., LPE, Pearson Education.
3) **K.H. Rosen**: Discrete Mathematics and its Applications (sixth edition), Tata McGraw Hill Publishing Company.

Reference Books:

1) P.R. Halmos: Naive Set Theory, Springer.
2) E. Kamke, Theory of Sets, Dover Publishers.
3) Anton : Calculus, Wiley.
4) R.P. Grimaldi: Discrete and Combinatorial Mathematics, Pearson Education.

OBJECTIVES

1) To get familiarized with different set operations.
2) To learn about different kind of functions and sets.
3) To understand concepts like limit and continuity.
4) To introduce basic logic.

LESSON PLAN

Unit/ Hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **16 Hours**	Set operations, Relations.	• Lecture • Discussion • Participative learning • Problem solving	Seminar on Set Operations.	To master in Set Operations.	Evaluation through test paper

Module II **16 Hours**	Functions, Different kinds of Sets.	• Lecture • Discussion • Participative learning • Problem solving	Assignment on One-one and Onto functions.	To understand different kinds of functions and sets.	Evaluation through test paper
Module III **20 Hours**	Shifting Graphs, Limit and Continuity.	• Lecture • Discussion • Participative learning • Problem solving	Peer discussion on Limits.	To get introduced to Limit and Continuity.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Logical equivalences, Quantifiers.	• Lecture • Discussions • Problem solving	Assignment on Logical equivalences.	To understand Logical equivalences.	Evaluation through testpaper

Course Outcomes

CO1	Get introduced to new mathematical terms.
CO2	Understand set properties and set functions.
CO3	Learn about functions and know about limit and continuity
CO4	To appreciate the beauty of logical arguments.

Teacher in Charge:

Ms. Geethu Simon

MAT2B02: CALCULUS

Lecture Hours per week: 4, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce students to the fundamental ideas of differentiability and integrability and also to some basic theorems of differential calculus.

Module I (20 hrs)

Extreme value of functions, The mean value theorem, The first derivative test for local extremum values , Graphing with y' and y'', Limit as x, Assymptotes and dominant terms.

Module II (20 hrs)

Optimization, Linearization and differentials, Riemann sums and definite – integrals, Properties, area and the mean value theorem, The fundamental theorem, Substitution in Definite Integrals.

Module III (20 hrs)

Areas between curves, Finding volumes by slicing ,Volumes of solids of revolution, Lengths of plane curves, Areas of surface of revolution.

Module IV (12 hrs)

Moments and centres of mass, Work

Textbooks:

1) **Thomas / Finney**: Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1) Anton : Calculus, Wiley.
2) S.K. Stein : Calculus with Analytic Geometry, McGraw Hill.

OBJECTIVES

1) To get an idea of sketching of curves.
2) To see different applications of derivatives and integrals.
3) To solve some optimization problems of interest in real life.
4) To establish the close connection between the two branches of Calculus: Differential and Integral Calculus.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	Extreme value of functions, The mean value theorem, The first derivative test for local extremum values , Graphing with y' and y'', Limit as x, Assymptotes and dominant terms.	• Lecture • Discussion • Participative learning • Problem solving	Group discussion on Curve Sketching	To understand several techniques of sketching curves and learning limits.	Evaluation through test paper and group discussion
Module II **20 Hours**	Optimization, Linearization and differentials, Riemann sums and definite – integrals, Properties, area and the mean value	• Lecture • Discussion • Participative learning • Problem solving	Assignment to find integrals of functions	To deal with real life problems in Physics, Chemistry etc.	Evaluation through test paper

	theorem, The fundamental theorem, Substitution in Definite Integrals.				
Module III **20 Hours**	Areas between curves, Finding volumes by slicing, Volumes of solids of revolution, Lengths of plane curves, Areas of surface of Revolution	• Lecture • Discussion • Participative learning • Problem solving	Assignment to find volume of some familiar objects	To explore relationship between Surfaces and Curves	Evaluation through testpaper
Module IV **12 Hours**	Moments and centres of mass, Work	• Lecture • Problem solving • Participative learning • Videos	Seminars related to Centre of Mass	To understand concepts like Work and Moment.	Evaluation through test paper and viva

Course Outcomes

CO1	To explore the relationship between moving/changing objects
CO2	To master integrals which is a powerful tool in solving problems in Physics, Chemistry, Biology, Engineering, Economics and other fields.
CO3	To deal with real life optimization problems.
CO4	To learn the practical way of evaluating the definite integral.

Teacher in Charge:

Ms. Geethu Simon

MAT3B03 CALCULUS AND ANALYTIC GEOMETRY

Lecture Hours per week: 5, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce fundamentals of calculus and geometry

Module I (15 hrs)

Natural logarithms, The Exponential function, and log , Growth and decay ,
L'Hopital's Rule, Relative rates of growth, Hyperbolic functions

Module II (25 hrs)

Limits of sequence of numbers,Theorems for calculating limits of sequences, Infinite series, Integral test for series of non-
negative terms,Comparison test for series of non negativeterms,Ratio and root test for series of non negati veterms, Alternating series, Absolute and conditional convergence.

Module III (15 hrs)

Power series, Taylor and Maclaurin's series, Convergence of Taylor series ,Error estimate

Module IV (35 hrs)

Conic section and quadratic equations, Classifying conic section by eccentricity ,Quadratic equations and rota tions, Parametrisation of plane curves, Calculus with parametrisedcurves,Polar coordinates, Graphing in polar co- ordinates, Polar equations for conic sections, Integration in polar coordinates.

Textbooks :

1) Thomas / Finney: Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1) Anton : Calculus, Wiley.

2) S.K. Stein : Calculus and Analytic Geometry, McGraw Hill

OBJECTIVES

1) To know transcendental functions such as natural logarithmic and exponential function.
2) To study a related notion of convergence of series
3) To study Power series, Taylor series , Maclaurin's series and their convergence
4) To understand parametrisation of plane curves

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **15 Hours**	Natural logarithms , The Exponential function, and log , Growth and decay ,L'Hopital's Rule, Relative rate of growth, Hyper-bolic functions.	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on Growth and decay functions	To understand transcendental functions	Evaluation through test paper
Module II **25 Hours**	Limits of sequence of numbers, Infinite series, Integral test for series,Comparison test ,Ratio and root test , Alternating series, Absolute and co	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to convergence tests of infinite series	To understand convergence of sequences and series	Evaluation through test paper

	nditional converg ence.				
Module III **15 Hours**	Power series, Tay lor and Maclaurin's series, Convergence of Taylor series , Error estimate	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on power series	To study power series and convergence	Evaluation through test paper and group discussion
Module IV **35 Hours**	Conic section and quadratic equations ,Quadratic equation and rotations, Para metrisation of plane curves,Polar coordinates, Graph ing in polar co-ordinates, Polar eq uations for conic se ctions, Integration in polar coordinate s	• Lecture • Discussions • Problem solving	• Student seminars in connection with polar coordinates	To understand parametrisation of plane curves	Evaluation through test paper

Course Outcomes

CO1	To understand transcendental functions such as natural logarithmic and exponential function
CO2	To handle the convergence of series with different tests.
CO3	To learn Power series, Taylor series , Maclaurin's series and their convergence
CO4	To understand parametrisation of plane curves

Teacher in Charge:

Ms. Reshma Joshy

Ms. Jiji Pauly

MAT4B04: THEORY OF EQUATIONS, MATRICES AND VECTOR CALCULUS

Lecture Hours per week: 5, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

Develops a new and fundamental ideas of calculus for the simple, but important case of polynomials. Also uses the matrices to solve system of linear equations.

Module I (30 hrs)

Polynomial Equations and Fundamental Theorem of Algebra(without proof). Applications of the Fundamental theorem to equations having one or more complex roots, Rational roots or multiple roots. Relations between roots and co-efficients of a polynomial equation and computation of symmetric functions of roots.Finding equations whose roots are functions of the roots of a given equation. Reciprocal equation and method of finding its roots. Analytical methods for solving polynomial equations of order up to four - quadratic formula.Cardano's method for solving cubic equations.Ferrari's method (for quadratic equations). Remarks about the insolvability of equations of degree five or more.Finding the nature of roots without solving Descartes' rule of signs.

Module II (16 hrs)

Elementary transformation, reduction to normal form, row reduced echelon form.Computing the inverse of a non singular matrix using elementary row transformation.

Module III (20 hrs)

System of linear homogeneous equations.Null space and nullity of matrix. Sylvester's law of nullity.Range of a matrix.Systems of linear non homogeneous equations. Characteristic roots and characteristic vectors of a square matrix. Some fundamental theorem.Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices.Characteristic equation of a matrix, Cayley- Hamilton theorem

Module IV (24 hrs)

Lines and planes in space. Cylinders and Quadric surfaces, Cylindrical and spherical coordinates, Vector valued functions and space curves, Arc length and Unit tangent vector , Curvature, torsion and TNB frame

Textbooks :

1. Bernard and Child: Higher Algebra, Macmillan

2.Shanti Narayanan &Mittal : A Text Book of Matrices, Revised edn., S. Chand

3. Thomas /Finney : Calculus, 9th ed., LPE, Pearson Education

Reference Books:

1.Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.

2.ManicavachagomPillai, Natarajan, Ganapathy- Algebra

3.Dickson: First Course in Theory of Equation

4. Frank Ayres, Jr. : Matrices, Schaum's Outline Series, Asian Student edition.

5. Devi Prasad : Elementary Linear Algebra, Narosa Pub. House.

6. Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.

7. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,

OBJECTIVE

- Learn to find the roots of polynomial equations up to degree 4, insolvability of equations of degree 5 or more.
- To compute the inverse of a non singular matrix using elementary row transformations.
- To understand about the characteristic equation and characteristic root of a matrix.
- Learn to use matrix to solve system of linear equations.
- Understand the basics of vector algebra
- Learn inner product, vector product and scalar triple product.
- Understand the concept of cylindrical and spherical coordinates.
- Learn about the plane and curves in space.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **30 Hours**	Polynomial Equations and Fundamental Theorem of Algebra. Applications of the Fundamental theorem to equations having one or more complex roots, Rational roots or multiple roots. Relations between roots and co-efficients of a polynomial equation	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to find roots of polynomial equations. • Seminar on the topic Transformation of	• Learned to solve polynomials using cardan's method, Ferrari methods etc	Evaluation through test paper.

	and computation of symmetric functions of roots.Finding equations whose roots are functions of the roots of a given equation. Reciprocal equation and method of finding its roots. Analytical methods for solving polynomial equations of order up to four - quadratic formula.Cardano's method for solving cubic equations.Ferrari's method (for quadratic equations). Remarks about the insolvability of equations of degree five or more.Finding the nature of roots without solving Descartes' rule of signs.		equations.		
Module II **16 Hours**	Elementary transformation, reduction to normal form, row reduced echelon form.Computing the inverse of a non singular matrix using elementary row transformation.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to find the inverse of a non singular matrix using elementary row transformation .	• Learn to determine wether a matrix is singular or non singular • Learn to find out the rank of a matrix.	Evaluation through test paper.
Module III **20 Hours**	System of linear homogeneous equations.Null space and nullity of matrix.	• Lecture • Discussion • Participative learning	• Seminar on the topic related to vector space	• Understand to solve system of equation using matrix	Evaluation through Test paper

	Sylvester's law of nullity. Range of a matrix.Systems of linear non homogeneous equations. Characteristic roots and characteristic vectors of a square matrix. Some fundamental theorem. Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices. Characteristic equation of a matrix, Cayley- Hamilton theorem	• Problem solving	of n-tuples. • Assignments to solve system of equations.	• Learn about characteristic roots and vectors.	
Module IV **24 Hours**	Lines and planes in space. Cylinders and Quadric surfaces, Cylindrical and spherical coordinates, Vector valued functions and space curves, Arc length and Unit tangent vector , Curvature, torsion and TNB frame	• Lecture • Discussions • Problem solving	• Group discussion on Cylindrical and spherical coordinates.	• Learn basic results in vector algebra.	Evaluation through test paper

Course Outcomes

CO1	Learned to find out the roots of polynomial equations.
CO2	Computed the inverse of a non singular matrix using elementary row transformations.
CO3	Understand about the characteristic equation and characteristic root of a matrix.
CO4	Understand the method of Gauss-Jordan elimination to find the solutions of systems of simultaneous linear equations and Learned to solve a system of linear equations by row-reduced echelon form.
CO5	Understand the basic concepts in vector algebra.

Teacher in Charge:

Ms. Reshma Joshy

Ms. Jiji Pauly

MAT5B06 : ABSTRACT ALGEBRA

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To introduce the basic concept of the nature of abstract algebra also gives the idea of group and ring.

Module I (20 hrs)

Binary operations, Isomorphic binary structures, Groups, Sub groups

Module II (25 hrs)

Cyclic groups, Groups and permutations, Orbits, cycles and Alternating groups

Module III (15 hrs)

Cosets and Theorem of Lagrange, Homomorphisms

Module IV (30hrs)

Rings and Fields, Integral Domains, The Field of Quotients of an Integral Domain

Textbooks :

John B. Fraleigh : A First Course in Abstract Algebra, 7th Ed., Pearson.

Reference Books:

1. Joseph A. Gallian : Contemporary Abstract Algebra. Narosa Pub. House.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: Basic Abstract Algebra, 2nded., Cambridge University
3. Artin : Algebra, PHI.
4. Durbin : Modern Algebra : An Introduction, 5th ed., Wiley.

OBJECTIVES

1) To enable one to determine whether the given binary operation on a given set forms a group.
2) To understand the concept of subgroups.
3) To describe all elements of a cyclic group using generators.
4) To enable one to understand the homomorphism and Theorem of Lagrange.
5) To understand the concept of rings, fields and integral domains.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	Binary operations, Isomorphic binary structures, Groups; Sub groups	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Binary operation.	• Enable to understand the concept of Groups.	Evaluation through test paper
Module II **25 Hours**	Cyclic groups, Groups and permutations, Orbits, cycles and Alternating groups	• Lecture • Discussion • Participative learning • Problem solving	• Assignments on permutation and orbits.	• enable one to compute the expression of permutation and permutation multiplication • Enable to understand different type of groups.	Evaluation through test paper
Module III **15 Hours**	Cosets and Theorem of Lagrange, Homomorphism	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of homomorphism • Peer group discussion on	• Understand the theorem Lagrange and homomorphisam.	Evaluation through test paper

			Cosets.		
Module IV **30 Hours**	Rings and Fields, Integral Domains, The Field of Quotients of an Integral Domain	• Lecture • Discussion • Participative learning • Problem solving	• Seminar on the topic Rings and fields.	• To understand the concept of rings and fields • Learn the concept of Integral domain.	Evaluation through test paper and viva

Course Outcomes

CO1	Understand the concept of binary operation on a given set.
CO2	To get the idea of groups, rings, fields and integral domain.
CO3	Understand different type of groups like cyclic and alternating groups
CO4	Understand the homomorphism and Theorem of Lagrange

Teacher in Charge:

Ms. Geethu simon

MAT5B07: BASIC MATHEMATICAL ANALYSIS

Lecture Hours per week: 6, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To develop ability to analyze and prove statements of mathematics using logical arguments.

Module I (20 hrs)

A quick review of sets and functions, Mathematical induction, Finite and infinite sets, Real Numbers, The algebraic property of real numbers.

Module II (24 hrs)

Absolute value and real line, The completeness property of R, Applications of supremum property, Intervals, Nested interval property and uncountability of R.

Module III (30 hrs)

Sequence of real numbers, Sequence and their limits, Limit theorems, Monotone sequences, Subsequence and Bolzano – Weirstrass theorem, Cauchy criterio,Properly divergent sequences, Open and closed sets.

Module IV (34 hrs)

COMPLEX NUMBERS: Sums and Products, Basic Algebraic properties, Further properties, Vectors and Moduli, Complex Conjugates, Exponential form, Product and powers in exponential form, Arguments of products and quotients, Roots of complex numbers, Regions in the complex plane, Functions of complex variable, Limits, Theorems on limits, Limits involving the points at infinity, Continuity.

Textbooks:

1) **Robert G. Bartle & Donald R. Sherbert**: Introduction to Real Analysis, 3rded., Wiley.
2) **J.W. Brown and Ruel V. Churchill**: Complex Variables and Applications, 8th Ed., McGraw Hill.

Reference Books:

1) J.M. Howie : Real Analysis, Springer 2007.

2) Ghorpade and Limaye : A Course in Calculus and Real Analysis, Springer, 2006.
3) K.A. Ross : Elementary Real Analysis : The Theory of Calculus, Springer Indian Reprint.
4) J.V. Deshpande : Mathematical Analysis and Applications, Narosh Pub. House.
5) M.R. Spiegel : Complex Variables, Schaum's Outline Series.

OBJECTIVES

1) To learn to prove Archimedean property, density theorem, existence of a positive square root for positive numbers and so on and the learning will help them to appreciate the beauty of logical arguments.
2) To learn how monotone convergence theorem can be used in establishing the divergence of the harmonic series, how it helps in the calculation of square root of positive numbers and how it establishes the existence of the transcendental number e.
3) To understand the concept of open and closed sets, their properties, their characterization and so on.
4) To familiarize the use of geometry, comparison between real and complex calculus-areas

LESSON PLAN

Unit/ Hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	A quick review of sets and functions ,Mathematical induction, Finite and infinite sets Real Numbers, The algebraic property of	• Lecture • Discussion • Participative learning • Problem solving	Group discussion on Algebraic properties of R.	To generate the ability to analyze and prove statements of Mathematics.	Evaluation through test paper

	real numbers.				
Module II **24 Hours**	Absolute value and real line, The completeness property of R, Applications of supremum property Intervals, Nested interval property and uncountability of R.	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Completeness Property of R.	To master different techniques of finding limits.	Evaluation through test paper
Module III **30 Hours**	Sequence of real numbers, Sequence and their limits, Limit theorems, Monotone sequences, Subsequence and Bolzano – Weirstrass theorem, Cauchy criterio, Properly divergent sequences, Open and closed sets.	• Lecture • Discussion • Participative learning • Problem solving	• Assignment in Limit Theorems. • Discussion on Open and Closed Sets.	To familiarize with different kinds of sequences.	Evaluation through testpaper and Viva
Module IV **34 Hours**	Sums and Products, Basic Algebraic properties, Further properties, Vectors and Moduli, Complex Conjugates, Exponential form, Product and powers in exponential form, Arguments of products and quotients, Roots of	• Lecture • Discussions • Problem solving	Student seminars to familiarize properties of Complex Numbers.	To understand areas where real and complex calculus agree and where they differ.	Evaluation through testpaper

	complex numbers, Regions in the complex plane, Functions of complex variable, Limits, Theorems on limits, Limits involving the points at infinity, Continuity.				

Course Outcomes

CO1	To appreciate the beauty of logical arguments and embolden them to apply it in similar and unknown problems.
CO2	To establish the divergence and convergence of different sequences and series.
CO3	To understand some basic topological properties of real number system.
CO4	To demystify student's belief that complex variable theory is incomprehensible.

Teacher in Charge:

Ms. Geethu Simon

Ms. Reshma Joshy

MAT5B08: DIFFERENTIAL EQUATIONS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To find out ways and means for solving differential equations.

Module I (24 hrs)

Some Basic Mathematical Models: Direction Fields, Solutions of some Differential equations, Classification of Differential Equations, Historical Remarks, First order differential equations: Linear equations with variable coefficients, Separable equations, Modeling with first order equations, Differences between linear and non linear equations, Exact equations and integrating factors, The existence and uniqueness theorem.

Module II (29 hrs)

Second Order Linear Differential Equations: Homogeneous equation with constant coefficients, Fundamental solutions of Linear Homogeneous equations, Linear independence and Wronskian, Complex roots of characteristic equations, Repeated roots Reduction of order, Non homogeneous equations, Method of Undetermined coefficients, Variation of parameters, Mechanical and Electrical vibrations, Systems of First Order Linear equations: Introduction, Basic theory of systems of first order Linear Equations.

Module III (17 hrs)

Definition of Laplace Transforms , Solution of Initial Value Problem , Step functions , Impulse functions, The Convolution Integral.

Module IV (20 hrs)

Two point Boundary value problems , Fourier Series, The Fourier Convergence Theorem, Even and odd functions , Separation of variables; Heat conduction in a rod , The Wave equation, Vibrations of an elastic string.

Textbooks:

1) Thomas / Finney : Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1) Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.
2) H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,Universal Book Stall, New Delhi.

OBJECTIVES

1) To learn to solve DEs that are in linear, separable and in exact forms and also to analyze the solution.
2) To be familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.
3) To acquire the knowledge of solving a differential equation using Laplace method.
4) To get familiarized with Fourier series and its applications.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **24 Hours**	Some Basic Mathematical Models, First order differential equations	• Lecture • Discussion • Participative learning • Problem solving	Assignment on solving first order differential equations.	To learn to solve DEs that are in linear, separable and in exact forms and also to analyze the solution.	Evaluation through test paper

Module II **29 Hours**	Second Order Linear Differential Equations, Systems of First Order Linear equations	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Completeness Property of R.	To be familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.	Evaluation through test paper
Module III **17 Hours**	Laplace Transforms	• Lecture • Discussion • Participative learning • Problem solving	Assignment in solving Differential equations using Laplace transforms.	To acquire the knowledge of solving a differential equation using Laplace method.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Partial Differential Equations and Fourier Series	• Lecture • Discussions • Problem solving	Student seminars in applications of Fourier Series.	To get familiarized with Fourier series and its applications.	Evaluation through testpaper

Course Outcomes

CO1	Students could identify a number of areas where the modelling process results in a differential equation.
CO2	They will realize the basic differences between linear and non linear DEs and also basic results that guarantees a solution in each case.
CO3	They will become familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.
CO4	Students acquire the knowledge of solving a differential equation using Laplace method which is especially suitable to deal with problems arising in engineering field.

Teacher in Charge:

Ms. Reshma Joshy

MAT5D02: MATHEMATICS FOR NATURAL SCIENCES

Lecture Hours per week: 2 Credits: 2

Internal: 10, External: 40, Examination 2 Hours

Objectives

To get introduced to statistical measures and analysis.

Module I (20 hrs)

The idea of sets, Operation on sets, Relations and functions, Variables and graphs, Frequency distributions, The Mean, Median, Mode and other measures of central tendency, Dispersion or variation, The Range, The Mean deviation, The Semi- inter quartile range, The 10- 90 Percentile range.

Module II (16 hrs)

The standard deviation, Properties of Standard Deviation, The variance, Short methods of computing standard deviation, Moments, Moments for grouped data, relation between moments, Computation of moment for grouped data. Skewness and Kurtosis.

Textbooks :

Murray R. Spiegel : Statistics, 2nd Edn., Schaum's Outline Series.

Reference Books:

1) Hogg & Craig: Introduction to Mathematical Statistics.
2) Freund & Walpole: Mathematical Statistics

OBJECTIVES

1) To understand different measures of tendency.
2) To analyse data using measures like SD, Skewness and Kurtosis.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **18 Hours**	Sets, Frequency Distribution, Measures of Tendency	• Lecture • Discussion • Participative learning • Problem solving	Assignment on different measures of tendency.	To understand which measure is better for different kinds of data.	Evaluation through test paper and viva
Module II **12 Hours**	Standard Deviation, Moments, Skewness and Kurtosis.	• Lecture • Discussion • Participative learning • Problem solving	Student seminars on Skewness and Kurtosis on different datas.	To visualize how the data behaves.	Evaluation through test paper

Course Outcomes

CO1	Students get an understanding about the use of some statistical tools.
CO2	They learn to analyze data using different measures.

Teacher in Charge:

Ms. Reshma Joshy

MAT5B05: VECTOR CALCULUS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To Provide skils to visualize and manipulate multivariable and vector values functions. Also enable students to evaluate multiple integrals.

Module I (15 hrs)

Functions of several variables, Limits and Continuity, Partial derivatives, Differentiability linearization and differentials, Chain rule, Partial derivatives with constrained variables.

Module II (20 hrs)

Directional derivatives, gradient vectors and tangent planes, Extreme value and saddle points, Lagrange multipliers, Taylor's formula, Double Integrals, Double integrals in polar form.

Module III (25 hrs)

Triple integrals in Rectangular Coordinates, Triple integrals in cylindrical and spherical coordinates, Substitutions in multiple integrals, Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields.

Module IV (30hrs)

Green's theorem in the plane, Surface area and surface integrals, Parametrized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).

Textbooks :

Thomas / Finney : Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1. Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.
2. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,

OBJECTIVES

1) To enable one to apply the basic concepts of partial derivatives.
2) To learn to find multiple integrals.
3) To understand concept of the integrals of the functions and vector fields over parametrized surfaces and compute them in simple examples.
4) To calculate directional derivatives and gradients.
5) To learn application of greens theorem and stokes theorem.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **15 Hours**	Functions of several variables, Limits and Continuity, Partial derivatives, Differentiability linearization and differentials, Chain rule, Partial derivatives with constrained variables.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Partial derivatives.	• Enable to find partial derivatives.	Evaluation through test paper
Module II **20 Hours**	Directional derivatives, gradient vectors and tangent planes, Extreme value and saddle points, Lagrange multipliers, Taylor's formula, Double Integrals, Double integrals in polar	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding Directional derivatives and double integrals.	• Enable to evaluate double integrals.	Evaluation through test paper

	form.				
Module III **25 Hours**	Triple integrals in Rectangular Coordinates, Triple integrals in cylindrical and spherical coordinates, Substitutions in multiple integrals, Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain vector fields, work and circulation	Understand triple integrals and vector fields.	Evaluation through MCQ and Group Discussion
Module IV **30 Hours**	Green's theorem in the plane, Surface area and surface integrals, Parametrized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to Surface integrals.	Learn the application of greens theorem and stokes theorem in multiple integrals.	Evaluation through test paper

Course Outcomes

CO1	Understand the basic concept of partial derivatives.
CO2	Enable to calculate multiple integrals.
CO3	Understand the concept of a conservative vector field
CO4	Learn the application of greens theorem and stokes theorem in multiple integrals and understand how they are generalizations of the Fundamental theorem of calculus.

Teacher in Charge:

Ms. Jiji Pauly

MAT6B10 : COMPLEX ANALYSIS

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To learn basic concepts of complex analysis and its applications.

Module I : Analytic Functions (15 hrs)

Derivatives, Differentiation formula, Cauchy-
Riemann Equations, Polar coordinates, Analytic functions, Harmonic functions , Elementary functions , The exponential function, Logarithmic function, Complex exponents, Trigonometric functions, Hyperbolic f unctions, Inverse Trigonometric and Hyperbolic functions.

Module II : Integrals (25 hrs)

Derivatives of functions ω(t); Indefinite integral of ω(t); Contours, Contour integrals, Antiderivatives, Cauchy -
Goursat theorem (without proof), Simply and multiply connected domains, Cauchy's integral formula and its e xtension, Liouville's theorem and fundamental theorem of algebra, Maximum modulus principle.

Module III : Series (25 hrs)

A quick review of convergence of sequence and series of complex numbers,Taylor series, Laurents series (wi thoutproof), Applications,Power series: Absolute and uniform convergence,Continuity of sum of powerseries, Differentiation and integration of power series, Multiplication and division of power series.

Module IV : Residues (25 hrs)

Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, Three types of isolated

singular points, Residues at poles, Zeroes of analytic functions, Zeroes and poles,Applications of residues, E valuation of improper integrals, Jordan's Lemma (statement only), Definite integrals involving sines and cosi nes.

Textbooks :

1) **James Ward Brown and Ruel V. Churchill** : Complex Variables and Applications (8th Edn.), McGraw Hill.

Reference Books:

1) Mark J.Ablowitz and Anthanassios S. Fokas: Complex Variables, Cambridge Text, 2nd Edn

2) S. Ponnusamy : Foundation of Complex Analysis : Narosa.

3) Murray R. Spiegel: Complex Variables, Schaum's Outline series.

4) J.M. Howie: Complex Analysis: Springer India Reprint

5) Stewart & Tall: Complex Analysis, CUP

OBJECTIVES

1) To develop differentiability and analyticity of complex valued functions
2) To develop complex integration
3) To represent an analytic function as power series.
4) To classify the singular points using Laurent series and develop the concept of residues and its applications.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **15 Hours**	Derivatives, Cauchy- Riemann Equations,Analytic functions,Harmonic functions , Exponential ,	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding harmonic conjugates	To understand the difference between differentiability and analyticity	Evaluation through test paper

	Logarithmic, Trigonometric , Hyperbolic , Inverse Trigonometric and Hyperbolic functions				
Module II **25 Hours**	Derivatives ofω(t), Indefinite integral of ω(t); Contours, Contour integrals, Antiderivatives, Cauchy- Goursat theorem , Simplyand multiply connected domains, Cauchy's integralformula and its extension, Liouville's theorem and fundamental theorem of algebra, Maximum modulus principle.	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on contour integrals	To understand integration of complex functions and related theorems	Evaluation through test paper and viva
Module III **25 Hours**	Convergence of sequence and series of complex numbers ,Taylor series, Laurents series , Absolute and Uniform convergence, Continuity of sum of powerseries,	• Lecture • Discussion • Participative learning • Problem solving	• Student seminar to explain absolute and uniform convergence of power series	To understand Taylor series and Laurent series	Evaluation through Test paper and Group Discussion

	Differentiation and integration of power series, Multiplication and division of power series.				
Module IV **25 Hours**	Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, Three types of isolated singular points, Residues at poles, Zeroes of analytic functions, Zeroes and poles, Applications of residues, Evaluation of improper integrals, Jordan's Lemma , Definite integral involving sines and cosines.	• Lecture • Discussions • Problem solving	• Assignments in finding isolated singular points and residues	To understand isolated singular points, residues and applications of residues	Evaluation through test paper

Course Outcomes

CO1	To understand difference between differentiability and analyticity of complex valued functions.

CO2	To learn indefinite integrals of complex valued functions.
CO3	Learn to express an analytic function as a power series.
CO4	To understand the concepts of singular points, residues, and applications of residues.

Teacher in Charge:

Ms. Geethu Simon

MAT6B13(E02) : LINEAR PROGRAMMING

Lecture Hours per week: 3, Credits: 2

Internal: 20, External: 80, Examination 3 Hours

Objectives

Formulate our real life problem into a mathematical model also different techniques to solve LPP are introduced.

Module I (16 hrs)

Formulation, Convex sets, General LLP

Module II (14 hrs)

Simplex Method, Duality

Module III (18 hrs)

The transportation problem, The assignment Problems

Textbooks :

Gupta and Manmohan - Linear Programming And Theory of Games

Reference Books:

1. . K. V. Mital&Manmohan: Optimization methods in Operations Research and Systems Analysis, 3rdEdn., New Age International publishers.
2. DipakChatterjee: Linear Programming and Game Theory, Prentice Hall of India.

OBJECTIVE

1. Enable to formulate LPP from real life problem
2. Conceptulize the feasible region, feasible solution, optimal solution etc.
3. Solve the LPP with two variables using graphical method
4. Solve the LPP using simplex method
5. Formulate the dual problem from primal
6. Solve transportation problem and the assignment Problems which are relevent in daily life.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **16 Hours**	Formulation, Convex sets, General LLP	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on formulation of lpp. • Seminar on the topic convex sets.	• Understand to formulate lpp.	Evaluation through test paper
Module II **14 Hours**	Simplex Method, Duality	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in solving LPP using simplex method.	• Understand to solve lpp in finite number of steps using simplex method.	Evaluation through test paper and viva
Module III **18 Hours**	The transportation problem, The assignment Problems	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to solve transportation problems and assignment problems	• Enable one to solve transportation problem and the assignment Problems which are relevent in daily life.	Evaluation through Test paper and Group Discussion

Course Outcomes

Course Outcomes

CO1	Enable one to formulate LPP from real life problem.

CO2	Solve the LPP with two variables using graphical method
CO3	Solve the LPP using simplex method
CO4	Solve transportation problem and the assignment Problems which are relevent in daily life.

Teacher in Charge:

Ms. Reshma Joshy

MAT6B12 : NUMBER THEORY AND LINEAR ALGEBRA

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To study about the integers and integer valued functions. Also introduce the concept of vector fields and linear transformations.

Module I (30 hrs)

Divisibility theory in the integers – the division algorithm, the greatest common divisor, the Euclidean algorithm, the Diophantine equation ax + by = c. Primes and their distribution. The fundamental theorem of arithmetic.The sieve of Eratosthenes. The theory of congruences.Basic properties of congruence.Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem

Module II (25 hrs)

Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors.The greatest integer function.Euler's phi-function.Euler's generalization of Fermat's theorem.Properties of the phi-function.

Module III (15 hrs)

Vectorspaces-examples, linearcombinations, spanning, linearindependence, base, finite dimensional vector spaces.

Module IV (20 hrs)

Linear mappings- Linear transformations, examples, nullspace, rank –nullity theorem, linear isomorphism

Textbooks :

1. David M. Burton : Elementary Number Theory, Sixth Edn., TMH.

2. T. S. Blynth and E.F. Robertson: Basic Linear Algebra, second Edn springer under graduate mathematics series 2009

Reference Books:

1. C.Y. Hsiung : Elementary Theory of Numbers. Allied Publishers.

2. Neville Robbins : Beginning Number Theory, Second Ed. Narosa.
3. George E. Andrews : Number Theory, HPC.
4. Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.
5. Frank Ayres, Jr. : Matrices, Schaum's Outline Series, Asian Student edition.
6. Devi Prasad : Elementary Linear Algebra, Narosa Pub. House

OBJECTIVE

1. Enable to find gcd using Euclidean algorithm.
2. To understand the solution of diophantine equations.
3. Enable to solve system of congruence using chinese remainder theorem.
4. To learn Wilson's theorem, Fermat's little theorem and Euler's theorem
5. Understand the concept of vector space and its basis.
6. Understand the concept of linear transformation and application of rank nullity theorem.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I 30 Hours	The division algorithm, Gcd, the Euclidean algorithm, the Diophantine equation. Primes and their distribution. The fundamental theorem of arithmetic. The sieve of Eratosthenes. The theory of congruences. Basic	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on gcd and euclidean algorithm. • Assignment in finding solution of system of congruence using chinese remainder theorem	• Understand the linear congruence and the method for finding its solutions.	Evaluation through test paper

	properties of congruence. Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem.				
Module II **25 Hours**	Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors. The greatest integer function. Euler's phi-function. Euler's generalization of Fermat's theorem. Properties of the phi-function.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding sum and number of divisors • Seminar on the topic Euler's phi-function and Properties of the phi-function.	• Understand fermat's theorem, wilson's theorem, euler's theorem and its applications.	Evaluation through test paper and viva
Module III **15 Hours**	Vectorspaces- examples, linearcombinations, spanning, linearindependence, base, finite dimensional vector spaces.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to vector space and its example.	• Understand the definition of vector space and its basis.	Evaluation through MCQ and Group Discussion
Module IV **20 Hours**	Linear mappings- Linear transformations, examples, nullspace, ranknullity theorem, linear isomorphism.	• Lecture • Discussions • Problem solving	• Student seminars inconnection with Linear transformation and its example.	• Become familiar with the concept of Linear transformations and rank nullity theorem.	Evaluation through test paper

Course Outcomes

CO1	To prove results involving divisibility, greatest common divisor, least commonmultiple and a few applications.
CO2	Enable to solve system of congruence and diophantine equation
CO3	To learn the theorems viz. Wilson's theorem, Fermat's little theorem and Euler's theorem and its applications.
CO4	To Lean if a set of vectors is a vector space or a basis for a vetor space.
CO5	Understand the concept of linear transformation and application of rank nullity theorem.

Teacher in Charge:

Ms. Jiji Pauly

MAT6B11 : NUMERICAL METHODS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To provide techniques and algorithms to find approximate numerical solution to problems in several areas of mathematics.

Module I : Solution of Algebraic and Transcendental Equation (23 hrs)

Introduction, Bisection Method, Method of false position, Iteration method, Newton- Raphson Method, Ramanujan's method, The Secant Method, Finite Differences, Forward differences, Backward differences, Central differences, Symbolic relations and separation of symbols, Differences of a Polynomial.

Module II : Interpolation (23 hrs)

Newton's formulae for intrapolation, Central difference interpolation formulae, Gauss' Central Difference Formulae, Interpolation with unevenly spaced points, Langrange's interpolation formula, Divided differences and their properties, Newton's General interpolation formula, Inverse interpolation, Numerical Differentiation and Integration, Introduction, Numerical differentiation (using Newton's forward and backward formulae), Numerical Integration, Trapizoidal Rule, Simpson's 1/3- Rule , Simpson's 3/8- Rule.

Module III : Matrices and Linear Systems of equations (22 hrs)

Solution of Linear Systems – Direct Methods, Gauss elimination, Gauss- Jordan Method, Modification of Gauss method to compute the inverse, LU Decomposition, LU Decomposition from Gauss elimination, Solution of Linear Systems – Iterative methods, The eigen value problem, Eigen values of Symmetric Tridiazonal matrix.

Module IV : Numerical Solutions of Ordinary Differential Equations (22 hrs)

Introduction, Solution by Taylor's series, Picard's method of successive approximations, Euler's method, Modified Euler's Method, Runge- Kutta method, Predictor- Corrector Methods, Adams- Moulton Method, Milne's method.

Textbooks:

1) **S.S. Sastry** : Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

Reference Books:

1) S. SankaraRao : Numerical Methods of Scientists and Engineer, 3rd ed., PHI.
2) F.B. Hidebrand : Introduction to Numerical Analysis, TMH.
3) J.B. Scarborough : Numerical Mathematical Analysis, Oxford and IBH

OBJECTIVES

1) To understand several methods such as bisection method, fixed point iteration method, regula falsi method etc.
2) To understand the concept of interpolation.
3) To solve system of linear equations using matrices.
4) To learn to find numerical approximations to solutions of initial value problems.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **23 Hours**	Solution of Algebraic and Transcendental Equation, Finite differences	• Lecture • Discussion • Participative learning • Problem solving	• Assignment in different methods to solve equations	To learn to solve equations using different techniques.	Evaluation through test paper

			• Seminars in Finite differences		
Module II **23 Hours**	Interpolation, Numerical Differentiation, Numerical Integration	• Lecture • Discussion • Participative learning • Problem solving	Assignments in different techniques.	To find derivatives and integrals at a point using numerical techniques.	Evaluation through test paper
Module III **22 Hours**	Matrices and Linear Systems of equations	• Lecture • Discussion • Participative learning • Problem solving	Seminar on which technique is better and easier.	To learn to use matrices to solve system of linear equations.	Evaluation through testpaper and Viva
Module IV **22 Hours**	Numerical Solutions of Ordinary Differential Equations	• Lecture • Discussions • Problem solving	Assignment related to IVP	To find out numerical approximations to solutions of initial value problems.	Evaluation through testpaper

Course Outcomes

CO1	Understand several methods such as bisection method, fixed point iteration method, regula falsi method etc. to find out the approximate numerical solutions of algebraic and transcendental equations with desired accuracy.
CO2	Understand the concept of interpolation and also learn some well known interpolation techniques.
CO3	Understand a few techniques for numerical differentiation and integration and also realize their merits and demerits.
CO4	Find out numerical approximations to solutions of initial value problems and also to understand the efficiency of various methods.
CO5	Learn to solve system of linear equations using matrices.

Teacher in Charge:

Ms. Reshma Joshy

MAT6B09: REAL ANALYSIS

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To teach one how to combine different definitions, theorems and techniques to solve problems.

Module I : Continuous Functions (25 hrs)

Continuous functions, Continuous functions on intervals, Uniform continuity

Module II : Riemann Integral (25 hrs)

Riemann Integral, Riemann Integrable Functions, The fundamental theorem, Substitution theorem and application, Approximate Integration

Module III : Sequence and series of functions (20 hrs)

A quick review of series of real numbers, Pointwise and uniform convergence, Interchange of limit and continuity, Series of functions .

Module IV (20 hrs)

Improper Integrals : Improper integrals of the first kind, Improper integrals of the second kind,Cauchy Principal value, Improper Integrals of the third kind.

Beta and Gamma functions : Beta Functions, Gamma Functions, Relation between Beta and Gamma Functions

Textbooks:

1) **G. Bartle, Donald R. Sherbert** : Introduction to Real Analysis (3rd Edn.)
2) **R.R. Goldberg** : Methods of Real Analysis.
3) **Narayanan & Manicavachagom Pillay** : Calculus, Vol. II

Reference Books:

1) J.V. Deshpande: Mathematical Analysis and Applications, Narosa Pub. House.
2) Torence Tao : Analysis I, TRIM 37, Hindustan Book Agency.
3) K.A. Ross: Elementary Real Analysis : Theory of Calculus, Springer.
4) K.G. Binmore: Mathematical Analysis, CUP

OBJECTIVES

1) To state the definition of continuous functions, formulate sequential criteria for continuity and prove or disprove continuity of functions using this criteria.
2) To develop the notion of Riemann integrability of a function using the idea of tagged partitions and calculate the integral value of some simple functions using the definition.
3) To prove convergence and divergence of sequences of functions and series.
4) To learn the properties of and relationship among two important improper integrals.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **25 Hours**	Continuous Functions, Uniform Continuity	• Lecture • Discussion • Participative learning • Problem solving	Assignment regarding difference in Continuity and Uniform Continuity.	To understand several deep and fundamental results of continuous functions on intervals.	Evaluation through test paper

Module II **25 Hours**	Riemann Integral	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Riemann Intregrability.	To understand a few basic and fundamental results of integration theory.	Evaluation through test paper
Module III **20 Hours**	Sequence and series of functions	• Lecture • Discussion • Participative learning • Problem solving	Assignment on convergence of series and sequences of functions.	To understand the difference between pointwise and uniform convergence of sequences and series of functions.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Improper Integrals, Beta and Gamma functions	• Lecture • Discussions • Problem solving	Seminars related to Improper Integrals and Principal Value.	To understand the notion of improper integrals, their convergence, principal value and evaluation.	Evaluation through testpaper

Course Outcomes

CO1	To understand several deep and fundamental results of continuous functions on intervals such as boundedness theorem, maximum-minimum theorem, intermediate value theorem, preservation of interval theorem and so on.
CO2	To develop the notion of Riemann integrability of a function using the idea of tagged partitions and calculate the integral value of some simple functions using the definition.
CO3	To learn and find out examples/counter examples to prove or disprove the validity of several mathematical statements that arise naturally in the process/context of learning.
CO4	To learn the properties of and relationship among two important improper integrals namely beta and gamma functions that frequently appear in mathematics, statistics, science and engineering.

Teacher in Charge:

Ms. Geethu Simon

Ms. Reshma Joshy

MT1C02: LINEAR ALGEBRA
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of Linear Algebra.

MODULE I

Vector Spaces & Linear Transformations

MODULE II

Linear Transformations (continued) and Elementary Canonical Forms

MODULE III

Elementary Canonical Forms (continued), Inner Product Spaces

TEXT:

HOFFMAN K. and KUNZE R., LINEAR ALGEBRA (2nd Edn.), Prentice Hall of India, 199

REFERENCES :

[1] P. R. Halmos: Finite Dimensional Vector spaces; Narosa Pub House, New Delhi; 1980.

[2] A. K. Hazra: Matrix: Algebra, Calculus and generalised inverse- Part I; Cambridge International Science Publishing; 2007.

[3] I. N. Herstein: Topics in Algebra; Wiley Eastern Ltd Reprint; 1991.

[4] S. Kumaresan: Linear Algebra-A Geometric Approach; Prentice Hall of India; 2000.

[5] S. Lang: Linear Algebra; Addison Wesley Pub.Co.Reading, Mass; 1972.

[6] S. Maclane and G. Bikhrkhoff: Algebra; Macmillan Pub Co NY; 1967.

[7] N. H. McCoy and R. Thomas: Algebra; Allyn Bacon Inc NY; 1977.

[8] R. R. Stoll and E.T.Wong: Linear Algebra; Academic Press International Edn; 1968.

[9] G. Strang: linear algebra and its applications(4th edn.); Cengage Learning; 2006.

OBJECTIVES

a) **To understand the concept of vector spaces, basis and dimension.**

b) **To study about linear transformations and its properties.**

c) **To understand the concept of functionals and dual space**

d) **To study the relation between linear transformations and corresponding matrices.**

e) **To study about inner product spaces.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Vector spaces, subspace, basis, dimension, properties, linear transformations	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on properties of vector spaces	To understand: • the basics of vector spaces, basis • notion of linear transformation • properties of linear transformation	Evaluation through test papers and interaction with students
Module I1 (35 hours)	linear transformations, functionals, dual space and elementary canonical transformations	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of linear transformations	To understand: • More about linear transformation • Significance of dual space	Evaluation through test paper
Module III (25 Hours)	canonical transformations inner product spaces,	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on inner product spaces	To understand: • Inner product spaces and their relevance • Orthogonal compliment and direct sums of vector spaces	Evaluation through test paper

Course Outcomes

CO1	To understand the concept of vector spaces, their basis, dimension and linear transformations
CO2	To understand more about linear transformations and some of its important properties, elementary canonical forms
CO3	To introduce the concept of Inner product spaces, orthogonal compliment and direct sums of vector spaces

Faculty in charge:
Dr. Nidhin T J

MT1C05: NUMBER THEORY

Number of hours of Lectures per week: 5

Number of Credits: 4

Objectives

To understand the basic concepts of Number Theory.

Module 1

Arithmetical functions and Dirichlet multiplication; Averages of arithmetical functions

Module 2

Some elementary theorems on the distribution of prime numbers

Module 3

Quadratic residues and quadratic reciprocity law ,Cryptography, Public key.

TEXT 1 : APOSTOL T.M., INTRODUCTION TO ANALYTIC NUMBER THEORY, Narosa Publishing House, New Delhi, 1990.

TEXT 2: KOBLITZ NEAL A., COURSE IN NUMBER THEROY AND CRYPTOGRAPHY, SpringerVerlag, NewYork, 1987.

References

[1] A. Beautelspacher: Cryptology; Mathematical Association of America (Incorporated); 1994

[2] H. Davenport: The higher arithmetic(6th Edn.); Cambridge Univ.Press; 1992

[3] G. H. Hardy and E.M. Wright: Introduction to the theory of numbers; Oxford International Edn; 1985

[4] A. Hurwitz & N. Kritiko: Lectures on Number Theory; Springer Verlag ,Universitext; 1986

[5] T. Koshy: Elementary Number Theory with Applications; Harcourt / Academic Press; 2002

[6] D. Redmond: Number Theory; Monographs & Texts in Mathematics No: 220; Marcel Dekker Inc.; 1994

[7] P. Ribenboim: The little book of Big Primes; Springer-Verlag, New York; 1991

[8] K.H. Rosen: Elementary Number Theory and its applications(3rd Edn.); Addison Wesley Pub Co.; 1993

[9] W. Stallings: Cryptography and Network Security-Principles and Practices; PHI; 2004

[10] D.R. Stinson: Cryptography- Theory and Practice(2nd Edn.); Chapman & Hall / CRC (214. Simon Sing : The Code Book The Fourth Estate London); 1999

[11] J. Stopple: A Primer of Analytic Number Theory-From Pythagorus to Riemann; Cambridge Univ Press; 2003

[12] S.Y. Yan: Number Theroy for Computing(2nd Edn.); Springer-Verlag; 2002

OBJECTIVES

a) **To understand the basic arithmetical functions and its averages.**

b) **To get familiarize with theorems on the distribution of prime numbers.**

c) **To understand quadratic residues, quadratic reciprocity law.**

d) **To study about basics of cryptography .**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Arithmetical functions and Dirichlet multiplication; Averages of arithmetical functions	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on various arithmetic functions.	To understand: • Arithmetical functions • Dirichlet multiplication and derivatives of arithmetical functions • Averages of arithmetical functions.	Evaluation Through Test paper
Module I1	Some elementary theorems on the	• Lecture • Discussion • Participative	• Student seminars to	To understand: • Equivalent	Evaluation Through test paper

(30 hours)	distribution of prime numbers	learning • Problem solving	explain theorems on distribution of prime numbers.	forms of prime number theorem. • Partial sums of Mobius function.	
Module III (30 Hours)	Quadratic residues and quadratic reciprocity law, Cryptography, Public key	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on legendre's symbol, its properties and Gauss lemma.	To understand: • Quadratic Residues and Quadratic reciprocity law,jacobi's symbol. • Basics of cryptography, types of crypto-system and its cryptanalysis.	Evaluation through test paper

Course Outcomes

CO1	To introduce the Arithmetical functions,Dirichlet multiplication and derivatives of arithmetical functions,Averages of arithmetic.
CO2	To understand the Equivalent forms of prime number theorem, Partial sums of Mobius function.
CO3	To understand the quadratic residues and quadratic reciprocity law, jacobi's symbol , basics of cryptography, types of cryptosystem and its cryptanalysis.

Faculty in charge:
Ms. Smitha Davis

MT1C03: REAL ANALYSIS I
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of real analysis.

MODULE I

Basic Topololgy, Finite, Countable and Uncountable sets Metric Spaces, Compact Sets, Perfect Sets, Connected Sets. Continuity - Limits of function, Continuous functions, Continuity and compactness, continuity and connectedness, Discontinuities, Monotonic functions, Infinite limits and Limits at Infinity

MODULE II

Differentiation The derivative of a real function, Mean Value theorems, The continuity of Derivatives, L Hospitals Rule, Derivatives of Higher Order, Taylors Theorem, Differentiation of Vector valued functions. The Riemann Stieltjes Integral, - Definition and Existence of the integral, properties of the integral, Integration and Differentiation

MODULE III

The Riemann Stieltjes Integral (Continued) - Integration of Vector vector-valued Functions, Rectifiable curves. Sequences and Series of Functions - Discussion of Main problem, Uniform convergence, Uniform convergence and continuity, Uniform convergence and Integration, Uniform convergence and Differentiation. Equicontinuous Families of Functions, The Stone Weierstrass

TEXT:

RUDIN W., PRINCIPLES OF MATHEMATICAL ANALYSIS (3rd Edn.), Mc. Graw-Hill, 1986.

REFERENCES :

[1] H. Amann and J. Escher: Analysis-I; Birkhuser; 2006.

[2] T. M. Apostol: Mathematical Analysis(2nd Edn.); Narosa; 2002.

[3] R. G. Bartle: Elements of Real Analysis(2nd Edn.); Wiley International Edn.; 1976.

[4] R. G. Bartle and D.R. Sherbert: Introduction to Real Analysis; John Wiley Bros; 1982.

[5] J. V. Deshpande: Mathematical Analysis and Applications- an Introduction; Alpha Science International; 2004.

OBJECTIVES

a) **To understand the basic concepts of Topology: Finite, Countable and Uncountable sets, Metric spaces, Compact sets, Perfect sets, Connected sets.**

b) **To develop the notion of continuity of functions in R^K.**

c) **To understand the concept of differentiation of real valued and complex valued functions.**

d) **To study about Riemann Stieltjes Integral and Rectifiable curves.**

e) **To understand the convergence of sequence and series of functions.**

f) **To understand the relation between uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Basic topology, Continuous functions, continuity and compactness, continuity and connectedness, discontinuities	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic topology and continuity of functions	To understand: • the basics of topology • notion of continuity • difference between continuity and uniform continuity	Evaluation Through MCQ
Module I1 (30 hours)	Differentiation, derivatives of higher order, differentiation of	• Lecture • Discussion • Participative	• Student seminars to explain the	To understand: • differentiation of vector valued	Evaluation Through test paper

	vector valued functions, Riemann Stieltjes Integral	learning • Problem solving	properties of differentiation and integration	functions • integration of vector valued functions	
Module III (25 Hours)	Convergence of sequence and series of functions, uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of convergence of functions	To understand: • Convergence of sequence and series of functions • Differentiate between convergence and uniform convergence	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of basic topology, difference between continuous and uniformly continuous functions and its properties.
CO2	To understand the concept of differentiation of vector valued functions and integration of functions.
CO3	To understand the difference between pointwise convergence and uniform convergence of sequence of functions, convergence of series of functions

Faculty in charge:
Dr. Vijitha Mukundan

MTH1C01: ALGEBRA I
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of abstract algebra.

MODULE I

Plane Isometries, Direct products & finitely generated Abelian Groups, Factor Groups, Factor-Group Computations and Simple Groups, Group action on a set, Applications of G-set to counting

MODULE II

Isomorphism theorems, Series of groups, (Omit Butterfly Lemma and proof of the Schreier Theorem), Sylow theorems, Applications of the Sylow theory, Free Groups

MODULE III

Group Presentations, Rings of polynomials, Factorization of polynomials over a field, Non Commutative examples, Homomorphism and factor rings

TEXT:

JOHN B. FRALEIGH, A FIRST COURSE IN ABSTRACT ALGEBRA(7th Edn.), Pearson Education Inc., 2003.

REFERENCES :

[1] N. Bourbaki: Elements of Mathematics: Algebra I, Springer; 1998.

[2] Dummit and Foote: Abstract algebra(3rd edn.); Wiley India; 2011.

[3] P.A. Grillet: Abstract algebra(2nd edn.); Springer; 2007

[4] I.N. Herstein: Topics in Algebra(2nd Edn); John Wiley & Sons, 2006.

[5] T.W. Hungerford: Algebra; Springer Verlag GTM 73(4th Printing); 1987.

[6] N. Jacobson: Basic Algebra-Vol. I; Hindustan Publishing Corporation(India), Delhi; 1991.

[7] T.Y. Lam: Exercises in classical ring theory(2nd edn); Springer; 2003.

[8] C. Lanski: Concepts in Abstract Algebra; American Mathematical Society; 2010.

[9] N.H. Mc Coy: Introduction to modern algebra, Literary Licensing, LLC; 2012.

[10] S. M. Ross: Topics in Finite and Discrete Mathematics; Cambridge; 2000.

[11] J. Rotman: An Introduction to the Theory of Groups(4th edn.); Springer, 1999.

OBJECTIVES

a) **To understand the basic concepts of groups, factor groups, simple groups and group action on a set.**

b) **To get familiarize with Isomorphism theorems and its properties.**

c) **To understand the concept of sylow theorems and its applications.**

d) **To study more about rings of polynomials and factorization of polynomials over a field.**

e) **To understand homomorphism and factor ring.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Plane Isometries, Abelian groups, Factor groups, Simple groups, group action on a set	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on groups and its properties	To understand: • the basics of different types of groups • notion of group action on a set	Evaluation Through MCQ
Module I1 (30 hours)	Isomorphism theorems, Sylow theorems and its applications	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of Isomprhism • Peer group discussion on Sylow theorems	To understand: • Isomorphism theorems and their significance • Sylow theorems and its applications	Evaluation Through test paper

Module III (30 Hours)	Ring of polynomials, factorization of a polynomial over a field, homomorphism and factor rings	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of homomorphism and factor rings	To understand: • homomorphism and factor rings • factorization of a polynomial over a field convergence	Evaluation through test paper

Course Outcomes

CO1	To get the idea of different types of groups and group action on a set
CO2	To understand the concept of isomorphism theorems and their significance, Sylow theorems and its applications
CO3	To understand factorization of a polynomial over a field, homomorphism and factor rings

Faculty in charge:
Ms. Linet Roslin Antony

MTH1C05 – DISCRETE MATHEMATICS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To understand concepts in graph theory, lattices and automata.

MODULE I

Order Relations, Lattices; Boolean Algebra Definition and Properties, Boolean Functions.

MODULE II

Basic concepts, Subgraphs, Degree of vertices, Paths and connectedness, Automorphism of a simple graph, Operations on graphs, Vertex cuts and Edge cuts, Connectivity and Edge connectivity, Trees-Definition, Characterization and Simple properties, Eulerian graphs, Planar and Non planar graphs, Euler formula and its consequences, K5 and K3,3 are non planar graphs, Dual of a plane graph.

MODULE III

Automata and Formal Languages: Introduction to the theory of Computation, Finite Automata.

TEXTBOOKS

TEXT 1: R. BALAKRISHNAN and K. RANGANATHAN, A TEXT BOOK OF GRAPH THEORY, Springer-Verlag New York, Inc., 2000.

TEXT 2: K. D JOSHI, FOUNDATIONS OF DISCRETE MATHEMATICS, New Age International(P) Limited, New Delhi, 1989.

TEXT 3: PETER LINZ, AN INTRODUCTION TO FORMAL LANGUAGES AND AUTOMATA (2nd Edn.), Narosa Publishing House, New Delhi, 1997.

REFERENCES

[1] J. C. Abbot: Sets, lattices and Boolean Algebras; Allyn and Bacon, Boston; 1969.

[2] J. A. Bondy, U.S.R. Murty: Graph Theory; Springer; 2000.

[3] S. M. Cioaba and M.R. Murty: A First Course in Graph Theory and Combinatorics; Hindustan Book Agency; 2009.

[4] J. A. Clalrk: A first look at Graph Theory; World Scientific; 1991.

OBJECTIVES

- To understand the definition of Boolean algebra and Boolean functions along with various properties.
- To study graph and its types with suitable examples.
- To learn about connectivity of graphs.
- To understand the definition of trees and learn various theorems related to it.
- To study about language, grammar and types of acceptors.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Lattices; Boolean Algebra Definition and Properties, Boolean Functions	• Discussion • Participative learning • Problem solving	Seminars by students	To study about Boolean algebra and Boolean functions.	Evaluation through test paper.
MODULE II	Graph definition with examples, isomorphism, connected graphs, planar graphs, trees and eulerian graphs	• Lecture • Discussion • Participative learning • Problem solving	Assignments on isomorphism of graphs. Discussion about various definitions.	To learn basics about graphs and trees. To study about planarity and connectivity.	Evaluation through test paper.
MODULE III	Definition of automata. Languages and Grammars. DFA and NFA	• Lecture • Discussion • Participative learning • Problem solving	Discussion on applications of automata. Working out exercise problems on DFA and NFA	To know the basic about automata. To learn about DFA and NFA	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about Boolean algebra and Boolean functions.
CO2	To learn basics about graphs and trees. To study about planarity and connectivity.
CO3	To know the basic about automata. To learn about DFA and NFA

Faculty in Charge
Ms. Amala Mary George

MTH2C06: ALGEBRA II
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the ideas and concepts of insolvability of the quintic.

MODULE I

Prime and Maximal Ideals, Introduction to Extension Fields, Algebraic Extensions (Omit Proof of the Existence of an Algebraic Closure), Geometric Constructions. [27, 29, 31, 32]

MODULE II

Finite Fields, Automorphisms of Fields, the Isomorphism Extension Theorem, Splitting Fields, Separable Extensions. [33, 48, 49, 50, 51]

MODULE III

Galois Theory, Illustration of Galois Theory, Cyclotomic Extensions, Insolvability of the Quintic. [53, 54, 55, 56]

TEXT: John B. Fraleigh: A FIRST COURSE IN ABSTRACT ALGEBRA (7th Edn), Pearson Education Inc., 2003.

REFERENCES :

[1] N. Bourbaki: Elements of Mathematics: Algebra I, Springer; 1998

[2] Dummit and Foote: Abstract algebra (3rd Edn); Wiley India; 2011

[3] M.H. Fenrick: Introduction to the Galois correspondence (2nd Edn); Birkhuser; 1998

[4] P.A. Grillet: Abstract algebra (2nd Edn); Springer; 2007

[5] I.N. Herstein: Topics in Algebra (2nd Edn); John Wiley & Sons, 2006.

[6] T.W. Hungerford: Algebra; Springer Verlag GTM 73 (4th Printing); 1987

[7] C. Lanski: Concepts in Abstract Algebra; American Mathematical Society; 2010

[8] R. Lidl and G. Pilz Applied abstract algebra(2nd edn.); Springer; 1998

[9] N.H. Mc Coy: Introduction to modern algebra, Literary Licensing, LLC; 2012

[10] J. Rotman: An Introduction to the Theory of Groups (4th Edn); Springer; 1999

[11] I. Stewart: Galois theory(3rd edn.); Chapman & Hall/CRC; 2003

OBJECTIVES

a) **To understand the basic concepts of Prime and Maximal Ideals.**

b) **To get familiarize with Algebraic Extensions.**

c) **To understand the Automorphisms of fields, Separable Extensions and Splitting Fields.**

d) **To study about the Galois Theory, Cyclotomic Extensions and the Insolvability of the Quintic.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Prime and Maximal Ideals, Introduction to Extension Fields, Algebraic Extensions, Geometric Constructions.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on prime and maximal ideals and algebraic extensions	To understand: • the basics of extension fields • geometric constructions	Evaluation through MCQ
Module I1 (30 hours)	Finite Fields, Automorphisms of Fields, the Isomorphism Extension Theorem, Splitting Fields, Separable Extensions.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about separable extensions	To understand: • Isomorphism Extension Theorem Splitting and Separable Extensions	Evaluation through test paper
Module III (30 hours)	Galois Theory, Illustration of Galois Theory, Cyclotomic Extensions, Insolvability of the Quintic.	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on Cyclotomic Extensions	To understand: • Galois Theory • Insolvability of the Quintic	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of finite and extension fields, geometric constructions etc.
CO2	To understand the concept of Isomorphism Extension Theorem, Splitting and Separable Extensions.
CO3	To understand Galois theory and the Insolvability of the Quintic

Faculty in charge:
Ms. Smitha Davis

MT2C10: ODE AND CALCULUS OF VARIATIONS
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of ordinary differential equations and its applications.

MODULE I

Power Series Solutions and Special functions; Some Special Functions of Mathematical Physics.

MODULE II

Some special functions of Mathematical Physics (continued), Systems of First Order Equations; Non linear Equations

MODULE III

Oscillation Theory of Boundary Value Problems, The Existence and Uniqueness of Solutions, The Calculus of Variations.

TEXT:

SIMMONS, G.F., DIFFERENTIAL EQUATIONS WITH APPLICATIONS AND HISTORICAL NOTES (3rd Edn.), New Delhi, 1974.

REFERENCES :

[1] G. Birkhoff and G.C. Rota: Ordinary Differential Equations(3rd Edn.); Edn. Wiley & Sons; 1978
[2] W.E. Boyce and R.C. Diprima: Elementary Differential Equations and boundary value problems (2nd Edn.); John Wiley & Sons, NY; 1969
[3] A. Chakrabarti: Elements of ordinary Differential Equations and special functions; Wiley Eastern Ltd., New Delhi; 1990
[4] E.A. Coddington: An Introduction to Ordinary Differential Equtions; Printice Hall of India, New Delhi; 1974
[5] R.Courant and D. Hilbert: Methods of Mathematical Physics- vol I; Wiley Eastern Reprint; 1975
[6] P. Hartman: Ordinary Differential Equations; John Wiley & Sons; 1964 [7] L.S. Pontriyagin : A course in ordinary Differential Equations Hindustan Pub. Corporation, Delhi; 1967

[8] I. Sneddon: Elements of Partial Differential Equations; McGraw-Hill International, Edn.;1957

OBJECTIVES

a) **To study how to compute power series solution of first order ODE.**

b) **To get familiarize with some special functions of Mathematical Physics.**

c) **To study the methods to solve systems of first order equations.**

d) **To study more about qualitative properties of solutions.**

e) **To understand the concept of calculus of variations.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Power series solutions of first order ODEs, special functions in Mathematical Physics	• Lecture • Discussion • Participative learning • Problem solving	• Problem solving sessions in groups. • Discussing the solutions obtained	To understand: • the basics of solutions of ODE • significance of special functions	Evaluation Through test papers
Module I1 (30 hours)	Solve systems of first order and nonlinear equations	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain nonlinear equations	To understand: • the method to solve systems of first order equations • theory of solutions of nonlinear equations	Evaluation through test paper
Module III (25 Hours)	Existence and uniqueness of solutions, calculus of variations	• Lecture • Discussion • Participative learning • Problem solving	• Assignment on existence and uniqueness of solutions • Discussion in peer groups on	To understand: • the applications in Calculus of variations • the	Evaluation through test paper

			Calculus of Variations	qualitative nature of solutions	

Course Outcomes

CO1	To understand the power series solutions of ordinary differential equations and the significance of special functions.
CO2	To know more about special functions, systems of first order equations and nonlinear equations
CO3	To understand the qualitative nature of solutions and calculus of variation.

Faculty in charge:
Dr. Vijitha Mukundan

MTH2C10 – OPERATIONS RESEARCH

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn various methods to solve an LPP and study about game theory and networking.

MODULE I

Convex Functions; Linear Programming

MODULE II

Linear Programming (contd.); Transportation Problem

MODULE III

Integer Programming; Sensitivity Analysis; Flow and Potential in Networks; Theory of Games

TEXTBOOK

K.V. MITAL; C. MOHAN., OPTIMIZATION METHODS IN OPERATIONS RESEARCH AND SYSTEMS ANALYSIS(3rd. Edn.), New Age International(P) Ltd., 1996.

REFERENCES

[1] R.L. Ackoff and M.W. Sasioni: Fundamentals of Operations Research; Wiley Eastern Ltd. New Delhi; 1991

[2] C.S. Beightler, D.T. Philiphs and D.J. Wilde: Foundations of optimization(2nd Edn.); Prentice Hall of India, Delhi; 1979

[3] G. Hadley: Linear Programming; Addison-Wesley Pub Co Reading, Mass; 1975

[4] G. Hadley: Non-linear and Dynamic Programming; Wiley Eastern Pub Co. Reading, Mass; 1964

OBJECTIVES

- To learn about convex function and few theorems related to it.
- To study LPP and simplex method to solve it.

- ❖ Understand and solve transportation problems.
- ❖ To study about the sensitivity analysis.
- ❖ To learn flow and networks.
- ❖ To understand the problems related to game theory.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Convex functions. Definition of LPP.	• Discussion • Participative learning • Problem solving • Lecture	Assignments on LPP	To study about convex functions and definition of LPP	Evaluation through test paper.
MODULE II	Simplex method to solve LPP. Transportation problem. VAM and MODI method to solve transportation problem.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on simplex method and solving of transportation method	To learn to solve LPP using simplex method. To solve Transportation problem.	Evaluation through test paper.
MODULE III	Integer programming and sensitivity analysis. Networking. Introduction to Game theory.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students on sensitivity analysis. Methods to solve flow and network. Game theory problem solving.	Discussion on sensitivity analysis. To solve networks and problems on game theory.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about convex functions
CO2	To learn about methods to solve LPP and transportation problems
CO3	To know about sensitivity in LPP and methods to solve networks. To understand game theory.

Faculty in charge:

Ms. Amala Mary George

MTH2C08: TOPOLOGY
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the motivation and concepts of topology.

MODULE I

A Quick Revision of Chapter 1,2 and 3. Topological space, basic concepts [Chapter 4 and Chapter5 Section 1, Section 2(excluding 2.11 and 2.12) and Section 3 only]

MODULE II

Making Functions Continuous, quotient spaces, spaces with special properties [Chapter 5 Section 4 and Chapter 6]

MODULE III

Separation axioms: Hierarchy of separation axioms, Compactness and separation axioms, The Urysohn characterization of normality, Tietze characterization of normality.[Chapter 7 Section 1 to 3 and Section 4 up to and including 4.6]

TEXT:

JOSHI K D, INTRODUCTION TO GENERAL TOPOLOGY (Revised Edn.), New Age International (P) Ltd., New Delhi, 1983

Inc., 2003.

REFERENCES :

[1] M A Armstrong: Basic Topology, Springer- Verlag New York; 1983.

[2] J Dugundji: Topology; Prentice hall of India; 1975.

[3] M Gemignani: Elementary Topology; Addison Wesley Pub Co Reading Mass, 1971

[4] M G Murdeshwar: General Topology(2nd Edn);Wiley Eastern Ltd, 1990

[5] G F Simmons: Introduction to Topology and modern analysis; McGraw-Hill international student Edn;1963.

OBJECTIVES

a) **To understand the basic concepts of Topological Spaces.**

b) **To get familiarize with making functions continuous, Quotient Spaces.**

c) **To understand the separation axioms, Hierarchy of separation axioms, compactness and separation axioms.**

d) **To study the Urysohn characterization of normality, Tietze characterization of normality.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Topological Spaces, Basic concepts	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic topology and topological space	To understand: • the basics of topology • topological spaces • different types of topologies	Evaluation Through MCQ
Module I1 (30 hours)	Making functions continuous, quotient spaces, spaces with special properties	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about making functions continuous	To understand: • Compact Lindeloff spaces • Connectedness Local Connectedness	Evaluation Through test paper

				Path Connectedness	
Module III (30 Hours)	Separation axioms: Hierarchy of separation axioms, compactness and separation axioms, The Urysohn characterization of normality, Tietze characterization of normality	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on separation axioms	To understand: • Separation axioms • Urysohn characterization of normality	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of basic topology, topological space, different types of topologies.
CO2	To understand the concept of making functions continuous, quotient spaces
CO3	To understand the separation axioms, the Urysohn characterization of normality, Tietz characterization of normality

Faculty in charge:
Ms. Linet Roslin Antony

MT2C08: REAL ANALYSIS - II
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the advanced concepts of real analysis.

MODULE I

Lebesgue outer measure, measurable sets, regularity, measurable functions, Borel and Lebesgue measurability, Integration of non-negative functions, the general integral, integration of series Reimann and Lebesgue integrals

MODULE II

Differentiation, continuous non-differentiable functions, functions of bounded variation, Lebesgue's differentiation theorem, differentiation and integration, Lebegues set, Measures and outer measures, extension of a measure, uniqueness of the extension, completion of a measure, measure spaces, integration with respect to a measure

MODULE III

Signed measures and the Hahn decomposition, Jordan decompositon, Radon– Nikodym theorem, some applications of Radon Nikodym Theorem, bounded linear functionals on L^p, Lebesgue stieltjes measure, absolutely continuous functions, integration by parts, change of variable, Riesz Representation theorem for C(I).

TEXT:

G.de Barra, Measure Theory and Integration, New Age International Ltd. Publishers, New Delhi, 2006.

REFERENCES :

[1] K. B. Athreya and S. N. Lahiri, Measure Theory, Hindustan Book Agency, New Delhi, 2006.

[2] R. G. Bartle, The Element of Integration, John Wiley, 1964.

[3] S. K. Berberian, Measure and Integration, The McMillan Company, NewYork, 1965.

[4] P. R. Halmos, Measure Theory, Springer verlag.

[5] H. L. Royden, Real Analysis, Prentice Hall India, 1988 (3rd edition).

[6] W. Rudin, Real and Complex Analysis, Tata McGraw Hill, New Delhi, 2006.

[7] I. K. Rana, An Introduction to Measure and Integration, Narosa Publishing company, New York, Analysis,Tata McGraw Hill,New Delhi,2006

[7] I K Rana:,An Introduction to Measure and Integration,Narosa Publishing Company,New York.

[8] Terence Tao: ,An Introduction to Measure Theory,Graduate Studies in Mathematics,Vol 126 AMS

OBJECTIVES

a) **To understand the basic concepts of Outer measure and measurable functions**

b) **To study about Reimann and Lebesgue Integrals**

c) **To understand Lebesgue Measure and Lebesgue Measurable Functions and its properties**

d) **To understand the concept of bounded linear functionals on L^p**

e) **To perform differentiation and Integration**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Lebesgue outer measure, measurable sets, regularity, measurable functions, Integration of non-negative functions, Reimann and Lebesgue integrals Measure, Lebesgue Measurable Functions	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Lebesgue measure and Lebesgue measurable functions	To understand: • the basics of sigma algebra • notion of Lebesgue measure and measurable functions	Evaluation through interaction with students and test papers
Module I1 (30 hours)	Differentiation,Lebesgue's differentiation theorem, differentiation and integration, Lebegues set, Measures and outer measures, measure spaces, integration with respect to a measure	• Lecture • Discussion • Participative learning • Problem solving	Student seminars on some topics Differentiation and Integration	To understand: • Concepts of Lebesgue integration and Differentiation	Evaluation through test papers and interaction with students
Module II1 (30 hours)	Signed measures and the Hahn decomposition, Jordan decompositon, Radon–	• Lecture • Discussion • Participativ	• Peer group discussion on theorems	To understand: • Concepts of signed	Evaluation through test paper

	Nikodym theorem, Riesz Representation theorem for C(I).	e learning		measures	

Course Outcomes

CO1	To introduce the concept of Sigma Algebra, Borel sets, Lebesgue Measure, Lebesgue Measurable Functions
CO2	To understand the concept of differentiation and integration.
CO3	To understand the concept of signed measures, bounded linear functionals on $L^{p.}$

Faculty in charge:
Dr. Nidhin T J

MT 3C 12: COMPLEX ANALYSIS
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the ideas and concepts of analytic functions and singularities..

MODULE I

Conformality, Linear Transformations, Fundamental Theorems, Cauchy's Integral Formula.

MODULE II

Local Properties of Analytical Functions, The General Form of Cauchy's Theorem, The Calculus of Residues, Harmonic Functions.

MODULE III

Power Series Expansions, Simply Periodic Functions, Doubly Periodic Functions, The Weierstrass Theory.

TEXT: LARS V. AHLFORS : Complex Analysis, 3rd edn. Mc Graw Hill (1979)

REFERENCES :

1. Cartan, H. : Elementary Theory of Analytic Functions of one or Several . Variables, Addison - Wesley Pub. Co. (1973)
2. Conway, J.B. : Functions of One Complex Variable, Narosa Pub. Co., New Delhi. . (1973)
3. Moore T.O. &Hadlock E.H. : Complex Analysis, Series in Pure Mathematics - Vol. 9. World Scientific . (1991)
4. Pennisi, L. : Elements of Complex Variables, Holf, Rinehart & Winston, 2nd Edn. . (1976)
5. Rudin, W. : Real and Complex Analysis, 3rd Edn. McGraw - Hill International . Edn. (1987)
6. Silverman, H. : Compex Variables, Houghton Mifflin Co. Boston (1975)
7. Remmert, R. : Theory of Complex Functions, UTM, Springer- Verlag, NY, (1991)

OBJECTIVES

a) **To understand the basic concepts of** Power series, Analytic functions, Analytic functions as mappings and Mobius transformations.

b) **To get familiarize with** Conformal mappings, Weistrass theory

c) **To understand the** Power series representation of analytic functions, Zeros of an analytic function, The index of a closed curve, Cauchy's Theorem and Integral Formula and the classification of singularities.

LESSON PLAN

Unit/ session / hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Conformal mappings, Cauchy Integral formula	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Power series and Analytic functions	To understand: • Conformal mappings • Fundamental theorems	Evaluation through MCQ
Module I1 (30 hours)	Analytic functions, Harmonic funcions	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about Power series representation of analytic functions	To understand: • Residue theorem • Calculus of residue.	Evaluation through test paper
Module III (30	Entire functions Wiestrass Theory	• Lecture • Discussion • Participative learning	• Seminar and assignment on	To understand: • Simply periodic doubly	Evaluation through test paper

hours)		• Problem solving	classification of singularities	periodic functions	

Course Outcomes

CO1	To introduce the concept of Power series and Analytic functions
CO2	To understand the concept of Cauchy's Theorem and Integral Formula, Open Mapping Theorem and Goursat's Theorem.
CO3	To understand the Argument Principle, the Maximum Principle and Schwarz's Lemma.

Faculty in charge:
Ms. Linet Roslin Antony

MT3C14 – ADVANCED FUNCTIONAL ANALYSIS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn about metric spaces, normed spaces, Banach spaces and Inner product spaces.

MODULE I

Metric spaces and Continuous Functions, Lp spaces , Fourier series and Integrals, Normed spaces Continuity of linear maps

MODULE II

Hahn-Banach Theorems, Banach spaces, Uniform Boundedness Principle

MODULE III

Closed Graph and Open Mapping Theorems, Bounded Inverse Theorem, Inner product spaces, Orthonormal sets

TEXTBOOK

LIMAYE , B.V, FUNCTIONAL ANALYSIS, (2nd Edn.) New Age International Ltd, Publishers, New Delhi, Bangalore (1996)

REFERENCES

[1]R. Bhatia, Notes on Functional Analysis TRIM series, Hindustan Book Agency

[2]KesavanS, Functional Analysis TRIM series, Hindustan Book Agency

[3] S David Promislow, A First Course in Functional Analysis Wiley Interscience, John wiley & Sons, INC., (2008)

[4]E.Kreyszig, Introductory Functional Analysis with Applications John Wiley & Sons (1978)

OBJECTIVES

- ❖ To define Metric spaces along with examples.
- ❖ To study normed spaces and its continuity.
- ❖ To learn Hahn Banach theorems.
- ❖ To understand Banach spaces.
- ❖ To study about Inner product spaces and orthonormality.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Metric spaces.L_p spaces. Normed spaces. Continuity of linear maps	• Discussion • Participative learning • Problem solving • Lecture	Assignments on examples of metric spaces and normed spaces.	To study about metric spaces and its properties. To learn normed spaces.	Evaluation through test paper.
MODULE II	Hahn Banach Theorems. Banach spaces.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on corollaries of Hahn Banach theorems.	To learn Hahn Banach theorem and study about Banach spaces	Evaluation through test paper.
MODULE III	Closed graph theorem. Open mapping theorem. Inner products. Orthonormality.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students	To study important theorems. To learn about Inner products and orthonormal space.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about metric space and normed space along with its continuity
CO2	To study Hahn Banach theorem and Uniform Boundedness principle
CO3	To learn about inner products and orthonormal spaces.

Faculty in charge:
Ms. Amala mary George

MTH3C11 – MULTIVARIABLE CALCULUS AND GEOMETRY

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To understand concepts in Differential Geometry

MODULE I

Functions of Several Variables Linear Transformations, Differentiation, The Contraction Principle, The Inverse Function Theorem, the Implicit Function Theorem.

MODULE II

What is a curve? Arc-length, Reparametrization, Closed curves, Level curves versus parametrized curves. Curvature, Plane curves, Space curves What is a surface, Smooth surfaces, Smooth maps, Tangents and derivatives, Normals and orientability.

MODULE III

Level surfaces, Ruled surfaces and surfaces of revolution, Applications of the inverse function theorem, Lengths of curves on surfaces, Equiareal maps and a theorem of Archimedes, The second fundamental form, The Gauss and Weingarten maps, Normal and geodesic curvatures. Gaussian and mean curvatures, Principal curvatures of a surface.

TEXTBOOKS

TEXT 1 : RUDIN W., PRINCIPLES OF MATHEMATICAL ANALYSIS, (3rd Edn.), Mc. Graw Hill, 1986.

TEXT 2: ANDREW PRESSLEY, ELEMENTARY DIFFERENTIAL GEOMETRY(2nd Edn.), Springer-Verlag, 2010.

REFERENCES

[1] M. P. do Carmo: Differential Geometry of Curves and Surfaces;

[2] W. Klingenberg: A course in Differential Geometry;

[3] J. R. Munkres: Analysis on Manifolds; Westview Press; 1997

[4] C. C. Pugh: Real Mathematical Analysis, Springer; 2010

[5] M. Spivak: A Comprehensive Introduction to Differential Geometry-Vol. I; Publish

or Perish, Boston; 1970

[6] M. Spivak: Calculus on Manifolds; Westview Press; 1971

[7] V.A. Zorich: Mathematical Analysis-I; Springer; 2008

OBJECTIVES

- To understand functions of several variables and its differentiation
- To study curves, level curves and curvature.
- To learn about surfaces and its properties as normal, orientablity and tangents.
- To understand the definition Guass Weingarten maps
- To study about Guassian, mean curvatures

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	The Contraction Principle, The Inverse Function Theorem, the Implicit Function Theorem.	• Discussion • Participative learning • Problem solving	Seminars by students	To study about Functions of Several Variables Linear Transformations and its properties	Evaluation through test paper.
MODULE II	Arc-length, Reparametrization, Level curves versus parametrized curves. Curvature, Tangents and derivatives, Normals and orientability.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on Tangents and derivatives. Discussion about various definitions.	To learn basics about Curves, Level curves, curvature, Smooth maps,Tangents, Normals.	Evaluation through MCQ

MODULE III	Level surfaces, Applications of the inverse function theorem, Normal and geodesic curvatures. Gaussian and mean curvatures, Principal curvatures of a surface.	• Lecture • Discussion • Participative learning • Problem solving	Discussion on Surfaces and its properties.	To know the about Level, ruled surfaces, Guassian, mean, principal curvatures. The Gauss and Weingarten maps,	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about functions of several variables
CO2	To learn about the analytical and geometric concepts of curves and its variations To study about cuvature and sufaces
CO3	To know The Gauss and Weingarten maps, To learn Guassian and mean curvature.

Faculty in Charge

Ms. Nidhin T J

MT3C15: PDE and Integral Equations
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic theory of PDE and Integral Equations.

MODULE I

First Order PDE .

MODULE II

Second Order PDE .

MODULE III

Integral Equations

TEXTS : 1. AMARNATH, M., : PARTIAL DIFFERENTIAL EQUATIONS, Narosa , New Delhi (1997)

2. HILDEBRAND, F.B.: METHODS OF APPLIED MATHEMATICS, (2 nd Edn.) Prentice-Hall of India, New Delhi, 1972

REFERENCES :

1. G. Birkhoff & G.C. Rota : Ordinary Differential Equations, Edn. Wiley & Sons 3rd Edn (1978)
2. E.A. Coddington : An Introduction to Ordinary Differential Equations, Printice Hall of India, New Delhi (1974)
3. P. Hartman : Ordinary Differential Equations, John Wiley & Sons (1964)
4. L.S. Pontriyagin : A Course in Ordinary Differential Equations, Hindustan Pub. Corporation, Delhi (1967)
5. F. John : Partial Differential Equations, Narosa Pub. House New Delhi (1986)
6. Phoolan Prasad & : Partial Differential Equations, Renuka Ravindran Wiley Eastern Ltd New Delhi (1985)
7. R. Courant and D.Hilbert : Methods of Mathematical Physics , Vol I, Wiley Eastern Reprint (1975) 8. W.E. Boyce & R.C. Deprima : Elementary Differential Equations, and Boundary Value Problems

John Wiley & Sons, NY, 9th Edition

OBJECTIVES

a) **To study the basic methods of solving partial differential equations.**

b) **To study different methods for solving second order linear and nonlinear pde.**

c) **To study the classification of PDE and to obtain the canonical forms.**

d) **To understand the relation between integral equations and differential equations and to study different methods to solve integral equations.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Linear equations of first order,Quasilinear equations, method of characteristics, the Lagrange method, Charpit method, Jacobi method, Cauchy problem	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on different methods of solving first order pde	To understand: • Different types of PDE • methods to solve pde • solving non linear problem	Evaluation through test paper and interaction with students

Module I1 (30 hours)	Classification of second order pde, solving wave, heat and Laplace equations, Separation of variables, canonical form, Cauchy problem for second order pde	• Lecture • Discussion • Participative learning • Problem solving	Student seminars to understand the method of solving wave, heat and Laplace equations	To understand: • Methods to solve second order PDE • Solutions of heat, wave and Laplace equations	Evaluation through test paper
Module III (25 Hours)	Integral equations, Fredholm and Volterra equations, Resolvent kernel,Neumann series, Fredholm Schmidt theory	• Lecture • Discussion • Participative learning • Problem solving	• Assignment and problem solving sessions on Integral equations	To understand: • Relation between integral equation and differential equation • Methods tosolve integral equations of different kinds	Evaluation through test paper

Course Outcomes

CO1	To study different types of PDE and methods for solving them.

CO2	To study methods of solving second order PDE, heat, wave and Laplace equation, Cauchy problem
CO3	To understand the relation between differential equation and integral equations, also different methods to solve integral equations.

Faculty in charge:
Ms. Vijitha Mukundan

MTH4E06: Algebraic Number Theory
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the concepts of Algebraic Number Theory.

MODULE I

Symmetric polynomials, Modules, Free abelian groups, Algebraic Numbers, Conjugates and Discriminants, Algebraic Integers, Integral Bases, Norms and Traces, Rings of Integers, Quadratic Fields, Cyclotomic Fields

MODULE II

Historical background, Trivial Factorizations, Factorization into Irreducibles, Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals Historical background, Prime Factorization of Ideals, The norm of an ideal

MODULE III

Lattices, The Quotient Torus, Minkowski theorem, The Space Lst, The Class-Group An Existence Theorem, Finiteness of the Class-Group, Factorization of a Rational Prime, Fermats Last Theorem Some history, Elementary Considerations, Kummers Lemma, Kummers Theorem.

TEXT : I. N. STEWART & D.O. TALL, ALGEBRAIC NUMBER THEORY, (2nd Edn.), Chapman & Hall, (1987)

REFERENCES :

[1] P. Samuel : Theory of Algebraic Numbers, Herman Paris Houghton Mifflin, NY, (1975)
[2] S. Lang : Algebraic Number Theory, Addison Wesley Pub Co., Reading, Mass, (1970)
[3] bf D. Marcus : Number Fields, Universitext, Springer Verlag, NY, (1976)
[4] 4T.I.FR. Pamphlet No: 4 : Algebraic Number Theory (Bombay, 1966)
[5] Harvey Cohn : Advanced Number Theory, Dover Publications Inc., NY, (1980)
[6] Andre Weil : Basic Number Theory, (3rd Edn.), Springer Verlag, NY, (1974)
[7] G.H. Hardy and E.M. Wright : An Introduction to the Theory of Numbers, Oxford University Press.
[8] Z.I. Borevich & I.R.Shafarevich : Number Theory, Academic Press, NY 1966.
[9] Esmonde & Ram Murthy : Problems in Algebraic Number Theory, Springer Verlag 2000

OBJECTIVES

a) **To study the basic concepts of numberfield, quadratic field, Guassian field and their properties.**

b) **To study how factorization into irreducibles hold in different fields.**

c) **To understand the concepts of lattices, the quotient torus and geometric representation of algebraic numbers.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Factorization into Irreducibles, Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals, Prime Factorization of Ideals,	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on numberfields and its properties	To understand: • the factorization into irreducibles • different types of numberfields • the factorization of ideals • properties of ideals	Evaluation through test paper and interaction with students

Module I1 (30 hours)	Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals Historical background, Prime Factorization of Ideals, The norm of an ideal	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to understand prime factorization and quadratic fields	To understand: • Nonunique Factorization into Irreducibles • Factorization of Ideals and norm of an ideal	Evaluation Through test paper
Module III (25 Hours)	Lattices, The Quotient Torus, Minkowski theorem, The Space Lst, The Class-Group An Existence Theorem, Finiteness of the Class-Group, Factorization of a Rational Prime, Kummers Lemma, Kummers Theorem	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion and assignments to understand geometric representation of algebraic numbers	To understand: • The Quotient Torus • The classgroup	Evaluation through test paper

Course Outcomes

CO1	Awareness about different types of numberfield and their properties
CO2	Able to check unique factorization in fields and also can provide examples of nonunique factorizations
CO3	To understand the geometric representation of algebraic numbers

Faculty in charge:
Dr. Vijitha Mukundan

MT4E11 – ADVANCED FUNCTIONAL ANALYSIS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn about duality, compactness and boundedness of spaces.

MODULE I

Duals and Transposes, Duals of Lp [a,b] and C[a,b], weak and weak* convergence, Reflexivity

MODULE II

Definition of Compact Linear Map, spectrum of a compact operator, Riesz Representation Theorems

MODULE III

Bounded Operators and Adjoints , Normal, Unitary and Self Adjoint Operators , Spectrum and Numerical Range , Compact self Adjoint Operator

TEXTBOOK

LIMAYE , B.V, FUNCTIONAL ANALYSIS, (2nd Edn.) New Age International Ltd, Publishers, New Delhi, Bangalore (1996)

REFERENCES

[1]R. Bhatia, Notes on Functional Analysis TRIM series, Hindustan Book Agency

[2]KesavanS, Functional Analysis TRIM series, Hindustan Book Agency

[3] S David Promislow, A First Course in Functional Analysis Wiley Interscience, John wiley & Sons, INC., (2008)

[4]E.Kreyszig, Introductory Functional Analysis with Applications John Wiley & Sons (1978)

OBJECTIVES

- To understand the concept of duality and reflexivity.
- To study spectrum of compact operators.
- To understand the concept of Bounded linear operators and its types.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Dual spaces. Weak convergence Reflexivity	• Discussion • Participative learning • Problem solving • Lecture	Assignments on examples of dual spaces	To study about duality and weak convergence. To learn reflexivity.	Evaluation through test paper.
MODULE II	Compact operators and its spectrum. Riesz Representation theorems.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on compact operators and examples	To learn about spectrum of compact operators	Evaluation through test paper.
MODULE III	Bounded operators. Adjoint, normal, unitary and self adjoint operators. Compact self adjoint operator.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students	To study Self adjoint operators and compactness.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about duality and the concept of reflexivity
CO2	To learn about compact operators
CO3	To learn about Bounded linear operators and self adjoint operators

Faculty in charge:

Ms. Amala Mary George

MTH4C11: GRAPH THEORY
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the basic concepts of Graph theory.

Module 1

Basic concepts of Graph. Trees, Cut edges and Bonds, Cut vertices, Cayleys Formula, The Connector Problem, Connectivity, Blocks, Construction of Reliable Communication Networks, Euler Tours, Hamilton Cycles, The Chineese Postman Problem, The Travelling Salesman Problem.

Module 2

Matchings, Matchings and Coverings in Bipartite Graphs, Perfect Matchings, The Personnel Assignment Problem, Edge Chromatic Number, Vizings Theorem, The Timetabling Problem, Independent Sets, Ramseys Theorem

Module 3

Vertex Colouring-Chromatic Number, Brooks Theorem, Chromatic Polynomial, Girth and Chromatic Number, A Storage Problem, Plane and Planar Graphs, Dual Graphs, Eulers Formula, Bridges, Kuratowskis Theorem, The Five-Colour Theorem, Directed Graphs, Directed Paths, Directed Cycles.

TEXT : J.A. Bondy and U.S.R.Murty : Graph Theory with applications. Macmillan

References

[1] F. Harary : Graph Theory, Narosa publishers, Reprint 2013.
[2] Geir Agnarsson, Raymond Greenlaw: Graph Theory Modelling, Applications and Algorithms, Pearson Printice Hall, 2007.
[3] John Clark and Derek Allan Holton : A First look at Graph Theory, World Scientific (Singapore) in 1991 and Allied Publishers (India) in 1995
[4] R. Balakrishnan & K. Ranganathan : A Text Book of Graph Theory, Springer Verlag, 2nd edition 2012.

OBJECTIVES

a) **To understand the basic concepts of graphs, Trees, Cut edges and Bonds, Cut vertices, Euler Tours, Hamilton Cycles**

b) **To get familiarize with Matchings and Coverings in Bipartite Graphs, Perfect**

Matching, Independent Sets, Ramseys Theorem

c) **To understand the concept of Vertex Colouring-Chromatic Number, Edge Chromatic Number , The Five-Colour Theorem, Directed Graphs.**

d) **To study more about Chromatic Polynomial, Girth and Chromatic Number**

e) **To understand The Five-Colour Theorem, Directed Graphs, Directed Paths, Directed Cycles.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Basic concepts of graph, Trees, Cut edges and Bonds, Cut vertices, Connectivity, Blocks, Euler Tours, Hamilton Cycles	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic concepts of graph	To understand: • the basics of graph, trees • Concepts of cut edges, cut vertices, Euler tour and Hamilton cycles	Evaluation Through MCQ
Module I1 (30 hours)	Matchings and Coverings, Perfect Matchings, Edge Chromatic Number, Vizings Theorem, Independent Sets, Edge colouring,Ramseys Theorem	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the Personnel Assignment Problem and The Timetabling Problem	To understand: • differentiation of matchings and covering • Concepts of edge colouring and Ramseys theorem	Evaluation Through test paper
Module III (30 Hours)	Vertex Colouring-Chromatic Number, Brooks Theorem, , Plane and Planar Graphs, Dual Graphs, Eulers Formula, Bridges,	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on Storage Problem	To understand: • Vertex colouring and it's important results • Planar	Evaluation through test paper

	Kuratowskis Theorem, The Five-Colour Theorem, Directed Graphs,			graphs, dual graphs and it's important result	

Course Outcomes

CO1	To introduce the concept of basic graph theory, trees, cut vertices and cut edges, Euler tour and Hamilton cycles
CO2	To understand the concept of matchings and covering, Edge colouring.
CO3	To understand the concepts of vertex colouring and it's important results. Planar graphs and dual graphs.

Faculty in charge:
Ms. Linet Roslin Antony

MTH4E09: DIFFERENTIAL GEOMETRY
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the basic concepts of differential geometry.

MODULE I

Graphs and Level Set, Vector fields, The Tangent Space, Surfaces, Vector Fields on Surfaces, Orientation. The Gauss Map .

MODULE II

Geodesics, Parallel Transport, The Weingarten Map, Curvature of Plane Curves, Arc Length and Line Integrals.

MODULE III

Curvature of Surfaces, Parametrized Surfaces, Local Equivalence of Surfaces and Parametrized Surfaces.

TEXT:

J.A.THORPE : ELEMENTARY TOPICS IN DIFFERENTIAL GEOMETRY

REFERENCES :

1) M. de Carmo : Differential Geometry of Curves and Surfaces, Prentice Hall Inc Englewood Cliffs NJ (1976).
2) V. Grilleman and A. Pollack : Differential Topology, Prentice Hall Inc Englewood Cliffs NJ (1974)
3) B. O'Neil : Elementary Differential Geometry, Academic Press NY (1966)
4) M. Spivak : A Comprehensive Introduction to Differential, Geometry, (Volumes 1 to 5), Publish or Perish, Boston (1970, 75)
5) R. Millmen and G. Parker : Elements of Differential Geometry, Prentice Hall Inc Englewood Cliffs NJ (1977)
6) I. Singer and J.A. Thorpe : Lecture Notes on Elementary Topology and Geometry, UTM, Springer Verlag, NY (1967)

7) W.L.Burke: Applied Differential Geometry , Cambridge University Press (1985).

OBJECTIVES

a) **To understand the basic concepts of level sets, surfaces and its curvature, geodesics,and parametrized surfaces .**

b) **To get familiarize with covariant derivatives and its properties.**

c) **To understand the concept of local and global parametrization.**

d) **To study more about parametrized surfaces and local equivalence of surface and parametrized surfaces.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I (30 hours)	Level sets,vector fields, the tangent space, surfaces and the gauss map.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on vector fields and level sets.	To understand: • the basics of surfaces • notion of tangent space and the gauss map	Evaluation Through MCQ
Module II (30 hours)	Geodesics, Parallel transport, The Weingarten map, Arc length and line integrals.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of derivatives of smooth vector field and covariant	To understand: • Local and global parametrization . • Concept of parallel transport.	Evaluation Through test paper

			derivative.		
Module III (30 Hours)	Curvature of surfaces, First and second fundamental forms,Parametrized surfaces and its local equivalence with surfaces.	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on local equivalence of surfaces and parametrized surfaces.	To understand: • Principal, Gaussian, Gauss Kronecker and Mean curvature • Inverse function theorems.	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of graphs and level sets, basics of surfaces and notion of tangent space anf gauss map.
CO2	To understand the concept of parallel transport, local and global parametrization, arc length and line integral.
CO3	To understand the principal ,Gaussian ,Gauss Kronecker and Mean curvature, and parametrized surfaces.

Faculty in charge:
Dr. Nidhin T J

ST1CO1 BASIC STATISTICS AND PROBABILITY

Lecture Hours per week: 4, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

Introduce basic concepts of statistics and to understand various approaches to probability and compute probabilities.

Module I (20 hrs)

Population, sample, measures of central tendency - arithmetic mean, weighted arithmetic mean, geometric mean, harmonic mean, median, mode, partition values - quartile, percentile, measures of deviations - variance, standard deviation, mean deviation about mean, quartile deviation, co-efficient of variation

Module II (15 hrs)

Fitting of straight line, parabola, exponential, polynomial, (least square method), correlation, regression, two regression lines, regression coefficients, properties - rank correlation, partial and multiple correlation

Module III (25 hrs)

Random experiment, Sample space, event, classical definition of probability, statistical regularity, relative frequency definition, field, sigma field, axiomatic definition of probability and simple properties, concept of probability measure, addition theorem(two and three events), conditional probability of two events, multiplication theorem, independence of events(pair wise and mutual), Bayes theorem. –numerical problems

Module IV (12 hrs)

Random variable- discrete and continuous, probability mass function (pmf) and probability density function (pdf) properties and examples, Cumulative Distribution function and its properties , change of variable (univariate case)

Reference Books:

1) V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.

2) S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chan and Sons

3) A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill

4) John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

OBJECTIVES

1) To understand the basic concepts of population and sample
2) To summarize the data in a diagrammatic and graphical way, obtain descriptive statistics and make possible and appropriate interpretations
3) To understand various approaches to probability and compute probabilities.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **20 Hours**	Population, sample, measures of central tendency, measures of deviations	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on methods of sampling	To understand advantages and limitations of sampling	Evaluation through test paper
Module II **15 Hours**	Fitting of straight line , parabola, exponential,	• Lecture • Discussion • Participative learning	• Students seminar related to curve fitting	To solve problems related to curve fitting	Evaluation through test paper

	polynomial, correlation, regression, two regression lines, regression coefficients, properties - rank correlation, partial and multiple correlation	• Problem solving			
Module III **25 Hours**	Random experiment, Sample space, event, classical definition of probability, axiomatic definition of probability and simple properties, addition theorem, conditional probability of two events, multiplication theorem, independence of events,	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to compute probabilities	To understand basic definition and properties of probability	Evaluation through test paper and viva

	Bayes theorem				
Module IV **12 Hours**	Random variable- discrete and continuous, probability mass function and probability density function , Cumulative Distribution Function and its properties change of variable	• Lecture • Discussions • Problem solving	• Student seminars on probability mass function , probability density function and their properties	To understand discrete and continuous random variables	Evaluation through test paper

Course Outcomes

CO1	To understand advantages and limitations of sampling
CO2	To summarize the data in a diagrammatic and graphical way, obtain descriptive statistics and make possible and appropriate interpretations
CO3	To understand various approaches to probability and compute probabilities
CO4	To understand discrete and continuous random variables and their probability functions

Teacher in Charge:

Ms. Jiji Pauly

ST2CO2 : PROBABILITY DISTRIBUTIONS

Lecture Hours per week: 4, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce the idea about mathematical expectation and conditional probability of univariate, Bivariate random variable, Also the standard distribution and its properties.

Module I (15 hrs)

Mathematical expectations (univariate): Definition, raw and central moments (definition and relationships), moment generating function and properties, characteristic function (definition and use only), Skewness and kurtosis (using moments)

Module II (15 hrs)

Bivariate random variable: joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.

Module III (30 hrs)

Standard distributions: Discrete type Bernoulli, Binomial, Poisson, Geometric, negative binomial (definition, properties and applications), Uniform (mean, variance and mgf), Continuous typeUniform, exponential, gamma, Beta, Normal (definition, properties and applications), Lognormal, Pareto and Cauchy (Definition only).

Module IV (12 hrs)

Chebyshev's inequality, variables, Convergence in probability weak law of large numbers (iid case), Bernoulli law of large numbers, example only), Central limit theorem (Lindberg Levyiid case).

Reference Books:

1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill
4. John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

OBJECTIVES

1. Discribe the moments, mgf, expectations, characteristic function, Skewness , kurtosis of univariate and bivariate random variable.
2. Give the knowledge of important discrete and continuous distributions such as Binomial, Poisson,

   Geometric, Negative Binomial and Hyper-geometric, normal, uniform, exponential, beta and gamma distributions
3. Understand the Concept of law large numbers and their uses.
4. Understand the Concept of central limit theorem and its uses.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **15 Hours**	Mathematical expectations (univariate): Definition, raw and central moments (definition and relationships), moment generating function and properties, characteristic function (definition and use only), Skewness and kurtosis (using moments)	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to mathematical expectation, raw and cenral moments, mgf	• Understand the definition of moments, mgf , characteristic function, Skewness and kurtosis	Evaluation through test paper
Module II **15 Hours**	Bivariate random variable: joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient,	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars on the topic bivariate Expectations, conditional mean variance, and covariance.	• Give knowledge related to the concept of Bivariate random variable including expectation moments and mgf.	Evaluation through test paper

	independence of random variables based on expectation.				
Module III 30 Hours	Standard distributions: Discrete type Bernoulli, Binomial, Poisson, Geometric, negative binomial, Uniform, Continuous typeUniform, exponential, gamma, Beta, Normal, Lognormal, Pareto and Cauchy.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on discrete and Continuous distribution.	• Enable to understand different type of distribution.	Evaluation through test paper
Module IV 12 Hours	Chebyshev's inequality, variables, Convergence in probability weak law of large numbers (iid case), Bernoulli law of large numbers, example only), Central limit theorem (Lindberg Levyiid case).	• Lecture • Discussion • Participative learning • Problem solving	• Assignment on the topic sample mean and variance.	• Understand the weak law of large numbers, Bernoulli law of large numbers, Central limit theorem and its applications	Evaluation through test paper and viva

Course Outcomes

CO1	Understand the concept of uni variate, Bivariate Discrete and continuous random variable including expectation, moments and mgf.
CO2	Enable one to identify and classify different type of standard distribution.
CO3	Understand the weak law of large numbers, Bernoulli law of large numbers, Central limit theorem and its applications.

Teacher in Charge:

Ms. Geethu Simon

ST3CO3: STATISTICAL INFERENCE
Lecture Hours per week: 5, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

Introduce different type of sampling distributions and the concept of testing hypotheses.

Module I (25 hrs)

Sampling distributions: Statistic, Sampling distribution of a statistic, Standard error, Sampling from normal distribution, distribution of sample mean, sample variance, chisquare distribution, t distribution, and F distribution (definition, derivations and relationships only).

Module II (20 hrs)

Theory of Estimation: Point Estimation, desirable properties of a good estimator, unbiasedness, consistency, sufficiency, Fisher Neyman factorization theorem, efficiency. Methods of Estimation: Method of maximum likelihood, method of moments

Module III (15 hrs)

Interval Estimation: Interval estimates of mean, difference of means, variance, proportions and difference of proportions. Derivation of exact confidence intervals for means, variance and ratio of variances based on normal, t, chi square and F distributions

Module IV (30 hrs)

Testing of Hypotheses: concept of testing hypotheses, simple and composite hypotheses, null and alternative hypotheses, type I and II errors, critical region, level of significance and power of a test. Neyman Pearson approach: Large sample tests concerning mean equality of means, proportions, equality of proportions, Small sample tests based on t distribution for mean, equality of means and paired t test. Tests based on Fdistribution for ratio of variances. Tests based on Chi square distribution for variance, goodness of fit and for independence of attributes.

Reference Books:

1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill
4. John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

OBJECTIVES

- Introduce different type of sampling distributions.

- Introduce the concept of random sample from a distribution, sampling distribution of a statistic, standard error of important estimates such as mean and proportions
- knowledge about important inferential aspects such as point estimation, test of hypotheses and associated concepts
- Introduce Neyman Pearson approach in testing of hypotheses.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **25 Hours**	Statistic, Sampling distribution of a statistic, Standard error, Sampling from normal distribution, distribution of sample mean, sample variance, chisquare distribution, t distribution, and F distribution	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on chisquare distribution, t distribution, and F distribution.	• Understand different type of sampling distributions.	Evaluation through test paper
Module II **20 Hours**	Point Estimation, desirable properties of a good estimator, unbiasedness, consistency, sufficiency, Fisher Neyman factorization	• Lecture • Discussion • Participative learning • Problem solving	• Seminar on the topic Method of maximum likelihood and methodof moments.	• Understand point estimation methods.	Evaluation through test paper.

	theorem, Method of maximum likelihood, method of moments.				
Module III **15 Hours**	Interval estimates of mean, difference of means, variance, proportions and difference of proportions. Derivation of exact confidence intervals for means, variance and ratio of variances based on normal, t, chi square and F distributions	• Lecture • Discussion • Participative learning • Problem solving	• Seminar related to the topic difference of means, variance, and difference of proportions.	• Understand Interval estimation methods	Evaluation through Group Discussion.
Module IV **30 Hours**	concept of testing hypotheses, simple and composite hypotheses, null and alternative hypotheses,type I and II errors, critical region, level of significance and power of a test. Large sample tests, proportions, equality of proportions, Small sample tests based on t distribution for	• Lecture • Discussions • Problem solving	• Student seminars in connection with type I and II errors.	• Become familiar with the concept of testing hypotheses and different sample tests.	Evaluation through test paper

	mean, equality of means and paired t test. Tests based on Fdistribution for ratio of variances. Tests based on Chi square distribution for variance, goodness of fit and for independence of attributes.				

Course Outcomes

CO1	Understnd different sampling distribution and its properties.
CO2	Understand the tecniques of estimation and testing hypotheses for mean, variance, proportions, correlation coefficient, association and goodness of fit.
CO3	Knowledge of point and interval estimation proceduers and different method of point estimation.

Teacher in Charge:

Ms. Geethu Simon

ST4CO4 APPLIED STATISTICS

Lecture Hours per week: 5, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce sampling techniques and statistical quality control

Module I (20 hrs)

Census and Sampling, Principal steps in a sample survey, different types of sampling, Organisation and execution of large scale sample surveys, errors in sampling(sampling and non sampling errors), preparation of questionnaire, simple random sampling with and without replacement, Systematic, stratified and cluster sampling

Module II (15 hrs)

Analysis of variance; one way, two way classifications. Null hypothesis, total, between and within sum of squares. Assumptions - ANOVA table..

Module III (30 hrs)

Time series : Components of time series additive and multiplicative models , measurement of trend , moving averages, seasonal indicessimple averageratio to moving average., Index numbers: meaning and definition uses and types - problems in the construction of index numbers -different types of simple and weighted index numbers. Test for an ideal index number - time and factor reversal test.

Module IV (25 hrs)

Statistical Quality Control: Concept of statistical quality control, assignable causes and chance causes, process control, Construction of control charts, 3sigma limits, Control chart for variables -Mean chart and Range chart, Control chart for attributes - pchart, d or np chart and c chart

Reference Books:

1) S.C.Gupta and V. K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand and Sons

2) Grant E L, Statistical quality control, McGraw Hill

3) Duncan A J, Quality Control and Industrial Statistics, Taraporewala and sons

4) Montegomery D C, Introduction to Statistical Quality Control, John Wiley and sons

5) S.P.Gupta: statistical methods

OBJECTIVES

1) To equip students with sampling techniques used in conducting sample surveys.
2) To understand the concepts of ANOVA model
3) To expose the area of time series and index numbers.
4) To provide an insight into quality assessment techniques.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	Census and Sampling, Principal steps in a sample survey, different types of sampling, Organisation and execution of large scale sample surveys, sampling and non sampling errors, simple random sampling	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on sampling and sample survey	To understand sampling techniques used in conducting sample surveys	Evaluation through test paper

	with and without replacement, Systematic, stratified and cluster sampling				
Module II **15 Hours**	Analysis of variance; one way, two way classifications, Null hypothesis, Assumptions - ANOVA table..	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding variance between the samples	To understand the concepts of ANOVA model	Evaluation through test paper and viva
Module III **30 Hours**	Time series, Components of time series, measurement of trend, moving averages, seasonal indices, Index numbers, different types of simple and weighted index numbers, time and factor reversal test.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars related to components of time series	To understand time series, seasonal indices and index numbers	Evaluation through MCQ and Group Discussion
Module IV **25 Hours**	Statistical Quality Control, assignable causes	• Lecture • Discussion s	• Assignment to construct control charts	To understand statistical quality control	Evaluation through test paper

	and chance causes, process control, Construction of control charts, 3sigma limits, Control chart for variables- Mean chart and Range chart,Control chart for attributes pcha rt, d or np chart and c chart	• Problem solving		and its uses	

Course Outcomes

CO1	To understand sampling techniques used in conducting sample surveys
CO2	To understand the concepts of ANOVA model
CO3	To learn the concepts of time series and index numbers
CO4	To provide an insight into quality assessment techniques.

Teacher in Charge:

Ms. Jiji Pauly

MTS1C01: MATHEMATICS I
Lecture Hours per week: 4, Credits: 3
Internal: 15, External: 60, Unty. Exam Dur. : 2 Hours

Objectives

To develop basic concepts of Mathematics that include continuity, differentiation and integration

Module I

Introduction to the derivative, instantaneous velocity, slope of tangent line, differentiating simplest functions, Limits Notion of limit, basic properties, derived properties, continuity, continuity of rational functions, one sided limit, limit involving $\pm\infty$, The derivative as Limit formal definition, examples, differentiability and continuity, Leibnitz notation, Differentiating Polynomials power rule, sum rule etc., Product and quotients product, quotient, reciprocal & integral power rule , Linear Approximation and Tangent Lines equation of tangent line and linear approximation, illustrations

Module II

Rate of change and second derivative linear or proportional change, rates of change, second derivative, The Chain Rule power of a function rule, chain rule, Fractional Power & Implicit Differentiation rational power of a function rule, implicit differentiation, Related rates and parametric curves Related rates, parametric curves, word problems involving related rates, Anti derivatives anti differentiation and indefinite integrals, antidifferentiation rules

Module III

Continuity and Intermediate value theorem IVT: first and second version Increasing and decreasing function Increasing and decreasing test, critical point test, first derivative test, Second derivative and concavity second derivative test for local maxima , minima and concavity , inflection points, Drawing of Graphs graphing procedure, asymptotic behaviour, Maximum Minimum Problems maximum and minimum values on intervals, extreme value theorem, closed interval test, word problems , The Mean Value Theorem The MVT, consequences of MVT, Rolles Theorem, horserace

theorem, L'Hospital rule Preliminary version, strengthened version

Module IV

Summation, distance and velocity, properties of summation, telescoping sum (quick introduction relevant ideas only) Sums and Areas step functions, area under graph and its counterpart in distance velocity problem The definition of Integral signed area , The integral, Riemann sums The Fundamental Theorem of Calculus Arriving at FTC intuitively using distance velocity problem, Fundamental integration Method, proof of FTC, Area under graph, displacements and velocity Definite and Indefinite integral indefinite integral test, properties of definite integral, fundamental theorem of calculus: alternative version (interpretation and explanation in terms of areas): Applications of the Integral Area between graphs, area between intersecting graphs, total changes from rates of change, Volume by slice method the slice method, volume of solid of revolution by Disk method

Text

(1) Calculus I (2/e) : Jerrold Marsden & Alan Weinstein SpringerVerlag New York Inc(1985) ISBN 0387909745 Text

(2) Calculus II (2/e) : Jerrold Marsden & Alan Weinstein SpringerVerlag New York Inc(1985) ISBN 0387909753

References

1. Soo T Tan: Calculus Brooks/Cole, Cengage Learning(2010)ISBN 0534 46579X
2. Gilbert Strang: Calculus Wellesley Cambridge Press(1991)ISBN:09614088 20
3. Ron Larson. Bruce Edwards: Calculus(11/e) Cengage Learning(2018) ISBN: 9781337275347
4. Robert A Adams & Christopher Essex : Calculus Single Variable (8/e) Pearson Education Canada (2013) ISBN: 0321877403
5. Joel Hass, Christopher Heil & Maurice D. Weir : Thomas' Calculus(14/e) Pearson (2018) ISBN 0134438981
6. Jon Rogawski & Colin Adams : Calculus Early Transcendentals (3/e) W. H. Freeman and

Company(2015) ISBN: 1319116450

OBJECTIVES

a) **To develop the concept of first order derivative**

b) **To understand how to calculate second order derivative**

c) **To study Continuity and Intermediate value theorem, drawing of graphs, the Mean value theorems**

d) **To study about Riemann sums, definite and indefinite integral**

LESSON PLAN

Unit/ hours	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 14 hours	First order derivative and its significance, Linear Approximation and Tangent Lines	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on first order derivative	To understand: • The difference between differentiability and analyticity	Evaluation through test papers
Module 2 **13 Hours**	Second order derivative, fractional derivative, implicit differentiation	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to understand second order derivative	To understand: • Second order derivative • Implicit differentiation	Evaluation through test paper
Module 3 **18 Hours**	Continuity and Intermediate value theorem, drawing of graphs, the MVT	• Lecture • Discussion • Participative learning	Peer group discussion on drawing graphs	To understand: • Continuity andIVT	Evaluation Through interaction with

				• Drawing graphs	students
Module4 **19 Hours**	Fundamental theorem of Calculus, Definite and Indefinite integral	• Lecture • Discussion • Problem solving	• Peer group discussion on definite and indefinite integral	To understand: • Fundamental theorem of calculus • definite and indefinite integral	Evaluation through test paper

Course Outcomes

CO1	**To develop the concept of first order derivative, its physical significance and antiderivative**
CO2	**To study derivative of second order, fractional Power & implicit differentiation and antiderivative**
CO3	**To develop the concepts of the MVT, consequences of MVT, Rolles Theorem.**
CO4	**To study fundamental theorem of calculus and calculate volume by slice method**

Teacher in Charge
Ms. Smitha Davis
Dr. Nidhin T J

MTS2C02: MATHEMATICS-2
Lecture Hours per week: 4, Credits: 3
Internal: 15, External: 60, Unty. Exam Dur. : 2 Hours

Objectives

To develop concepts of Mathematics that include hyperbolic functions, numerical integration, matrices and its properties.

Module I

Polar coordinates and Trigonometry – Cartesian and polar coordinates, Inverse functions-inverse function test, inverse function rule, Graphing in polar coordinates- Checking symmetry of graphs given in polar equation, drawings, tangents to graph in polar coordinates Hyperbolic functions- hyperbolic sine, cosine, tan etc., derivatives, antidifferentiation formulas Inverse hyperbolic functions- inverse hyperbolic functions (their derivatives and antiderivatives) Arc length and surface area- Length of curves, Area of surface of revolution about x and y axes

Module II

Improper integrals- integrals over unbounded intervals, comparison test, integrals of unbounded functions, Limit of sequences and Newton's method ε-N definition, limit of powers, comparison test, Newton's method : Numerical Integration- Riemann Sum, Trapezoidal Rule, Simpson's Rule The sum of an infinite series - convergence of series, properties of limit of sequences (statements only), geometric series, algebraic rules for series, the ith term test The comparison test and alternating series- comparison test, ratio comparison test, alternating series, alternating series test, absolute and conditional convergence

Module III

Vector spaces – definition, examples, subspaces, basis, dimension, span Gram-Schmidt Orthogonalization Process- orthonormal bases for R^n , construction of orthonomal basis of R^n Systems of Linear Algebraic Equations- General form, solving systems, augmented matrix, Elementary row operations, Elimination Methods- Gaussian elimination, Gauss– Jordan

elimination, row echelon form, reduced row echelon form, inconsistent system, networks, homogeneous system, over and underdetermined system ,Rank of a Matrix- definition, row space, rank by row reduction, rank and linear system, consistency of linear system, Determinants- definition, cofactor, Properties of determinant- properties, evaluation of determinant by row reducing to triangular form

Module IV

Inverse of a Matrix – finding inverse, properties of inverse, adjoint method, row operations method, using inverse to solve a linear system, The eigenvalue problem- Definition, finding eigenvalues and eigenvectors, complex eigenvalues, eigenvalues and singular matrices, eigenvalues of inverse Powers of Matrices- Cayley Hamilton theorem, finding the inverse, Orthogonal Matrices - symmetric matrices and eigenvalues, inner product, criterion for orthogonal matrix, construction of orthogonal matrix, Diagonalization- diagonalizable matrix-sufficient conditions, orthogonal diagonalizability of symmetric matrix, Quadratic Forms

Text

(1) Calculus I (2/e): Jerrold Marsden & Alan Weinstein Springer Verlag New York Inc(1985) ISBN 0387909745

(2) Calculus II (2/e): Jerrold Marsden & Alan Weinstein Springer Verlag New York Inc(1985) ISBN 0387909753

(3) Advanced Engineering Mathematics(6/e): Dennis G Zill Jones & Bartlett Learning, LLC (2018) ISBN: 978-1-284-10590-2.

References

1 Soo T Tan: Calculus Brooks/Cole, Cengage Learning (2010) ISBN 0-534-46579-X
2 Gilbert Strang: Calculus Wellesley Cambridge Press (1991)ISBN:0-9614088-2-0
3 Ron Larson. Bruce Edwards: Calculus(11/e) Cengage Learning (2018) ISBN: 978-1-337- 27534-7
4 Robert A Adams & Christopher Essex : Calculus Single Variable (8/e) Pearson Education Canada (2013) ISBN: 0321877403
5 Joel Hass, Christopher Heil & Maurice D. Weir : Thomas' Calculus(14/e) Pearson (2018) ISBN 0134438981
6 Advanced Engineering Mathematics(7/e) Peter V O'Neil: Cengage Learning (2012) ISBN:

978-1-
111-42741-2
7 Erwin Kreyszig: Advanced Engineering Mathematics(10/e) John Wiley & Sons (2011) ISBN: 978-
0- 470-45836-5
8 Glyn James: Advanced Modern Engineering Mathematics(4/e) 1 Pearson Education Limited (2011)
ISBN: 978-0-273-71923-6

OBJECTIVES

a) **To develop the concept of derivative and integral of hyperbolic functions and inverse hyperbolic functions.**

b) **To understand how to calculate arc length and area of surface of revolution.**

c) **To study about improper integrals and numerical integration.**

d) **To compute matrix inverse and study some important properties.**

LESSON PLAN

Unit/ hour	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 14 hours	Inverse functions, hyperbolic functions, Arc length and surface area- Length of curves, Area of surface of revolution about x and y axes	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion derivative and antiderivative of hyperbolic functions	To understand: • Hyperbolic functions • Length of curves • Surface of revolution	Evaluation through test papers
Module 2 **17 Hours**	Improper integrals, Numerical Integration- Riemann Sum, Trapezoidal Rule,	• Lecture • Discussion • Participative learning • Problem	• Assignments to understand numerical integration	To understand: • Improper integrals • Numerical integration	Evaluation through test paper

	Simpson's Rule	solving			
Module 3 19 Hours	Vector spaces, Gaussian elimination, Gauss– Jordan elimination, rank of matrix, determinants	• Lecture • Discussion • Participative learning	Peer group discussion on matrix properties	To understand: • Notion ofvector spaces • Matrix properties	Evaluation through test papers
Module 4 14 Hours	Inverse of a matrix, orthogonal matrix, power of matrices, diagonalization of matrices	• Lecture • Discussion • Problem solving	• Peer group discussion on inverse of a matrix	To understand: • Orthogonal matrix and its properties • Diagonalizationof matrices	Evaluation through test paper

Course Outcomes

CO1	**To develop the concept of differentiation and integration of hyperbolic and inverse hyperbolic functions, to calculate arc length and surface of revolution**
CO2	**To study about improper integrals and numerical integration.**
CO3	**To develop the concepts of vector spaces, and basics of matrices**
CO4	**To study how to compute inverse of matrix and diagonalization of the matrices.**

Teacher in Charge
Dr. Vijitha Mukundan
Ms. Geethika P R

MAT 3C03 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 5 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of Ordinary differential equations, matrices and vector calculus.

MODULE I

Basic concepts and ideas, Geometrical meaning of y' = f(x,y). Direction Fields, Separable Differential Equations. Exact Differential Equations; Integrating Factors, Linear Differential Equations; Bernoulli Equation, Orthogonal Trajectories of Curves.

MODULE II

Rank of a Matrix, Non-Singular and Singular matrices, Elementary Transformations, Inverse of an elementary Transformations, Row Canonical form, Normal form. Systems of Linear equations: Homogeneous and Non Homogenoeus Equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton Theorem (statement only) and simple applications.

MODULE III

A quick Review of vector algebra, Inner product and vector product in R^2 and R^3 . Vector and scalar functions and Fields, Derivatives, Curves, Tangents, Arc Length, Velocity and acceleration, Gradient of a scalar field; Directional Derivative, Divergence of a vector field, Curl of a Vector Field.

MODULE IV

Line Integrals, Independence of path, Green's Theorem in the Plane (without proof), surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Divergence theorem of Gauss and Stoke's theorem (without proofs).

TEXTBOOKS

1. Erwin Kreyszig : Advanced Engineering Mathematics, Eighth Edition, Wiley, India.

2. Frank Ayres JR : Matrices, Schaum's Outline Series, TMH Edition.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.

[2] Muray R Spiegel, Vector Analysis, Schaum's Outline series, Asian Student Edition.

[3] Shanthi Narayanan & P.K. Mittal, A Text Book of Matrices, S. Chand

[4] Harry F. Davis & Arthur David Snider, Introduction to Vector Analysis, 6th ed., Universal Book Stall, New Delhi.

OBJECTIVES

- To understand the concepts in ordinary differential equations
- To learn about matrices and its properties
- To learn about Cayley Hamilton theorem
- To understand vectors
- To study in detail Vector Calculus

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I (20 hours)	Modeling of differential equations, methods to solve first order differential equations.	• Discussion • Participative learning • Problem solving	Discussions Lectures and Quizzes	Geometrical meaning of ODE, solving I order ODEs	Evaluation through test paper.
MODULE II (20 hours)	Rank of a matrix, solution of system of linear equations, Cayley- Hamilton theorem	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about Eigen values and vectors	Normal and Echoleon form of matrices, Solution of linear system of equations, Eigen values and vectors	Evaluation through test paper.
MODULE III (25 hours)	Introduction to vectors and vector differential calculus	• Lecture • Discussion • Participative learning • Problem solving	Discussion on derivatives of vector functions	Know gradient, divergence, curl of a vector function	Evaluation through MCQ.

MODULE IV (25 hours)	Vector integral calculus	• Lecture • Discussion • Participative learning • Problem solving	Discussion on surface integrals	Greens theorem, Stoke's theorem, Gauss divergence theorem	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about I order ordinary differential equations
CO2	To learn solution of system of linear equations To study about eigen values and eigen vectors.
CO3	To know about vector differential calculus To learn about vector integral calculus

Faculty in Charge

Dr. Vijitha Mukundan

Ms. Linet Roslin Antony

Ms. Geethika P R

MAT 4C04 – MATHEMATICS(Complementary Course)

Number of hours of lectures per week : 5 hrs

Number of credits : 3

OBJECTIVE

To understand concepts of Second order differential equations, Laplace tranforms, Fourier series, Numerical methods

MODULE I

Linear Differential equations of Second and Higher order: Differential Operators, Euler-Cauchy Equation, Wronskian, Nonhomogeneous Equations, Solutions by Undetermined Coefficients, Solution by variation of Parameters.

MODULE II

Laplace Transforms: Laplace Transform, Inverse Transform, Linearity, Shifting, Transforms of Derivatives of Integrals, Differential Equations. Unit step Function, Second Shifting Theorem, Dirac Delta Function, Differentiation and integration of Transforms, Convolution, Integral Equations, Partial Fractions, Differential Equations.

.

MODULE III

Fourier Series : Periodic Functions, Trigonometric Series, Fourier Series, Even and Odd functions, Half-range Expansions, Partial differential Equations: Basic Concepts, Vibrating String, Wave Equation, Separation of Variables, Use of Fourier Series

MODULE IV

Numerical Methods: Methods of First-order Differential Equations, Picard's iteration for initial Value Problems. Numerical Integration: Trapezoidal Rule, Simpson's Rule.

TEXTBOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.

REFERENCES

[1] S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.
[2] Muray R Spiegel, Advanced Calculus, Schaum's Outline series.
[3] Murray R. Spiegel, Laplace Transforms, Schaum's Outline Series.

OBJECTIVES

- To understand the methods to solve II and higher order derivatives
- To learn Laplace and inverse Laplace equations
- To learn about Fourier series and Half range expansions
- To understand classical partial differential equations
- To study in detail some numerical methods for integration and ODEs.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I (20 hours)	Solution of II and higher order differential equations	• Discussion • Participative learning • Problem solving	Discussions Lectures on wronskian	Euler-Cauchy equations, various methods for solving II order DEs	Evaluation through test paper.
MODULE II (20 hours)	Laplace transforms, Inverse Laplace transforms, Shifting theorems	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about laplace and inverse Laplace transforms	Solution of differential equations using Laplace transforms	Evaluation through test paper.
MODULE III (30 hours)	Fourier series and its half range expansions	• Lecture • Discussion • Participative learning • Problem solving	Discussion on Fourier series expansions of periodic functions	Solution of heat and wave equations using Fourier series	Evaluation through test paper.

MODULE IV (20 hours)	Numerical methods for integration and solving differential equations	• Lecture • Discussion • Participative learning • Problem solving	Discussion on various numerical methods	Runge – Kutta, Euler methods, Trapeziodal, Simpson's rule.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about Euler- Cauchy equations, method of undetermined coefficients and method of variation of parameters
CO2	To learn Solving differential equations using Laplace transforms To study about Fourier series
CO3	To know about solution of Heat and Wave Equations To learn about various numerical methods.

Faculty in Charge

Ms. Smitha Davis

Ms. Linet Roslin Antony

Dr. Nidhin T J

MTS1 B01 BASIC LOGIC & NUMBER THEORY

Lecture Hours per week: 4, Credits: 4

Internal: 20, External: 80, Examination 2.5 Hours

Objectives

To enable one to think systematically, to make valid arguments in mathematical terms and master several techniques of problem solving.

Module I (15 hrs)

Propositions, Boolean variables, Truth Value, Conjunction, Boolean expression, Disjunction, Negation, Implication, Converse, Inverse and Contra positive, Biconditional statement, Order of Precedence, Tautology Contradiction and Contingency, Logical equivalences- laws of logic, Quantifiers- universal & existential, predicate logic, Arguments- valid and invalid arguments, inference rules, Proof Methods–vacuous proof, trivial proof, direct proof, indirect proof-contrapositive & contradiction, proof by cases , Existence proof-constructive & non constructive, counter example.

Module II (12hrs)

Mathematical induction- well ordering principle, simple applications, weak version of principle of mathematical induction, illustrations, strong version of induction, illustration, Recursion- recursive definition of a function, illustrations, The division algorithm – statement and proof, div & mod operator, card dealing, The two queens puzzle, pigeonhole principle and division algorithm, divisibility relation, illustration ,divisibility properties, union intersection and complement-inclusion-exclusion principle & applications, even and odd integers, Prime and Composite Numbers- definitions, infinitude of primes, The sieve of Eratosthenes, a number theoretic function, prime number theorem, distribution of primes.

Module III (17 hrs)

Greatest Common Divisor-gcd,symbolic definition, relatively prime integers, Duncan's identity, Polya's theorem, infinitude of primes, properties of gcd, linear combination, gcd as linear combination, an alternate definition of gcd, gcd of n positive integers, a linear combination of n positive integers, pairwise relatively prime integers, alternate proof for infinitude of prime, The Euclidean Algorithm- The Euclidean algorithm,

Ajigsaw puzzle, Lame's theorem, The Fundamental Theorem of Arithmetic- Euclid's lemma on division of product by a prime, fundamental theorem of arithmetic, Canonical Decomposition, number of trailing zeros, highest power of a prime dividing $n!$, Distribution of Primes Revisited, Dirichlet's Theorem, Least Common Multiple- definition, canonical decomposition to find lcm, relationship between gcd and lcm, relatively prime numbers and their lcm, Linear Diophantine Equations – LDE in two variables, conditions to have a solution, Aryabhatta's method, number of solutions, general solution, Mahavira's puzzle, hundred fowls puzzle, Monkey and Coconuts Puzzle, Fibonacci numbers and LDE, LDE in more number of variables and their solutions-theorem3.20.

Module IV (20hrs)

Congruences - congruence modulo m, properties of congruence, characterization of congruence, least residue, congruence classes, A Complete Set of Residues Modulo m, properties of congruence, use of congruence to find the remainder on division, Towers of Powers Modulo m, further properties of congruence and their application to find remainder congruences of two numbers with different moduli, Linear Congruence- solvability, uniqueness of solution, incongruent solutions, Modular Inverses, applications, Divisibility Tests-Divisibility Test for 10, Divisibility Test for 5, Divisibility Test for $2i$, Divisibility Tests for 3 and 9, Divisibility Test for 11, Wilson's Theorem- self invertible modulo prime, Wilson's theorem and its converse, Fermat's Little Theorem and its applications, inverse of a modulo p using FLT, application- solution of linear congruences , extension of FLT in various directions, Euler's Theorem- motivation, Euler's Phi Function φ, Euler's Theorem, applications, generalisation of Euler's theorem (koshy).

Textbooks :

1) **Thomas Koshy**: Discrete Mathematics with Applications**,** Elsever Academic Press (2004)
2) **Thomas Koshy**: Elementary Number Theory with Applications (2/e) , Elsever Academic Press (2007)

Reference Books:

1) Susanna S Epp: Discrete Mathematics with Applications(4/e) Brooks/Cole Cengage Learning(2011)
2) Kenneth H. Rosen: Discrete Mathematics and Its Applications(7/e) McGraw-Hill, NY(2007)
3) David M. Burton : Elementary Number Theory(7/e) McGraw-Hill (2011)

4) Gareth A. Jones and J. Mary Jones: Elementary Number Theory, Springer Undergraduate Mathematics Series(1998)
5) Underwood Dudley :Elementary Number Theory(2/e), Dover Publications (2008)
6) James K Strayer: Elementary Number Theory, Waveland Press, inc.(1994)
7) Kenneth H. Rosen: Elementary Number Theory(6/e), Pearson Education(2018)

OBJECTIVES

1) To enable one to think systematically.
2) To express ideas in precise and concise mathematical terms.
3) To learn to make valid arguments.
4) To master different techniques of problem solving.

LESSON PLAN

Unit/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **15 Hours**	Propositions, Logical Equivalences, Quantifiers, Arguments, Proof Methods	• Lecture • Discussion • Participative learning • Problem solving	Peer group discussion on Logical Equivalence	To understand techniques of logic and reasoning	Evaluation through test paper
Module II **12 Hours**	Mathematical Induction,	• Lecture • Discussion	Student seminars to	To understand several	Evaluation through test paper

	Recursion, Division Algorithm, Prime and Composite numbers.	• Participative learning • Problem solving	explain prime and composite numbers.	techniques of problem solving such as recursion and induction.	
Module III **17 Hours**	GCD, Euclidean algorithm, Fundamental theorem of arithmetic, LCM, Linear Diophantine Equations,	• Lecture • Discussion • Participative learning • Problem solving	Assignment to find GCD and LCM	To solve LDE	Evaluation through MCQ
Module IV **20 Hours**	Congruences, Linear congruence, Divisibility test, Wilson's Theorem, Fermat's LittleTheorem,Euler's Theorem.	• Lecture • Discussions • Problem solving	Student seminars to explain the divisibility test for 5 and 11	To solve linear congruences	Evaluation through test paper and viva

Course Outcomes

CO 1	To prove results involving divisibility, greatest common divisor, least common multiple and a few applications.
CO 2	To understand the theory and method of solutions of LDE.
CO	To understand the theory of congruence and a few applications.

CO 4	To solve linear congruent equations.
CO 5	To learn three classical theorems *viz*. Wilson's theorem, Fermat's little theorem and Euler's theorem and a few important consequences.

Teacher in Charge:

Ms. Geethu Simon

MTS2 B02 CALCULUS OF SINGLE VARIABLE-1
Lecture Hours per week: 4, Credits: 4
Internal: 20, External: 80, Examination 2.5 Hours

Objectives

To introduce students to the fundamental ideas of limit, continuity and differentiability and also to some basic theorems of differential calculus.

Module I - Functions and Limits (20 hrs)

Functions and their Graphs- Definition of a Function, Describing Functions, Evaluating Functions, Finding the Domain of a Function, The Vertical Line Test, Piecewise Defined Functions, Even and Odd Functions (quick review), Combining functions- Arithmetic Operations on Functions, Composition of Functions, Graphs of Transformed Functions, Vertical Translations, Horizontal Translations, Vertical Stretching and Compressing, Horizontal Stretching and Compressing, Reflecting , Intuitive introduction to Limits- A Real Life Example, Intuitive Definition of a Limit, One-Sided Limits, Using Graphing Utilities to Evaluate Limits, Techniques for finding Limits Computing Limits- Using the Laws of Limits, Limits of Polynomial and Rational Functions, Limits of Trigonometric Functions, The Squeeze Theorem, Precise Definition of a Limit $\varepsilon - \delta$ $definition$, A Geometric Interpretation, Some illustrative examples, Continuous Functions - Continuity at a Number, Continuity at an Endpoint, Continuity on an Interval, Continuity of Composite Functions, Intermediate Value Theorem ,Tangent Lines and Rate of change- An Intuitive Look, Estimating the Rate of Change of a Function from Its Graph, More Examples Involving Rates of Change, Defining a Tangent Line, Tangent Lines, Secant Lines, and Rates of Change The Derivatives Definition, Using the Derivative to Describe the Motion of the Maglev, Differentiation, Using the Graph of f to Sketch the Graph of f' Differentiability, Differentiability and Continuity , The role of derivative in the real world- Motion Along a Line, Marginal Functions in Economics , Differentials and Linear Approximations - increments, Differentials, Error Estimates, Linear Approximations, Error in Approximating Δy by dy.

Module II - Applications of the Derivative (17 hrs)

Extrema of Functions Absolute Extrema of Functions, Relative Extrema of Functions, Fermat's Theorem, Finding the Extreme Values of a Continuous Function on a Closed Interval, An Optimization Problem ,The Mean Value Theorem Rolle's Theorem, The Mean Value Theorem, Some Consequences of the Mean Value Theorem, Determining the Number of Zeros of a Function Increasing and Decreasing Functions definition ,

inferring the behaviour of function from sign of derivative, Finding the Relative Extrema of a Function, first derivative test, Concavity and Inflection points Concavity, Inflection Points, The Second Derivative Test, The Roles of f' and f'' in Determining the Shape of a Graph, Limits involving Infinity; Asymptotes Infinite Limits, Vertical Asymptotes, Limits at Infinity, Horizontal Asymptotes, Infinite Limits at Infinity, Precise Definitions, Curve Sketching The Graph of a Function, Guide to Curve Sketching, Slant Asymptotes , Finding Relative Extrema , Using a Graphing Utility, Optimization Problems – guidelines for finding absolute extrema, Formulating Optimization Problems application involving several real life problems.

Module III - Integration (14 hrs)

Anti derivatives, Indefinite integrals, Basic Rules of Integration, a few basic integration formulas and rules of integration, Differential Equations, Initial Value Problems, Area An Intuitive Look, The Area Problem, Defining the Area of the Region Under the Graph of a Function, technique of approximation, An Intuitive Look at Area , Defining the Area of the Region Under the Graph of a Function, Area and Distance, The Definite Integral Definition of the Definite Integral, Geometric Interpretation of the Definite Integral, The Definite Integral and Displacement, Properties of the Definite Integral , More General Definition of the Definite Integral, The Fundamental Theorem of Calculus, How Are Differentiation and Integration Related?, The Mean Value Theorem for Definite Integrals, The Fundamental Theorem of Calculus: Part I, inverse relationship between differentiation and integration, Fundamental Theorem of Calculus: Part 2, Evaluating Definite Integrals Using Substitution, Definite Integrals of Odd and Even Functions, The Definite Integral as a Measure of Net Change.

Module IV- Applications of Definite Integral (13 hrs)

Areas between Curves A Real Life Interpretation, The Area Between Two Curves, Integrating with Respect to *y*adapting to the shape of the region, What Happens When the Curves Intertwine? Volume – Solids of revolution, Volume by Disk Method, Region revolved about the x-axis, Region revolved about the y-axis , Volume by the Method of Cross Sections, Arc Length and Areas of surfaces of revolution Definition of Arc Length, Length of a Smooth Curve, arc length formula, The Arc Length Function, arc length differentials, Surfaces of Revolution, surface area as surface of revolution,Work Done by a Constant Force, Work Done by a Variable Force, Hook's Law, Moving non rigid matter, Work done by an expanding gas, Moments and Center of Mass Measures of Mass, Center of Mass of a System on a Line, Center of Mass of a System in the Plane, Center of Mass of Laminas.

Textbooks :

1) **Soo T Tan**, Calculus: Brooks/Cole, Cengage Learning (2010)

Reference Books:

1) Joel Hass, Christopher Heil & Maurice D. Weir : Thomas' Calculus(14/e) Pearson (2018)
2) Robert A Adams & Christopher Essex : Calculus Single Variable (8/e) Pearson Education Canada (2013)
3) Jon Rogawski & Colin Adams : Calculus Early Transcendentals (3/e) W. H. Freeman and Company(2015)
4) Anton, Bivens & Davis : Calculus Early Transcendentals (11/e) John Wiley & Sons
5) James Stewart : Calculus (8/e) Brooks/Cole Cengage Learning(2016)
6) Jerrold Marsden & Alan Weinstein : Calculus I and II (2/e) Springer Verlag NY(1985)

OBJECTIVES

1) To get an idea of sketching of curves.
2) To solve some optimization problems of interest in real life.
3) To establish the close connection between the two branches of Calculus: Differential and Integral Calculus

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I (Functions and Limits)	Functions and their Graphs, Combining	Lecture Discussion Participative	Seminar on real life applications of	To deal with real life measures	Evaluation through test paper and

20 Hours	Functions, Intuitive Introduction to Limits, Techniques for finding Limits, Precise definition of Limits, Continuous Functions, Tangent Lines and Rate of Change , The Derivatives, The Role of Derivative in the Real World, Differential and Linear Approximations	learning Problem solving	Derivatives	like speed and acceleration	group discussion
Module II (Applications of the Derivative) **17 Hours**	Extrema of Functions, The MVT, Increasing and Decreasing Functions, Concavity and Inflection Points, Limit involving Infinity, Curve Sketching, Optimization Problems	Lecture Discussion Participative learning Problem solving	Group discussion on Curve Sketching	To understand several techniques of sketching curves and learning limits	Evaluation through test paper
Module III (Integration) **14 Hours**	Indefinite Integrals, Area, The Definite Integrals, The Fundamental Theorem of Calculus	Lecture Discussion Participative learning Problem solving	Assignment to find integrals of functions	To deal with real life problems in Physics, Chemistry etc.	Evaluation through MCQ

Module IV (Applications of the Definite Integral) **13 Hours**	Areas between Curves, Volume, Arc Length and Areas of Surfaces of Revolution, Work, Moments and Center of Mass	Lecture Problem solving Participative learning Videos	Assignment to find volume of some familiar objects	To explore relationship between Surfaces and Curves	Evaluation through test paper and viva

Course Outcomes

CO1	To learn the practical way of evaluating the definite integral.
CO2	To master integrals which is a powerful tool in solving problems in physics, chemistry, biology, engineering, economics and other fields.
CO3	To deal with real life optimization problems.
CO4	To explore the relationship between moving/changing objects

Teacher in Charge:
Ms. Geethu Simon

MAT3B03 CALCULUS AND ANALYTIC GEOMETRY

Lecture Hours per week: 5, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce fundamentals of calculus and geometry

Module I (15 hrs)

Natural logarithms, The Exponential function, and log , Growth and decay , L'Hopital's Rule, Relative rates of growth, Hyperbolic functions

Module II (25 hrs)

Limits of sequence of numbers,Theorems for calculating limits of sequences, Infinite series, Integral test for series of non-negative terms,Comparison test for series of non negativeterms,Ratio and root test for series of non negativeterms, Alternating series, Absolute and conditional convergence.

Module III (15 hrs)

Power series, Taylor and Maclaurin's series, Convergence of Taylor series ,Error estimate

Module IV (35 hrs)

Conic section and quadratic equations, Classifying conic section by eccentricity ,Quadratic equations and rotations, Parametrisation of plane curves, Calculus with parametrisedcurves,Polar coordinates, Graphing in polar co-ordinates, Polar equations for conic sections, Integration in polar coordinates.

Textbooks :

1) Thomas / Finney: Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1) Anton : Calculus, Wiley.
2) S.K. Stein : Calculus and Analytic Geometry, McGraw Hill

OBJECTIVES

1) To know transcendental functions such as natural logarithmic and exponential function.
2) To study a related notion of convergence of series
3) To study Power series, Taylor series , Maclaurin's series and their convergence
4) To understand parametrisation of plane curves

LESSON PLAN

Unit/ session / hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **15 Hours**	Natural logarithms, The Exponential function, and log , Growth and decay ,L'Hopital's Rule, Relative rate of growth, Hyper-bolic functions.	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on Growth and decay functions	To understand transcendental functions	Evaluation through test paper
Module II **25 Hours**	Limits of sequence of numbers, Infinite series, Integral test for	• Lecture • Discussion • Participati	• Assignments related to convergence tests of	To understand convergence of sequences and series	Evaluation through test paper

	series,Comparison test ,Ratio and root test , Alternating series, Absolute and conditional convergence.	ve learning • Problem solving	infinite series		
Module III **15 Hours**	Power series, Taylor and Maclaurin's series, Convergence of Taylor series , Error estimate	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on power series	To study power series and convergence	Evaluation through test paper and group discussion
Module IV **35 Hours**	Conic section and quadratic equations,Quadratic equationand rotations, Parametrisation of plane curves,Polar coordinates, Graphing in polar co-ordinates, Polar equations for conic sections,	• Lecture • Discussions • Problem solving	• Student seminars in connection with polar coordinates	To understand parametrisation of plane curves	Evaluation through test paper

	Integration in pol ar coordinates				

Course Outcomes

CO1	To understand transcendental functions such as natural logarithmic and exponential function
CO2	To handle the convergence of series with different tests.
CO3	To learn Power series, Taylor series , Maclaurin's series and their convergence
CO4	To understand parametrisation of plane curves

Teacher in Charge:

Mr. Rahul M Raju
Ms. Jiji Pauly

MAT4B04: THEORY OF EQUATIONS, MATRICES AND VECTOR CALCULUS

Lecture Hours per week: 5, Credits: 4

Internal: 20, External: 80, Examination 3 Hours

Objectives

Develops a new and fundamental ideas of calculus for the simple, but important case of polynomials. Also uses the matrices to solve system of linear equations.

Module I (30 hrs)

Polynomial Equations and Fundamental Theorem of Algebra(without proof). Applications of the Fundamental theorem to equations having one or more complex roots, Rational roots or multiple roots. Relations between roots and co-efficients of a polynomial equation and computation of symmetric functions of roots.Finding equations whose roots are functions of the roots of a given equation. Reciprocal equation and method of finding its roots. Analytical methods for solving polynomial equations of order up to four - quadratic formula.Cardano's method for solving cubic equations.Ferrari's method (for quadratic equations). Remarks about the insolvability of equations of degree five or more.Finding the nature of roots without solving Descartes' rule of signs.

Module II (16 hrs)

Elementary transformation, reduction to normal form, row reduced echelon form.Computing the inverse of a non singular matrix using elementary row transformation.

Module III (20 hrs)

System of linear homogeneous equations.Null space and nullity of matrix. Sylvester's law of nullity.Range of a matrix.Systems of linear non homogeneous equations. Characteristic roots and characteristic vectors of a square matrix. Some fundamental theorem.Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices.Characteristic equation of a matrix, Cayley- Hamilton theorem

Module IV (24 hrs)

Lines and planes in space. Cylinders and Quadric surfaces, Cylindrical and spherical coordinates, Vector valued functions and space curves, Arc length and Unit tangent vector , Curvature, torsion and TNB frame

Textbooks :

1. Bernard and Child: Higher Algebra, Macmillan

2.Shanti Narayanan &Mittal : A Text Book of Matrices, Revised edn., S. Chand

3. Thomas /Finney : Calculus, 9th ed., LPE, Pearson Education

Reference Books:

1.Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.

2.ManicavachagomPillai, Natarajan, Ganapathy- Algebra

3.Dickson: First Course in Theory of Equation

4. Frank Ayres, Jr. : Matrices, Schaum's Outline Series, Asian Student edition.

5. Devi Prasad : Elementary Linear Algebra, Narosa Pub. House.

6. Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.

7. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,

OBJECTIVE

- Learn to find the roots of polynomial equations up to degree 4, insolvability of equations of degree 5 or more.
- To compute the inverse of a non singular matrix using elementary row transformations.
- To understand about the characteristic equation and characteristic root of a matrix.
- Learn to use matrix to solve system of linear equations.
- Understand the basics of vector algebra
- Learn inner product, vector product and scalar triple product.
- Understand the concept of cylindrical and spherical coordinates.
- Learn about the plane and curves in space.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **30 Hours**	Polynomial Equations and Fundamental Theorem of Algebra. Applications of the Fundamental theorem to equations having one or more complex roots, Rational roots or multiple roots.	• Lecture • Discussion • Participative learning • Problem	• Assignments to find roots of polynomial equations. • Seminar on	• Learned to solve polynomials using cardan's method,	Evaluation through test paper.

	Relations between roots and co-efficients of a polynomial equation and computation of symmetric functions of roots.Finding equations whose roots are functions of the roots of a given equation. Reciprocal equation and method of finding its roots. Analytical methods for solving polynomial equations of order up to four - quadratic formula.Cardano's method for solving cubic equations.Ferrari's method (for quadratic equations). Remarks about the insolvability of equations of degree five or more.Finding the nature of roots without solving Descartes' rule of signs.	solving	the topic Transformation of equations.	Ferrari methods etc	
Module II **16 Hours**	Elementary transformation, reduction to normal form, row reduced echelon form.Computing the inverse of a non singular matrix using elementary row transformation.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to find the inverse of a non singular matrix using elementary row transformation.	• Learn to determine wether a matrix is singular or non singular • Learn to find out the rank of a matrix.	Evaluation through test paper.

Module III **20 Hours**	System of linear homogeneous equations.Null space and nullity of matrix. Sylvester's law of nullity. Range of a matrix.Systems of linear non homogeneous equations. Characteristic roots and characteristic vectors of a square matrix. Some fundamental theorem. Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices. Characteristic equation of a matrix, Cayley- Hamilton theorem	• Lecture • Discussion • Participative learning • Problem solving	• Seminar on the topic related to vector space of n-tuples. • Assignments to solve system of equations.	• Understand to solve system of equation using matrix • Learn about characteristic roots and vectors.	Evaluation through Test paper
Module IV **24 Hours**	Lines and planes in space. Cylinders and Quadric surfaces, Cylindrical and spherical coordinates, Vector valued functions and space curves, Arc length	• Lecture • Discussions • Problem solving	• Group discussion on Cylindrical and spherical coordinates.	• Learn basic results in vector algebra.	Evaluation through test paper

	and Unit tangent vector , Curvature, torsion and TNB frame				

Course Outcomes

CO1	Learned to find out the roots of polynomial equations.
CO2	Computed the inverse of a non singular matrix using elementary row transformations.
CO3	Understand about the characteristic equation and characteristic root of a matrix.
CO4	Understand the method of Gauss-Jordan elimination to find the solutions of systems of simultaneous linear equations and Learned to solve a system of linear equations by row-reduced echelon form.
CO5	Understand the basic concepts in vector algebra.

Teacher in Charge:

Mr. Rahul M Raju

Ms. Jiji Pauly

MAT5B06 : ABSTRACT ALGEBRA

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To introduce the basic concept of the nature of abstract algebra also gives the idea of group and ring.

Module I (20 hrs)

Binary operations, Isomorphic binary structures, Groups, Sub groups

Module II (25 hrs)

Cyclic groups, Groups and permutations, Orbits, cycles and Alternating groups

Module III (15 hrs)

Cosets and Theorem of Lagrange, Homomorphisms

Module IV (30hrs)

Rings and Fields, Integral Domains, The Field of Quotients of an Integral Domain

Textbooks :

John B. Fraleigh : A First Course in Abstract Algebra, 7th Ed., Pearson.

Reference Books:

1. Joseph A. Gallian : Contemporary Abstract Algebra. Narosa Pub. House.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: Basic Abstract Algebra, 2nded., Cambridge University
3. Artin : Algebra, PHI.
4. Durbin : Modern Algebra : An Introduction, 5th ed., Wiley.

OBJECTIVES

1) To enable one to determine whether the given binary operation on a given set forms a group.
2) To understand the concept of subgroups.
3) To describe all elements of a cyclic group using generators.
4) To enable one to understand the homomorphism and Theorem of Lagrange.
5) To understand the concept of rings, fields and integral domains.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **20 Hours**	Binary operations, Isomorphic binary structures, Groups; Sub groups	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Binary operation.	• Enable to understand the concept of Groups.	Evaluation through test paper
Module II **25 Hours**	Cyclic groups, Groups and permutations, Orbits, cycles and Alternating groups	• Lecture • Discussion • Participative learning • Problem solving	• Assignments on permutation and orbits.	• enable one to compute the expression of permutation and permutation multiplication • Enable to understand different type of groups.	Evaluation through test paper
Module III **15 Hours**	Cosets and Theorem of Lagrange, Homomorphism	• Lecture • Discussion • Participativ	• Seminar and assignment on properties of	• Understand the theorem Lagrange and	Evaluation through test paper

		e learning • Problem solving	homomorphism • Peer group discussion on Cosets.	homomorphisam.	
Module IV **30 Hours**	Rings and Fields, Integral Domains, The Field of Quotients of an Integral Domain	• Lecture • Discussion • Participative learning • Problem solving	• Seminar on the topic Rings and fields.	• To understand the concept of rings and fields • Learn the concept of Integral domain.	Evaluation through test paper and viva

Course Outcomes

CO1	Understand the concept of binary operation on a given set.
CO2	To get the idea of groups, rings, fields and integral domain.
CO3	Understand different type of groups like cyclic and alternating groups
CO4	Understand the homomorphism and Theorem of Lagrange

Teacher in Charge:

Ms. Geethu simon

MAT5B08: DIFFERENTIAL EQUATIONS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To find out ways and means for solving differential equations.

Module I (24 hrs)

Some Basic Mathematical Models: Direction Fields, Solutions of some Differential equations, Classification of Differential Equations, Historical Remarks, First order differential equations: Linear equations with variable coefficients, Separable equations, Modeling with first order equations, Differences between linear and non linear equations, Exact equations and integrating factors, The existence and uniqueness theorem.

Module II (29 hrs)

Second Order Linear Differential Equations: Homogeneous equation with constant coefficients, Fundamental solutions of Linear Homogeneous equations, Linear independence and Wronskian, Complex roots of characteristic equations, Repeated roots Reduction of order, Non homogeneous equations, Method of Undetermined coefficients, Variation of parameters, Mechanical and Electrical vibrations, Systems of First Order Linear equations: Introduction, Basic theory of systems of first order Linear Equations.

Module III (17 hrs)

Definition of Laplace Transforms , Solution of Initial Value Problem , Step functions , Impulse functions, The Convolution Integral.

Module IV (20 hrs)

Two point Boundary value problems , Fourier Series, The Fourier Convergence Theorem, Even and odd functions , Separation of variables; Heat conduction in a rod , The Wave equation, Vibrations of an elastic string.

Textbooks:

1) Thomas / Finney : Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1) Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.
2) H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,Universal Book Stall, New Delhi.

OBJECTIVES

1) To learn to solve DEs that are in linear, separable and in exact forms and also to analyze the solution.
2) To be familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.
3) To acquire the knowledge of solving a differential equation using Laplace method.
4) To get familiarized with Fourier series and its applications.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **24 Hours**	Some Basic Mathematical Models, First order differential equations	• Lecture • Discussion • Participative learning	Assignment on solving first order differential equations.	To learn to solve DEs that are in linear, separable and in	Evaluation through test paper

		• Problem solving		exact forms and also to analyze the solution.	
Module II **29 Hours**	Second Order Linear Differential Equations, Systems of First Order Linear equations	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Completeness Property of R.	To be familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.	Evaluation through test paper
Module III **17 Hours**	Laplace Transforms	• Lecture • Discussion • Participative learning • Problem solving	Assignment in solving Differential equations using Laplace transforms.	To acquire the knowledge of solving a differential equation using Laplace method.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Partial Differential Equations and Fourier Series	• Lecture • Discussions • Problem solving	Student seminars in applications of Fourier Series.	To get familiarized with Fourier series and its applications.	Evaluation through testpaper

Course Outcomes

CO1	Students could identify a number of areas where the modelling process results in a differential equation.
CO2	They will realize the basic differences between linear and non linear DEs and also basic results that guarantees a solution in each case.
CO3	They will become familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.
CO4	Students acquire the knowledge of solving a differential equation using Laplace method which is especially suitable to deal with problems arising in engineering field.

Teacher in Charge:

Mr. Rahul M Raju

MAT5B07: BASIC MATHEMATICAL ANALYSIS

Lecture Hours per week: 6, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To develop ability to analyze and prove statements of mathematics using logical arguments.

Module I (20 hrs)

A quick review of sets and functions, Mathematical induction, Finite and infinite sets, Real Numbers, The algebraic property of real numbers.

Module II (24 hrs)

Absolute value and real line, The completeness property of R, Applications of supremum property, Intervals, Nested interval property and uncountability of R.

Module III (30 hrs)

Sequence of real numbers, Sequence and their limits, Limit theorems, Monotone sequences, Subsequence and Bolzano – Weirstrass theorem, Cauchy criterio,Properly divergent sequences, Open and closed sets.

Module IV (34 hrs)

COMPLEX NUMBERS: Sums and Products, Basic Algebraic properties, Further properties, Vectors and Moduli, Complex Conjugates, Exponential form, Product and powers in exponential form, Arguments of products and quotients, Roots of complex numbers, Regions in the complex plane, Functions of complex variable, Limits, Theorems on limits, Limits involving the points at infinity, Continuity.

Textbooks:

1) **Robert G. Bartle & Donald R. Sherbert**: Introduction to Real Analysis, 3rded., Wiley.
2) **J.W. Brown and Ruel V. Churchill**: Complex Variables and Applications, 8th Ed., McGraw Hill.

Reference Books:

1) J.M. Howie : Real Analysis, Springer 2007.
2) Ghorpade and Limaye : A Course in Calculus and Real Analysis, Springer, 2006.
3) K.A. Ross : Elementary Real Analysis : The Theory of Calculus, Springer Indian Reprint.
4) J.V. Deshpande : Mathematical Analysis and Applications, Narosh Pub. House.
5) M.R. Spiegel : Complex Variables, Schaum's Outline Series.

OBJECTIVES

1) To learn to prove Archimedean property, density theorem, existence of a positive square root for positive numbers and so on and the learning will help them to appreciate the beauty of logical arguments.
2) To learn how monotone convergence theorem can be used in establishing the divergence of the harmonic series, how it helps in the calculation of square root of positive numbers and how it establishes the existence of the transcendental number e.
3) To understand the concept of open and closed sets, their properties, their characterization and so on.
4) To familiarize the use of geometry, comparison between real and complex calculus-areas

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **20 Hours**	A quick review of sets and functions ,Mathematical induction, Finite and	• Lecture • Discussion • Participative learning • Problem	Group discussion on Algebraic properties of R.	To generate the ability to analyze and	Evaluation through test paper

	infinite sets Real Numbers, The algebraic property of real numbers.	solving		prove statements of Mathematics.	
Module II **24 Hours**	Absolute value and real line, The completeness property of R, Applications of supremum property Intervals, Nested interval property and uncountability of R.	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Completeness Property of R.	To master different techniques of finding limits.	Evaluation through test paper
Module III **30 Hours**	Sequence of real numbers, Sequence and their limits, Limit theorems, Monotone sequences, Subsequence and Bolzano – Weirstrass theorem, Cauchy criterio, Properly divergent sequences, Open and closed sets.	• Lecture • Discussion • Participative learning • Problem solving	• Assignment in Limit Theorems. • Discussion on Open and Closed Sets.	To familiarize with different kinds of sequences.	Evaluation through testpaper and Viva
Module IV **34 Hours**	Sums and Products, Basic Algebraic properties, Further properties, Vectors and Moduli,	• Lecture • Discussions • Problem solving	Student seminars to familiarize properties of Complex Numbers.	To understand areas where real and complex calculus agree and where they	Evaluation through testpaper

	Complex Conjugates, Exponential form, Product and powers in exponential form, Arguments of products and quotients, Roots of complex numbers, Regions in the complex plane, Functions of complex variable, Limits, Theorems on limits, Limits involving the points at infinity, Continuity.			differ.	

Course Outcomes

CO1	To appreciate the beauty of logical arguments and embolden them to apply it in similar and unknown problems.
CO2	To establish the divergence and convergence of different sequences and series.
CO3	To understand some basic topological properties of real number system.

CO4	To demystify student's belief that complex variable theory is incomprehensible.

Teacher in Charge:

Ms. Geethu Simon

Mr. Rahul P R

MAT5D02: MATHEMATICS FOR NATURAL SCIENCES

Lecture Hours per week: 2 Credits: 2

Internal: 10, External: 40, Examination 2 Hours

Objectives

To get introduced to statistical measures and analysis.

Module I (20 hrs)

The idea of sets, Operation on sets, Relations and functions, Variables and graphs, Frequency distributions, The Mean, Median, Mode and other measures of central tendency, Dispersion or variation, The Range, The Mean deviation, The Semi-inter quartile range, The 10-90 Percentile range.

Module II (16 hrs)

The standard deviation, Properties of Standard Deviation, The variance, Short methods of computing standard deviation, Moments, Moments for grouped data, relation between moments, Computation of moment for grouped data. Skewness and Kurtosis.

Textbooks :

Murray R. Spiegel : Statistics, 2nd Edn., Schaum's Outline Series.

Reference Books:

1) Hogg & Craig: Introduction to Mathematical Statistics.
2) Freund & Walpole: Mathematical Statistics

OBJECTIVES

1) To understand different measures of tendency.
2) To analyse data using measures like SD, Skewness and Kurtosis

LESSON PLAN

Unit/ Hours	Topics for student	Procedure (process)	Activity	Learning outcome	Assessment

(Time Required)	preparation (input)	Student centric Method of teaching		(output)	
Module I 18 Hours	Sets, Frequency Distribution, Measures of Tendency	• Lecture • Discussion • Participative learning • Problem solving	Assignment on different measures of tendency.	To understand which measure is better for different kinds of data.	Evaluation through test paper and viva
Module II 12 Hours	Standard Deviation, Moments, Skewness and Kurtosis.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars on Skewness and Kurtosis on different datas.	To visualize how the data behaves.	Evaluation through test paper

Course Outcomes

CO1	Students get an understanding about the use of some statistical tools.
CO2	They learn to analyze data using different measures.

Teacher in Charge:

Mr. Rahul M Raju

MAT5B05: VECTOR CALCULUS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To Provide skils to visualize and manipulate multivariable and vector values functions. Also enable students to evaluate multiple integrals.

Module I (15 hrs)

Functions of several variables, Limits and Continuity, Partial derivatives, Differentiability linearization and differentials, Chain rule, Partial derivatives with constrained variables.

Module II (20 hrs)

Directional derivatives, gradient vectors and tangent planes, Extreme value and saddle points, Lagrange multipliers, Taylor's formula, Double Integrals, Double integrals in polar form.

Module III (25 hrs)

Triple integrals in Rectangular Coordinates, Triple integrals in cylindrical and spherical coordinates, Substitutions in multiple integrals, Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields.

Module IV (30hrs)

Green's theorem in the plane, Surface area and surface integrals, Parametrized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).

Textbooks :

Thomas / Finney : Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1. Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.

2. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,

OBJECTIVES

1) To enable one to apply the basic concepts of partial derivatives.
2) To learn to find multiple integrals.
3) To understand concept of the integrals of the functions and vector fields over parametrized surfaces and compute them in simple examples.
4) To calculate directional derivatives and gradients.
5) To learn application of greens theorem and stokes theorem.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **15 Hours**	Functions of several variables, Limits and Continuity, Partial derivatives, Differentiability linearization and differentials, Chain rule, Partial derivatives with constrained variables.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Partial derivatives.	• Enable to find partial derivatives.	Evaluation through test paper
Module II **20 Hours**	Directional derivatives, gradient vectors and tangent planes, Extreme value and saddle	• Lecture • Discussion • Participative learning	• Assignments in finding Directional derivatives	• Enable to evaluate double integrals.	Evaluation through test paper

	points, Lagrange multipliers, Taylor's formula, Double Integrals, Double integrals in polar form.	• Problem solving	and double integrals.		
Module III **25 Hours**	Triple integrals in Rectangular Coordinates, Triple integrals in cylindrical and spherical coordinates, Substitutions in multiple integrals, Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain vector fields, work and circulation	Understand triple integrals and vector fields.	Evaluation through MCQ and Group Discussion
Module IV **30 Hours**	Green's theorem in the plane, Surface area and surface integrals, Parametrized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to Surface integrals.	Learn the application of greens theorem and stokes theorem in multiple integrals.	Evaluation through test paper

Course Outcomes

CO1	Understand the basic concept of partial derivatives.
CO2	Enable to calculate multiple integrals.
CO3	Understand the concept of a conservative vector field

CO4	Learn the application of greens theorem and stokes theorem in multiple integrals and understand how they are generalizations of the Fundamental theorem of calculus.

Teacher in Charge:

Ms. Jiji Pauly

MAT6B10 : COMPLEX ANALYSIS

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To learn basic concepts of complex analysis and its applications.

Module I : Analytic Functions (15 hrs)

Derivatives, Differentiation formula, Cauchy-Riemann Equations, Polar coordinates, Analytic functions, Harmonic functions , Elementary functions , The exponential function, Logarithmic function, Complex exponents, Trigonometric functions, Hyperbolic functions, Inverse Trigonometric and Hyperbolic functions.

Module II : Integrals (25 hrs)

Derivatives of functions ω(t); Indefinite integral of ω(t); Contours, Contour integrals, Antiderivatives, Cauchy -Goursat theorem (without proof), Simply and multiply connected domains, Cauchy's integral formula and its extension, Liouville's theorem and fundamental theorem of algebra, Maximum modulus principle.

Module III : Series (25 hrs)

A quick review of convergence of sequence and series of complex numbers,Taylor series, Laurents series (withoutproof), Applications,Power series: Absolute and uniform convergence,Continuity of sum of powerseries, Differentiation and integration of power series, Multiplication and division of power series.

Module IV : Residues (25 hrs)

Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, Three types of isolated singular points, Residues at poles, Zeroes of analytic functions, Zeroes and poles,Applications of residues, Evaluation of improper integrals, Jordan's Lemma (statement only), Definite integrals involving sines and cosines.

Textbooks :

1) **James Ward Brown and Ruel V. Churchill** : Complex Variables and Applications (8th Edn.),

McGraw Hill.

Reference Books:

1) Mark J.Ablowitz and Anthanassios S. Fokas: Complex Variables, Cambridge Text, 2nd Edn
2) S. Ponnusamy : Foundation of Complex Analysis : Narosa.
3) Murray R. Spiegel: Complex Variables, Schaum's Outline series.
4) J.M. Howie: Complex Analysis: Springer India Reprint
5) Stewart & Tall: Complex Analysis, CUP

OBJECTIVES

1) To develop differentiability and analyticity of complex valued functions
2) To develop complex integration
3) To represent an analytic function as power series.
4) To classify the singular points using Laurent series and develop the concept of residues and its applications.

LESSON PLAN

Unit/ session / hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **15 Hours**	Derivatives, Cauchy-Riemann Equations,Analytic functions,Harmon	• Lecture • Discussion • Participative learning • Problem	• Assignments in finding harmonic conjugates	To understand the difference between differentiability and	Evaluation through test paper

	ic functions , Exponential , Logarithmic, Trigonometric , Hyperbolic , Inver seTrigonometric a nd Hyperbolic functions	solving		analyticity	
Module II 25 Hours	Derivatives ofω(t) , Indefinite integral of ω(t); Contours, Contour integrals, Antiderivatives, Cauchy-Goursat theorem , Simplya nd multiply conne cted domains, Cau chy's integralformula a nd its extension, Liouville's theore m and fundamenta l theorem of algebr a, Maximum mod ulus principle.	• Lecture • Discussi on • Participati ve learning • Problem solving	• Group discussion on contour integrals	To understand integration of complex functions and related theorems	Evaluation through test paper and viva
Module III	Convergence of sequence and serie	• Lecture • Discussi	• Student seminar to	To understand Taylor series	Evaluation through

25 Hours	s of complex numbers,Taylor series, Laurents series , Absolute and Uniform convergence, Continuity of sum of powerseries, Differentiation and integration of power series, Multiplication and division of power series.	on • Participative learning • Problem solving	explain absolute and uniform convergence of power series	and Laurent series	Test paper and Group Discussion
Module IV **25 Hours**	Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, Three types of isolated singular points, Residues at poles, Zeroes of analytic functions , Zeroes and poles, Applications of residues, Evaluation of improper integral	• Lecture • Discussions • Problem solving	• Assignments in finding isolated singular points and residues	To understand isolated singular points, residues and applications of residues	Evaluation through test paper

	s, Jordan's Lemma , Definite integral involving sines an d cosines.				

Course Outcomes

CO1	To understand difference between differentiability and analyticity of complex valued functions.
CO2	To learn indefinite integrals of complex valued functions.
CO3	Learn to express an analytic function as a power series.
CO4	To understand the concepts of singular points, residues, and applications of residues.

Teacher in Charge:

Ms. Geethu Simon

MAT6B13(E02) : LINEAR PROGRAMMING

Lecture Hours per week: 3, Credits: 2

Internal: 20, External: 80, Examination 3 Hours

Objectives

Formulate our real life problem into a mathematical model also different techniques to solve LPP are introduced.

Module I (16 hrs)

Formulation, Convex sets, General LLP

Module II (14 hrs)

Simplex Method, Duality

Module III (18 hrs)

The transportation problem, The assignment Problems

Textbooks :

Gupta and Manmohan - Linear Programming And Theory of Games

Reference Books:

1. . K. V. Mital&Manmohan: Optimization methods in Operations Research and Systems Analysis, 3rdEdn., New Age International publishers.
2. DipakChatterjee: Linear Programming and Game Theory, Prentice Hall of India.

OBJECTIVE

1. Enable to formulate LPP from real life problem
2. Conceptulize the feasible region, feasible solution, optimal solution etc.
3. Solve the LPP with two variables using graphical method
4. Solve the LPP using simplex method
5. Formulate the dual problem from primal
6. Solve transportation problem and the assignment Problems which are relevent in daily life.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **16 Hours**	Formulation, Convex sets, General LLP	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on formulation of lpp. • Seminar on the topic convex sets.	• Understand to formulate lpp.	Evaluation through test paper
Module II **14 Hours**	Simplex Method, Duality	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in solving LPP using simplex method.	• Understand to solve lpp in finite number of steps using simplex method.	Evaluation through test paper and viva
Module III **18 Hours**	The transportation problem, The assignment Problems	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to solve transportation problems and assignment problems	• Enable one to solve transportation problem and the assignment Problems which are relevent in daily life.	Evaluation through Test paper and Group Discussion

Course Outcomes

Course Outcomes

CO1	Enable one to formulate LPP from real life problem.
CO2	Solve the LPP with two variables using graphical method
CO3	Solve the LPP using simplex method
CO4	Solve transportation problem and the assignment Problems which are relevent in daily life.

Teacher in Charge:

Mr. Rahul M Raju

MAT6B12 : NUMBER THEORY AND LINEAR ALGEBRA

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To study about the integers and integer valued functions. Also introduce the concept of vector fields and linear transformations.

Module I (30 hrs)

Divisibility theory in the integers – the division algorithm, the greatest common divisor, the Euclidean algorithm, the Diophantine equation ax + by = c. Primes and their distribution. The fundamental theorem of arithmetic.The sieve of Eratosthenes. The theory of congruences.Basic properties of congruence.Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem

Module II (25 hrs)

Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors.The greatest integer function.Euler's phi-function.Euler's generalization of Fermat's theorem.Properties of the phi-function.

Module III (15 hrs)

Vectorspaces-examples, linearcombinations, spanning, linearindependence, base, finite dimensional vector spaces.

Module IV (20 hrs)

Linear mappings- Linear transformations, examples, nullspace, rank –nullity theorem, linear isomorphism

Textbooks :

1. David M. Burton : Elementary Number Theory, Sixth Edn., TMH.

2. T. S. Blynth and E.F. Robertson: Basic Linear Algebra, second Edn springer under graduate mathematics series 2009

Reference Books:

1. C.Y. Hsiung : Elementary Theory of Numbers. Allied Publishers.
2. Neville Robbins : Beginning Number Theory, Second Ed. Narosa.
3. George E. Andrews : Number Theory, HPC.
4. Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.
5. Frank Ayres, Jr. : Matrices, Schaum's Outline Series, Asian Student edition.
6. Devi Prasad : Elementary Linear Algebra, Narosa Pub. House

OBJECTIVE

1. Enable to find gcd using Euclidean algorithm.
2. To understand the solution of diophantine equations.
3. Enable to solve system of congruence using chinese remainder theorem.
4. To learn Wilson's theorem, Fermat's little theorem and Euler's theorem
5. Understand the concept of vector space and its basis.
6. Understand the concept of linear transformation and application of rank nullity theorem.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **30 Hours**	The division algorithm, Gcd, the Euclidean algorithm, the Diophantine equation. Primes and their distribution. The fundamental theorem of arithmetic. The sieve of	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on gcd and euclidean algorithm. • Assignment in finding solution of system of congruence using chinese remainder	• Understand the linear congruence and the method for finding its solutions.	Evaluation through test paper

	Eratosthenes. The theory of congruences. Basic properties of congruence. Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem.		theorem		
Module II **25 Hours**	Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors. The greatest integer function. Euler's phi-function. Euler's generalization of Fermat's theorem. Properties of the phi-function.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding sum and number of divisors • Seminar on the topic Euler's phi-function and Properties of the phi-function.	• Understand fermat's theorem, wilson's theorem, euler's theorem and its applications.	Evaluation through test paper and viva
Module III **15 Hours**	Vectorspaces-examples, linearcombinations, spanning, linearindependence, base, finite dimensional vector spaces.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to vector space and its example.	• Understand the definition of vector space and its basis.	Evaluation through MCQ and Group Discussion
Module IV **20 Hours**	Linear mappings-Linear transformations, examples, nullspace, ranknullity theorem, linear isomorphism.	• Lecture • Discussions • Problem solving	• Student seminars inconnection with Linear transformation and its	• Become familiar with the concept of Linear transformations and rank	Evaluation through test paper

			example.	nullity theorem.	

Course Outcomes

CO1	To prove results involving divisibility, greatest common divisor, least commonmultiple and a few applications.
CO2	Enable to solve system of congruence and diophantine equation
CO3	To learn the theorems viz. Wilson's theorem, Fermat's little theorem and Euler's theorem and its applications.
CO4	To Lean if a set of vectors is a vector space or a basis for a vetor space.
CO5	Understand the concept of linear transformation and application of rank nullity theorem.

Teacher in Charge:

Ms. Jiji Pauly

MAT6B11 : NUMERICAL METHODS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To provide techniques and algorithms to find approximate numerical solution to problems in several areas of mathematics.

Module I : Solution of Algebraic and Transcendental Equation (23 hrs)

Introduction, Bisection Method, Method of false position, Iteration method, Newton-Raphson Method, Ramanujan's method, The Secant Method, Finite Differences, Forward differences, Backward differences, Central differences, Symbolic relations and separation of symbols, Differences of a Polynomial.

Module II : Interpolation (23 hrs)

Newton's formulae for intrapolation, Central difference interpolation formulae, Gauss' Central Difference Formulae, Interpolation with unevenly spaced points, Langrange's interpolation formula, Divided differences and their properties, Newton's General interpolation formula, Inverse interpolation, Numerical Differentiation and Integration, Introduction, Numerical differentiation (using Newton's forward and backward formulae), Numerical Integration, Trapizoidal Rule, Simpson's 1/3-Rule , Simpson's 3/8-Rule.

Module III : Matrices and Linear Systems of equations (22 hrs)

Solution of Linear Systems – Direct Methods, Gauss elimination, Gauss-Jordan Method, Modification of Gauss method to compute the inverse, LU Decomposition, LU Decomposition from Gauss elimination, Solution of Linear Systems – Iterative methods, The eigen value problem, Eigen values of Symmetric Tridiazonal matrix.

Module IV : Numerical Solutions of Ordinary Differential Equations (22 hrs)

Introduction, Solution by Taylor's series, Picard's method of successive approximations, Euler's method, Modified Euler's Method, Runge-Kutta method, Predictor-Corrector Methods, Adams-Moulton Method, Milne's method.

Textbooks:

1) **S.S. Sastry** : Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

Reference Books:

1) S. SankaraRao : Numerical Methods of Scientists and Engineer, 3rd ed., PHI.
2) F.B. Hidebrand : Introduction to Numerical Analysis, TMH.
3) J.B. Scarborough : Numerical Mathematical Analysis, Oxford and IBH

OBJECTIVES

1) To understand several methods such as bisection method, fixed point iteration method, regula falsi method etc.
2) To understand the concept of interpolation.
3) To solve system of linear equations using matrices.
4) To learn to find numerical approximations to solutions of initial value problems.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **23 Hours**	Solution of Algebraic and Transcendental	• Lecture • Discussion • Participative	• Assignment in different methods to	To learn to solve equations	Evaluation through test paper

	Equation, Finite differences	learning • Problem solving	solve equations • Seminars in Finite differences	using different techniques.	
Module II **23 Hours**	Interpolation, Numerical Differentiation, Numerical Integration	• Lecture • Discussion • Participative learning • Problem solving	Assignments in different techniques.	To find derivatives and integrals at a point using numerical techniques.	Evaluation through test paper
Module III **22 Hours**	Matrices and Linear Systems of equations	• Lecture • Discussion • Participative learning • Problem solving	Seminar on which technique is better and easier.	To learn to use matrices to solve system of linear equations.	Evaluation through testpaper and Viva
Module IV **22 Hours**	Numerical Solutions of Ordinary Differential Equations	• Lecture • Discussions • Problem solving	Assignment related to IVP	To find out numerical approximations to solutions of initial value problems.	Evaluation through testpaper

Course Outcome

CO1	Understand several methods such as bisection method, fixed point iteration method, regula falsi method etc. to find out the approximate numerical solutions of algebraic and transcendental equations with desired accuracy.

CO2	Understand the concept of interpolation and also learn some well known interpolation techniques.
CO3	Understand a few techniques for numerical differentiation and integration and also realize their merits and demerits.
CO4	Find out numerical approximations to solutions of initial value problems and also to understand the efficiency of various methods.
CO5	Learn to solve system of linear equations using matrices.

Teacher in Charge:

Mr. Rahul M Raju

MAT6B09: REAL ANALYSIS

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To teach one how to combine different definitions, theorems and techniques to solve problems.

Module I : Continuous Functions (25 hrs)

Continuous functions, Continuous functions on intervals, Uniform continuity

Module II : Riemann Integral (25 hrs)

Riemann Integral, Riemann Integrable Functions, The fundamental theorem, Substitution theorem and application, Approximate Integration

Module III : Sequence and series of functions (20 hrs)

A quick review of series of real numbers, Pointwise and uniform convergence, Interchange of limit and continuity, Series of functions .

Module IV (20 hrs)

Improper Integrals : Improper integrals of the first kind, Improper integrals of the second kind,Cauchy Principal value, Improper Integrals of the third kind.

Beta and Gamma functions : Beta Functions, Gamma Functions, Relation between Beta and Gamma Functions

Textbooks:

1) **G. Bartle, Donald R. Sherbert** : Introduction to Real Analysis (3rd Edn.)
2) **R.R. Goldberg** : Methods of Real Analysis.
3) **Narayanan & Manicavachagom Pillay** : Calculus, Vol. II

Reference Books:

1) J.V. Deshpande: Mathematical Analysis and Applications, Narosa Pub. House.
2) Torence Tao : Analysis I, TRIM 37, Hindustan Book Agency.
3) K.A. Ross: Elementary Real Analysis : Theory of Calculus, Springer.
4) K.G. Binmore: Mathematical Analysis, CUP

OBJECTIVES

1) To state the definition of continuous functions, formulate sequential criteria for continuity and prove or disprove continuity of functions using this criteria.
2) To develop the notion of Riemann integrability of a function using the idea of tagged partitions and calculate the integral value of some simple functions using the definition.
3) To prove convergence and divergence of sequences of functions and series.
4) To learn the properties of and relationship among two important improper integrals.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **25 Hours**	Continuous Functions, Uniform Continuity	• Lecture • Discussion • Participative learning • Problem	Assignment regarding difference in Continuity and Uniform	To understand several deep and fundamental results of	Evaluation through test paper

		solving	Continuity.	continuous functions on intervals.	
Module II **25 Hours**	Riemann Integral	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Riemann Intregrability.	To understand a few basic and fundamental results of integration theory.	Evaluation through test paper
Module III **20 Hours**	Sequence and series of functions	• Lecture • Discussion • Participative learning • Problem solving	Assignment on convergence of series and sequences of functions.	To understand the difference between pointwise and uniform convergence of sequences and series of functions.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Improper Integrals, Beta and Gamma functions	• Lecture • Discussions • Problem solving	Seminars related to Improper Integrals and Principal Value.	To understand the notion of improper integrals, their convergence, principal value and evaluation.	Evaluation through testpaper

Course Outcomes

CO1	To understand several deep and fundamental results of continuous functions on intervals such as boundedness theorem, maximum-minimum theorem, intermediate value theorem, preservation of interval theorem and so on.
CO2	To develop the notion of Riemann integrability of a function using the idea of tagged partitions and calculate the integral value of some simple functions using the definition.
CO3	To learn and find out examples/counter examples to prove or disprove the validity of several mathematical statements that arise naturally in the process/context of learning.
CO4	To learn the properties of and relationship among two important improper integrals namely beta and gamma functions that frequently appear in mathematics, statistics, science and engineering.

Teacher in Charge:

Ms. Geethu Simon

Mr. Rahul P R

MTH1C01: ALGEBRA I
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of abstract algebra.

MODULE I

Plane Isometries, Direct products & finitely generated Abelian Groups, Factor Groups, Factor-Group Computations and Simple Groups, Group action on a set, Applications of G-set to counting

MODULE II

Isomorphism theorems, Series of groups, (Omit Butterfly Lemma and proof of the Schreier Theorem), Sylow theorems, Applications of the Sylow theory, Free Groups

MODULE III

Group Presentations, Rings of polynomials, Factorization of polynomials over a field, Non Commutative examples, Homomorphism and factor rings

TEXT:

JOHN B. FRALEIGH, A FIRST COURSE IN ABSTRACT ALGEBRA(7th Edn.), Pearson Education Inc., 2003.

REFERENCES :

[1] N. Bourbaki: Elements of Mathematics: Algebra I, Springer; 1998.

[2] Dummit and Foote: Abstract algebra(3rd edn.); Wiley India; 2011.

[3] P.A. Grillet: Abstract algebra(2nd edn.); Springer; 2007

[4] I.N. Herstein: Topics in Algebra(2nd Edn); John Wiley & Sons, 2006.

[5] T.W. Hungerford: Algebra; Springer Verlag GTM 73(4th Printing); 1987.

[6] N. Jacobson: Basic Algebra-Vol. I; Hindustan Publishing Corporation(India), Delhi; 1991.

[7] T.Y. Lam: Exercises in classical ring theory(2nd edn); Springer; 2003.

[8] C. Lanski: Concepts in Abstract Algebra; American Mathematical Society; 2010.

[9] N.H. Mc Coy: Introduction to modern algebra, Literary Licensing, LLC; 2012.

[10] S. M. Ross: Topics in Finite and Discrete Mathematics; Cambridge; 2000.

[11] J. Rotman: An Introduction to the Theory of Groups(4th edn.); Springer, 1999.

OBJECTIVES

a) **To understand the basic concepts of groups, factor groups, simple groups and group action on a set.**

b) **To get familiarize with Isomorphism theorems and its properties.**

c) **To understand the concept of sylow theorems and its applications.**

d) **To study more about rings of polynomials and factorization of polynomials over a field.**

e) **To understand homomorphism and factor ring.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Plane Isometries, Abelian groups, Factor groups, Simple groups, group action on a set	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on groups and its properties	To understand: • the basics of different types of groups • notion of group action on a set	Evaluation Through MCQ
Module I1 (30 hours)	Isomorphism theorems, Sylow theorems and its applications	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of Isomprhism • Peer group discussion on Sylow theorems	To understand: • Isomorphism theorems and their significance • Sylow theorems and its applications	Evaluation Through test paper

Module III (30 Hours)	Ring of polynomials, factorization of a polynomial over a field, homomorphism and factor rings	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of homomorphism and factor rings	To understand: • homomorphism and factor rings • factorization of a polynomial over a field convergence	Evaluation through test paper

Course Outcomes

CO1	To get the idea of different types of groups and group action on a set
CO2	To understand the concept of isomorphism theorems and their significance, Sylow theorems and its applications
CO3	To understand factorization of a polynomial over a field, homomorphism and factor rings

Faculty in charge:
Ms. Linet Roslin Antony

MTH1C05 – DISCRETE MATHEMATICS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To understand concepts in graph theory, lattices and automata.

MODULE I

Order Relations, Lattices; Boolean Algebra Definition and Properties, Boolean Functions.

MODULE II

Basic concepts, Subgraphs, Degree of vertices, Paths and connectedness, Automorphism of a simple graph, Operations on graphs, Vertex cuts and Edge cuts, Connectivity and Edge connectivity, Trees-Definition, Characterization and Simple properties, Eulerian graphs, Planar and Non planar graphs, Euler formula and its consequences, K5 and K3,3 are non planar graphs, Dual of a plane graph.

MODULE III

Automata and Formal Languages: Introduction to the theory of Computation, Finite Automata.

TEXTBOOKS

TEXT 1: R. BALAKRISHNAN and K. RANGANATHAN, A TEXT BOOK OF GRAPH THEORY, Springer-Verlag New York, Inc., 2000.

TEXT 2: K. D JOSHI, FOUNDATIONS OF DISCRETE MATHEMATICS, New Age International(P) Limited, New Delhi, 1989.

TEXT 3: PETER LINZ, AN INTRODUCTION TO FORMAL LANGUAGES AND AUTOMATA (2nd Edn.), Narosa Publishing House, New Delhi, 1997.

REFERENCES

[1] J. C. Abbot: Sets, lattices and Boolean Algebras; Allyn and Bacon, Boston; 1969.

[2] J. A. Bondy, U.S.R. Murty: Graph Theory; Springer; 2000.

[3] S. M. Cioaba and M.R. Murty: A First Course in Graph Theory and Combinatorics; Hindustan Book Agency; 2009.

[4] J. A. Clalrk: A first look at Graph Theory; World Scientific; 1991.

OBJECTIVES

- To understand the definition of Boolean algebra and Boolean functions along with various properties.
- To study graph and its types with suitable examples.
- To learn about connectivity of graphs.
- To understand the definition of trees and learn various theorems related to it.
- To study about language, grammar and types of acceptors.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Lattices; Boolean Algebra Definition and Properties, Boolean Functions	• Discussion • Participative learning • Problem solving	Seminars by students	To study about Boolean algebra and Boolean functions.	Evaluation through test paper.
MODULE II	Graph definition with examples, isomorphism, connected graphs, planar graphs, trees and eulerian graphs	• Lecture • Discussion • Participative learning • Problem solving	Assignments on isomorphism of graphs. Discussion about various definitions.	To learn basics about graphs and trees. To study about planarity and connectivity.	Evaluation through test paper.
MODULE III	Definition of automata. Languages and Grammars. DFA and NFA	• Lecture • Discussion • Participative learning • Problem solving	Discussion on applications of automata. Working out exercise problems on DFA and NFA	To know the basic about automata. To learn about DFA and NFA	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about Boolean algebra and Boolean functions.
CO2	To learn basics about graphs and trees. To study about planarity and connectivity.
CO3	To know the basic about automata. To learn about DFA and NFA

Faculty in Charge
Ms. Geethika P R

MT1C02: LINEAR ALGEBRA
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of Linear Algebra.

MODULE I

Vector Spaces & Linear Transformations

MODULE II

Linear Transformations (continued) and Elementary Canonical Forms

MODULE III

Elementary Canonical Forms (continued), Inner Product Spaces

TEXT:

HOFFMAN K. and KUNZE R., LINEAR ALGEBRA (2nd Edn.), Prentice Hall of India, 199

REFERENCES :

[1] P. R. Halmos: Finite Dimensional Vector spaces; Narosa Pub House, New Delhi; 1980.

[2] A. K. Hazra: Matrix: Algebra, Calculus and generalised inverse- Part I; Cambridge International Science Publishing; 2007.

[3] I. N. Herstein: Topics in Algebra; Wiley Eastern Ltd Reprint; 1991.

[4] S. Kumaresan: Linear Algebra-A Geometric Approach; Prentice Hall of India; 2000.

[5] S. Lang: Linear Algebra; Addison Wesley Pub.Co.Reading, Mass; 1972.

[6] S. Maclane and G. Bikhrkhoff: Algebra; Macmillan Pub Co NY; 1967.

[7] N. H. McCoy and R. Thomas: Algebra; Allyn Bacon Inc NY; 1977.

[8] R. R. Stoll and E.T.Wong: Linear Algebra; Academic Press International Edn; 1968.

[9] G. Strang: linear algebra and its applications(4th edn.); Cengage Learning; 2006.

OBJECTIVES

a) **To understand the concept of vector spaces, basis and dimension.**

b) **To study about linear transformations and its properties.**

c) **To understand the concept of functionals and dual space**

d) **To study the relation between linear transformations and corresponding matrices.**

e) **To study about inner product spaces.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Vector spaces, subspace, basis, dimension, properties, linear transformations	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on properties of vector spaces	To understand: • the basics of vector spaces, basis • notion of linear transformation • properties of linear transformation	Evaluation through test papers and interaction with students
Module I1 (35 hours)	linear transformations, functionals, dual space and elementary canonical transformations	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of linear transformations	To understand: • More about linear transformation • Significance of dual space	Evaluation through test paper
Module III (25	canonical transformations inner product spaces,	• Lecture • Discussion • Participative learning	• Seminar and assignment on inner product	To understand: • Inner product spaces	Evaluation through test paper

Hours)		• Problem solving	spaces	and their relevance • Orthogonal compliment and direct sums of vector spaces	

Course Outcomes

CO1	To understand the concept of vector spaces, their basis, dimension and linear transformations
CO2	To understand more about linear transformations and some of its important properties, elementary canonical forms
CO3	To introduce the concept of Inner product spaces, orthogonal compliment and direct sums of vector spaces

Faculty in charge:
Dr. Nidhin T J

MT1C05: NUMBER THEORY

Number of hours of Lectures per week: 5

Number of Credits: 4

Objectives

To understand the basic concepts of Number Theory.

Module 1

Arithmetical functions and Dirichlet multiplication; Averages of arithmetical functions

Module 2

Some elementary theorems on the distribution of prime numbers

Module 3

Quadratic residues and quadratic reciprocity law ,Cryptography, Public key.

TEXT 1 : APOSTOL T.M., INTRODUCTION TO ANALYTIC NUMBER THEORY, Narosa Publishing House, New Delhi, 1990.

TEXT 2: KOBLITZ NEAL A., COURSE IN NUMBER THEROY AND CRYPTOGRAPHY, SpringerVerlag, NewYork, 1987.

References

[1] A. Beautelspacher: Cryptology; Mathematical Association of America (Incorporated); 1994

[2] H. Davenport: The higher arithmetic(6th Edn.); Cambridge Univ.Press; 1992

[3] G. H. Hardy and E.M. Wright: Introduction to the theory of numbers; Oxford International Edn; 1985

[4] A. Hurwitz & N. Kritiko: Lectures on Number Theory; Springer Verlag ,Universitext; 1986

[5] T. Koshy: Elementary Number Theory with Applications; Harcourt / Academic Press; 2002

[6] D. Redmond: Number Theory; Monographs & Texts in Mathematics No: 220; Marcel Dekker Inc.; 1994

[7] P. Ribenboim: The little book of Big Primes; Springer-Verlag, New York; 1991
[8] K.H. Rosen: Elementary Number Theory and its applications(3rd Edn.); Addison Wesley Pub Co.; 1993

[9] W. Stallings: Cryptography and Network Security-Principles and Practices; PHI; 2004

[10] D.R. Stinson: Cryptography- Theory and Practice(2nd Edn.); Chapman & Hall / CRC (214. Simon Sing : The Code Book The Fourth Estate London); 1999

[11] J. Stopple: A Primer of Analytic Number Theory-From Pythagorus to Riemann; Cambridge Univ Press; 2003

[12] S.Y. Yan: Number Theroy for Computing(2nd Edn.); Springer-Verlag; 2002

OBJECTIVES

a) **To understand the basic arithmetical functions and its averages.**

b) **To get familiarize with theorems on the distribution of prime numbers.**

c) **To understand quadratic residues, quadratic reciprocity law.**

d) **To study about basics of cryptography .**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Arithmetical functions and Dirichlet multiplication; Averages of arithmetical functions	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on various arithmetic functions.	To understand: • Arithmetical functions • Dirichlet multiplication and derivatives of arithmetical functions • Averages of arithmetical functions.	Evaluation Through Test paper

Module I1 (30 hours)	Some elementary theorems on the distribution of prime numbers	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain theorems on distribution of prime numbers.	To understand: • Equivalent forms of prime number theorem. • Partial sums of Mobius function.	Evaluation Through test paper
Module III (30 Hours)	Quadratic residues and quadratic reciprocity law, Cryptography, Public key	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on legendre's symbol, its properties and Gauss lemma.	To understand: • Quadratic Residues and Quadratic reciprocity law,jacobi's symbol. • Basics of cryptography, types of crypto-system and its cryptanalysis.	Evaluation through test paper

Course Outcomes

CO1	To introduce the Arithmetical functions,Dirichlet multiplication and derivatives of arithmetical functions,Averages of arithmetic.
CO2	To understand the Equivalent forms of prime number theorem, Partial sums of Mobius function.
CO3	To understand the quadratic residues and quadratic reciprocity law, jacobi's symbol , basics of cryptography, types of cryptosystem and its cryptanalysis.

Faculty in charge:
Ms. Smitha Davis

MT1C03: REAL ANALYSIS I
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of real analysis.

MODULE I

Basic Topololgy, Finite, Countable and Uncountable sets Metric Spaces, Compact Sets, Perfect Sets, Connected Sets. Continuity - Limits of function, Continuous functions, Continuity and compactness, continuity and connectedness, Discontinuities, Monotonic functions, Infinite limits and Limits at Infinity

MODULE II

Differentiation The derivative of a real function, Mean Value theorems, The continuity of Derivatives, L Hospitals Rule, Derivatives of Higher Order, Taylors Theorem, Differentiation of Vector valued functions. The Riemann Stieltjes Integral, - Definition and Existence of the integral, properties of the integral, Integration and Differentiation

MODULE III

The Riemann Stieltjes Integral (Continued) - Integration of Vector vector-valued Functions, Rectifiable curves. Sequences and Series of Functions - Discussion of Main problem, Uniform convergence, Uniform convergence and continuity, Uniform convergence and Integration, Uniform convergence and Differentiation. Equicontinuous Families of Functions, The Stone Weierstrass

TEXT:

RUDIN W., PRINCIPLES OF MATHEMATICAL ANALYSIS (3rd Edn.), Mc. Graw-Hill, 1986.

REFERENCES :

[1] H. Amann and J. Escher: Analysis-I; Birkhuser; 2006.

[2] T. M. Apostol: Mathematical Analysis(2nd Edn.); Narosa; 2002.

[3] R. G. Bartle: Elements of Real Analysis(2nd Edn.); Wiley International Edn.; 1976.

[4] R. G. Bartle and D.R. Sherbert: Introduction to Real Analysis; John Wiley Bros; 1982.

[5] J. V. Deshpande: Mathematical Analysis and Applications- an Introduction; Alpha Science International; 2004.

OBJECTIVES

a) **To understand the basic concepts of Topology: Finite, Countable and Uncountable sets, Metric spaces, Compact sets, Perfect sets, Connected sets.**

b) **To develop the notion of continuity of functions in R^K.**

c) **To understand the concept of differentiation of real valued and complex valued functions.**

d) **To study about Riemann Stieltjes Integral and Rectifiable curves.**

e) **To understand the convergence of sequence and series of functions.**

f) **To understand the relation between uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Basic topology, Continuous functions, continuity and compactness, continuity and connectedness, discontinuities	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic topology and continuity of functions	To understand: • the basics of topology • notion of continuity • difference between continuity and	Evaluation Through MCQ

				uniform continuity	
Module I1 (30 hours)	Differentiation, derivatives of higher order, differentiation of vector valued functions, Riemann Stieltjes Integral	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of differentiation and integration	To understand: • differentiation of vector valued functions • integration of vector valued functions	Evaluation Through test paper
Module III (25 Hours)	Convergence of sequence and series of functions, uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of convergence of functions	To understand: • Convergence of sequence and series of functions • Differentiate between convergence and uniform convergence	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of basic topology, difference between continuous and uniformly continuous functions and its properties.
CO2	To understand the concept of differentiation of vector valued functions and integration of functions.
CO3	To understand the difference between pointwise convergence and uniform convergence of sequence of functions, convergence of series of functions

Faculty in charge:
Dr. Vijitha Mukundan

MTH2C06: ALGEBRA II
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the ideas and concepts of insolvability of the quintic.

MODULE I

Prime and Maximal Ideals, Introduction to Extension Fields, Algebraic Extensions (Omit Proof of the Existence of an Algebraic Closure), Geometric Constructions. [27, 29, 31, 32]

MODULE II

Finite Fields, Automorphisms of Fields, the Isomorphism Extension Theorem, Splitting Fields, Separable Extensions. [33, 48, 49, 50, 51]

MODULE III

Galois Theory, Illustration of Galois Theory, Cyclotomic Extensions, Insolvability of the Quintic. [53, 54, 55, 56]

TEXT: John B. Fraleigh: A FIRST COURSE IN ABSTRACT ALGEBRA (7th Edn), Pearson Education Inc., 2003.

REFERENCES :

[1] N. Bourbaki: Elements of Mathematics: Algebra I, Springer; 1998

[2] Dummit and Foote: Abstract algebra (3rd Edn); Wiley India; 2011

[3] M.H. Fenrick: Introduction to the Galois correspondence (2nd Edn); Birkhuser; 1998

[4] P.A. Grillet: Abstract algebra (2nd Edn); Springer; 2007

[5] I.N. Herstein: Topics in Algebra (2nd Edn); John Wiley & Sons, 2006.

[6] T.W. Hungerford: Algebra; Springer Verlag GTM 73 (4th Printing); 1987

[7] C. Lanski: Concepts in Abstract Algebra; American Mathematical Society; 2010

[8] R. Lidl and G. Pilz Applied abstract algebra(2nd edn.); Springer; 1998

[9] N.H. Mc Coy: Introduction to modern algebra, Literary Licensing, LLC; 2012

[10] J. Rotman: An Introduction to the Theory of Groups (4th Edn); Springer; 1999

[11] I. Stewart: Galois theory(3rd edn.); Chapman & Hall/CRC; 2003

OBJECTIVES

a) **To understand the basic concepts of Prime and Maximal Ideals.**

b) **To get familiarize with Algebraic Extensions.**

c) **To understand the Automorphisms of fields, Separable Extensions and Splitting Fields.**

d) **To study about the Galois Theory, Cyclotomic Extensions and the Insolvability of the Quintic.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Prime and Maximal Ideals, Introduction to Extension Fields, Algebraic Extensions, Geometric Constructions.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on prime and maximal ideals and algebraic extensions	To understand: • the basics of extension fields • geometric constructions	Evaluation through MCQ
Module I1 (30 hours)	Finite Fields, Automorphisms of Fields, the Isomorphism Extension Theorem, Splitting Fields, Separable Extensions.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about separable extensions	To understand: • Isomorphism Extension Theorem Splitting and Separable Extensions	Evaluation through test paper
Module III (30 hours)	Galois Theory, Illustration of Galois Theory, Cyclotomic Extensions, Insolvability of the Quintic.	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on Cyclotomic Extensions	To understand: • Galois Theory • Insolvability of the Quintic	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of finite and extension fields, geometric constructions etc.
CO2	To understand the concept of Isomorphism Extension Theorem, Splitting and Separable Extensions.
CO3	To understand Galois theory and the Insolvability of the Quintic

Faculty in charge:
Ms. Smitha Davis

MTH2C09: ODE AND CALCULUS OF VARIATIONS
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of ordinary differential equations and its applications.

MODULE I

Power Series Solutions and Special functions; Some Special Functions of Mathematical Physics.

MODULE II

Some special functions of Mathematical Physics (continued), Systems of First Order Equations; Non linear Equations

MODULE III

Oscillation Theory of Boundary Value Problems, The Existence and Uniqueness of Solutions, The Calculus of Variations.

TEXT:

SIMMONS, G.F., DIFFERENTIAL EQUATIONS WITH APPLICATIONS AND HISTORICAL NOTES (3rd Edn.), New Delhi, 1974.

REFERENCES :

[1] G. Birkhoff and G.C. Rota: Ordinary Differential Equations(3rd Edn.); Edn. Wiley & Sons; 1978

[2] W.E. Boyce and R.C. Diprima: Elementary Differential Equations and boundary value problems (2nd Edn.); John Wiley & Sons, NY; 1969

[3] A. Chakrabarti: Elements of ordinary Differential Equations and special functions; Wiley Eastern Ltd., New Delhi; 1990

[4] E.A. Coddington: An Introduction to Ordinary Differential Eqution; Printice Hall of India, New Delhi; 1974

[5] R.Courant and D. Hilbert: Methods of Mathematical Physics- vol I; Wiley Eastern Reprint; 1975

[6] P. Hartman: Ordinary Differential Equations; John Wiley & Sons; 1964 [7] L.S. Pontriyagin : A course in ordinary Differential Equations Hindustan Pub. Corporation, Delhi; 1967

[8] I. Sneddon: Elements of Partial Differential Equations; McGraw-Hill International, Edn.;1957

OBJECTIVES

a) **To study how to compute power series solution of first order ODE.**

b) **To get familiarize with some special functions of Mathematical Physics.**

c) **To study the methods to solve systems of first order equations.**

d) **To study more about qualitative properties of solutions.**

e) **To understand the concept of calculus of variations.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Power series solutions of first order ODEs, special functions in Mathematical Physics	• Lecture • Discussion • Participative learning • Problem solving	• Problem solving sessions in groups. • Discussing the solutions obtained	To understand: • the basics of solutions of ODE • significance of special functions	Evaluation Through test papers
Module I1 (30 hours)	Solve systems of first order and nonlinear equations	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain nonlinear equations	To understand: • the method to solve systems of first order equations • theory of solutions of nonlinear equations	Evaluation through test paper
Module III (25 Hours)	Existence and uniqueness of solutions, calculus of variations	• Lecture • Discussion • Participative learning • Problem solving	• Assignment on existence and uniqueness of solutions • Discussion in peer groups on Calculus of Variations	To understand: • the applications in Calculus of variations • the qualitative nature of solutions	Evaluation through test paper

Course Outcomes

CO1	To understand the power series solutions of ordinary differential equations and the significance of special functions.
CO2	To know more about special functions, systems of first order equations and nonlinear equations
CO3	To understand the qualitative nature of solutions and calculus of variation.

Faculty in charge:
Dr. Vijitha Mukundan

MTH2C10 – OPERATIONS RESEARCH

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn various methods to solve an LPP and study about game theory and networking.

MODULE I

Convex Functions; Linear Programming

MODULE II

Linear Programming (contd.); Transportation Problem

MODULE III

Integer Programming; Sensitivity Analysis; Flow and Potential in Networks; Theory of Games

TEXTBOOK

K.V. MITAL; C. MOHAN., OPTIMIZATION METHODS IN OPERATIONS RESEARCH AND SYSTEMS ANALYSIS(3rd. Edn.), New Age International(P) Ltd., 1996.

REFERENCES

[1] R.L. Ackoff and M.W. Sasioni: Fundamentals of Operations Research; Wiley Eastern Ltd. New Delhi; 1991

[2] C.S. Beightler, D.T. Philiphs and D.J. Wilde: Foundations of optimization(2nd Edn.); Prentice Hall of India, Delhi; 1979

[3] G. Hadley: Linear Programming; Addison-Wesley Pub Co Reading, Mass; 1975

[4] G. Hadley: Non-linear and Dynamic Programming; Wiley Eastern Pub Co. Reading, Mass; 1964

OBJECTIVES

- To learn about convex function and few theorems related to it.
- To study LPP and simplex method to solve it.

- ❖ Understand and solve transportation problems.
- ❖ To study about the sensitivity analysis.
- ❖ To learn flow and networks.
- ❖ To understand the problems related to game theory.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Convex functions. Definition of LPP.	• Discussion • Participative learning • Problem solving • Lecture	Assignments on LPP	To study about convex functions and definition of LPP	Evaluation through test paper.
MODULE II	Simplex method to solve LPP. Transportation problem. VAM and MODI method to solve transportation problem.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on simplex method and solving of transportation method	To learn to solve LPP using simplex method. To solve Transportation problem.	Evaluation through test paper.
MODULE III	Integer programming and sensitivity analysis. Networking. Introduction to Game theory.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students on sensitivity analysis. Methods to solve flow and network. Game theory problem solving.	Discussion on sensitivity analysis. To solve networks and problems on game theory.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about convex functions
CO2	To learn about methods to solve LPP and transportation problems
CO3	To know about sensitivity in LPP and methods to solve networks. To understand game theory.

Faculty in charge:

Ms. Geethika P R

MTH2C07: REAL ANALYSIS II
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the advanced concepts of real analysis.

MODULE I

The Real Numbers: Sets, Sequences and Functions, Sigma Algebra, Borel sets, Lebesgue Measure, Lebesgue Measurable Functions

MODULE II

Lebesgue Integration, Lebesgue Integration: Further topics

MODULE III

Differentiation and Integration, The L^p spaces : Completeness and Approximation

TEXT:

H. L.Royden ,P. M. FitzpatrickH.L. REAL ANAYLSIS (4th Edn.), Prentice Hall of India, 2000.

REFERENCES :

[1] K B. Athreya and S N Lahiri:,Measure theory,Hindustan Book Agency,New Delhi,(2006).

[2] R G Bartle:, The Elements of Integration and Lebsgue Mesure , Wiley(1995).

[3] S K Berberian: ,measure theory and Integration,The Mc Millan Company,New York,(1965).

[4] L M Graves: ,The Theory of Functions of Real Variable Tata McGraw-Hill Book Co(1978)

[5] P R Halmos: , Measure Theory, GTM ,Springer Verlag [6] W Rudin:, Real and Complex Analysis,Tata McGraw Hill,New Delhi,2006

[7] I K Rana:,An Introduction to Measure and Integration,Narosa Publishing Company,New York.

[8] Terence Tao: ,An Introduction to Measure Theory,Graduate Studies in Mathematics,Vol 126 AMS

OBJECTIVES

a) **To understand the basic concepts of Sigma Algebra, Borel sets.**

b) **To understand Lebesgue Measure and Lebesgue Measurable Functions and its properties**

c) **To understand the concept of Lebesgue Integration,**

d) **To perform differentiation and Integration**

e) **To study about the L^p spaces : Completeness and Approximation**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Sets, Sequences and Functions, Sigma Algebra, Borel sets, Lebesgue Measure, Lebesgue Measurable Functions	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Lebesgue measure and Lebesgue measurable functions	To understand: • the basics of sigma algebra • notion of Lebesgue measure and measurable functions	Evaluation through interaction with students and test papers
Module I1 (30 hours)	Lebesgue Integration	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars on some topics of Lebesgue integration	To understand: • Concepts of Lebesgue integration	Evaluation through test paper
Module II1 (30 hours)	Differentiation and Integration, The L^p spaces : Completeness and	• Lecture • Discussion • Participative learning	• Assignments on Differentiatio	To understand: • Concepts of L^pspaces	Evaluation through test paper

	Approximation	• Problem solving	n and Integration		

Course Outcomes

CO1	To introduce the concept of Sigma Algebra, Borel sets, Lebesgue Measure, Lebesgue Measurable Functions
CO2	To understand the concept of Lebesgue integration, the L^p spaces : Completeness and Approximation
CO3	To understand the concept of differentiation and integration.

Faculty in charge:
Dr. Nidhin T J

MTH2C08: TOPOLOGY
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the motivation and concepts of topology.

MODULE I

A Quick Revision of Chapter 1,2 and 3. Topological space, basic concepts [Chapter 4 and Chapter5 Section 1, Section 2(excluding 2.11 and 2.12) and Section 3 only]

MODULE II

Making Functions Continuous, quotient spaces, spaces with special properties [Chapter 5 Section 4 and Chapter 6]

MODULE III

Separation axioms: Hierarchy of separation axioms, Compactness and separation axioms, The Urysohn characterization of normality, Tietze characterization of normality.[Chapter 7 Section 1 to 3 and Section 4 up to and including 4.6]

TEXT:

JOSHI K D, INTRODUCTION TO GENERAL TOPOLOGY (Revised Edn.), New Age International (P) Ltd., New Delhi, 1983

Inc., 2003.

REFERENCES :

[1] M A Armstrong: Basic Topology, Springer- Verlag New York; 1983.

[2] J Dugundji: Topology; Prentice hall of India; 1975.

[3] M Gemignani: Elementary Topology; Addison Wesley Pub Co Reading Mass, 1971

[4] M G Murdeshwar: General Topology(2nd Edn);Wiley Eastern Ltd, 1990

[5] G F Simmons: Introduction to Topology and modern analysis; McGraw-Hill international student Edn;1963.

OBJECTIVES

a) **To understand the basic concepts of Topological Spaces.**

b) **To get familiarize with making functions continuous, Quotient Spaces.**

c) **To understand the separation axioms, Hierarchy of separation axioms, compactness and separation axioms.**

d) **To study the Urysohn characterization of normality, Tietze characterization of normality.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Topological Spaces, Basic concepts	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic topology and topological space	To understand: • the basics of topology • topological spaces • different types of topologies	Evaluation Through MCQ
Module I1 (30 hours)	Making functions continuous, quotient spaces, spaces with special properties	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about making functions continuous	To understand: • Compact Lindeloff spaces • Connectedness Local Connectedness	Evaluation Through test paper

				Path Connectedness	
Module III (30 Hours)	Separation axioms: Hierarchy of separation axioms, compactness and separation axioms, The Urysohn characterization of normality, Tietze characterization of normality	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on separation axioms	To understand: • Separation axioms • Urysohn characterization of normality	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of basic topology, topological space, different types of topologies.
CO2	To understand the concept of making functions continuous, quotient spaces
CO3	To understand the separation axioms, the Urysohn characterization of normality, Tietz characterization of normality

Faculty in charge:
Ms. Linet Roslin Antony

MT 3C 12: COMPLEX ANALYSIS
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the ideas and concepts of analytic functions and singularities..

MODULE I

Conformality, Linear Transformations, Fundamental Theorems, Cauchy's Integral Formula.

MODULE II

Local Properties of Analytical Functions, The General Form of Cauchy's Theorem, The Calculus of Residues, Harmonic Functions.

MODULE III

Power Series Expansions, Simply Periodic Functions, Doubly Periodic Functions, The Weierstrass Theory.

TEXT: LARS V. AHLFORS : Complex Analysis, 3rd edn. Mc Graw Hill (1979)

REFERENCES :

1. Cartan, H. : Elementary Theory of Analytic Functions of one or Several . Variables, Addison - Wesley Pub. Co. (1973)
2. Conway, J.B. : Functions of One Complex Variable, Narosa Pub. Co., New Delhi. . (1973)
3. Moore T.O. &Hadlock E.H. : Complex Analysis, Series in Pure Mathematics - Vol. 9. World Scientific . (1991)
4. Pennisi, L. : Elements of Complex Variables, Holf, Rinehart & Winston, 2nd Edn. . (1976)
5. Rudin, W. : Real and Complex Analysis, 3rd Edn. McGraw - Hill International . Edn. (1987)
6. Silverman, H. : Compex Variables, Houghton Mifflin Co. Boston (1975)
7. Remmert, R. : Theory of Complex Functions, UTM, Springer- Verlag, NY, (1991)

OBJECTIVES

a) **To understand the basic concepts of** Power series, Analytic functions, Analytic functions as mappings and Mobius transformations.

b) **To get familiarize with** Conformal mappings, Weistrass theory

c) **To understand the** Power series representation of analytic functions, Zeros of an analytic function, The index of a closed curve, Cauchy's Theorem and Integral Formula and the classification of singularities.

LESSON PLAN

Unit/ session / hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	Conformal mappings, Cauchy Integral formula	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Power series and Analytic functions	To understand: • Conformal mappings • Fundamental theorems	Evaluation through MCQ
Module I1 (30 hours)	Analytic functions, Harmonic funcions	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about Power series representation of analytic functions	To understand: • Residue theorem • Calculus of residue.	Evaluation through test paper
Module III (30	Entire functions Wiestrass Theory	• Lecture • Discussion • Participative learning	• Seminar and assignment on	To understand: • Simply periodic doubly	Evaluation through test paper

hours)		• Problem solving	classification of singularities	periodic functions	

Course Outcomes

CO1	To introduce the concept of Power series and Analytic functions
CO2	To understand the concept of Cauchy's Theorem and Integral Formula, Open Mapping Theorem and Goursat's Theorem.
CO3	To understand the Argument Principle, the Maximum Principle and Schwarz's Lemma.

Faculty in charge:
Ms. Linet Roslin Antony

MT3C14 – ADVANCED FUNCTIONAL ANALYSIS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn about metric spaces, normed spaces, Banach spaces and Inner product spaces.

MODULE I

Metric spaces and Continuous Functions, Lp spaces , Fourier series and Integrals, Normed spaces Continuity of linear maps

MODULE II

Hahn-Banach Theorems, Banach spaces, Uniform Boundedness Principle

MODULE III

Closed Graph and Open Mapping Theorems, Bounded Inverse Theorem, Inner product spaces, Orthonormal sets

TEXTBOOK

LIMAYE , B.V, FUNCTIONAL ANALYSIS, (2nd Edn.) New Age International Ltd, Publishers, New Delhi, Bangalore (1996)

REFERENCES

[1]R. Bhatia, Notes on Functional Analysis TRIM series, Hindustan Book Agency

[2]KesavanS, Functional Analysis TRIM series, Hindustan Book Agency

[3] S David Promislow, A First Course in Functional Analysis Wiley Interscience, John wiley & Sons, INC., (2008)

[4]E.Kreyszig, Introductory Functional Analysis with Applications John Wiley & Sons (1978)

OBJECTIVES

- To define Metric spaces along with examples.
- To study normed spaces and its continuity.
- To learn Hahn Banach theorems.
- To understand Banach spaces.
- To study about Inner product spaces and orthonormality.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Metric spaces.L_p spaces. Normed spaces. Continuity of linear maps	• Discussion • Participative learning • Problem solving • Lecture	Assignments on examples of metric spaces and normed spaces.	To study about metric spaces and its properties. To learn normed spaces.	Evaluation through test paper.
MODULE II	Hahn Banach Theorems. Banach spaces.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on corollaries of Hahn Banach theorems.	To learn Hahn Banach theorem and study about Banach spaces	Evaluation through test paper.
MODULE III	Closed graph theorem. Open mapping theorem. Inner products. Orthonormality.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students	To study important theorems. To learn about Inner products and orthonormal space.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about metric space and normed space along with its continuity
CO2	To study Hahn Banach theorem and Uniform Boundedness principle
CO3	To learn about inner products and orthonormal spaces.

Faculty in charge:
Ms.Geethila P R

MTH3C11 – MULTIVARIABLE CALCULUS AND GEOMETRY

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To understand concepts in Differential Geometry

MODULE I

Functions of Several Variables Linear Transformations, Differentiation, The Contraction Principle, The Inverse Function Theorem, the Implicit Function Theorem.

MODULE II

What is a curve? Arc-length, Reparametrization, Closed curves, Level curves versus parametrized curves. Curvature, Plane curves, Space curves What is a surface, Smooth surfaces, Smooth maps, Tangents and derivatives, Normals and orientability.

MODULE III

Level surfaces, Ruled surfaces and surfaces of revolution, Applications of the inverse function theorem, Lengths of curves on surfaces, Equiareal maps and a theorem of Archimedes, The second fundamental form, The Gauss and Weingarten maps, Normal and geodesic curvatures. Gaussian and mean curvatures, Principal curvatures of a surface.

TEXTBOOKS

TEXT 1 : RUDIN W., PRINCIPLES OF MATHEMATICAL ANALYSIS, (3rd Edn.), Mc. Graw Hill, 1986.

TEXT 2: ANDREW PRESSLEY, ELEMENTARY DIFFERENTIAL GEOMETRY(2nd Edn.), Springer-Verlag, 2010.

REFERENCES

[1] M. P. do Carmo: Differential Geometry of Curves and Surfaces;

[2] W. Klingenberg: A course in Differential Geometry;

[3] J. R. Munkres: Analysis on Manifolds; Westview Press; 1997

[4] C. C. Pugh: Real Mathematical Analysis, Springer; 2010

[5] M. Spivak: A Comprehensive Introduction to Differential Geometry-Vol. I; Publish

or Perish, Boston; 1970

[6] M. Spivak: Calculus on Manifolds; Westview Press; 1971

[7] V.A. Zorich: Mathematical Analysis-I; Springer; 2008

OBJECTIVES

- To understand functions of several variables and its differentiation
- To study curves, level curves and curvature.
- To learn about surfaces and its properties as normal, orientablity and tangents.
- To understand the definition Guass Weingarten maps
- To study about Guassian, mean curvatures

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	The Contraction Principle, The Inverse Function Theorem, the Implicit Function Theorem.	• Discussion • Participative learning • Problem solving	Seminars by students	To study about Functions of Several Variables Linear Transformations and its properties	Evaluation through test paper.
MODULE II	Arc-length, Reparametrization, Level curves versus parametrized curves. Curvature, Tangents and derivatives, Normals and orientability.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on Tangents and derivatives. Discussion about various definitions.	To learn basics about Curves, Level curves, curvature, Smooth maps,Tangents, Normals.	Evaluation through MCQ

MODULE III	Level surfaces, Applications of the inverse function theorem, Normal and geodesic curvatures. Gaussian and mean curvatures, Principal curvatures of a surface.	• Lecture • Discussion • Participative learning • Problem solving	Discussion on Surfaces and its properties.	To know the about Level, ruled surfaces, Guassian, mean, principal curvatures. The Gauss and Weingarten maps,	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about functions of several variables
CO2	To learn about the analytical and geometric concepts of curves and its variations To study about cuvature and sufaces
CO3	To know The Gauss and Weingarten maps, To learn Guassian and mean curvature.

Faculty in Charge

Ms. Nidhin T J

MT3C15: PDE and Integral Equations
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic theory of PDE and Integral Equations.

MODULE I

First Order PDE .

MODULE II

Second Order PDE .

MODULE III

Integral Equations

TEXTS : 1. AMARNATH, M., : PARTIAL DIFFERENTIAL EQUATIONS, Narosa , New Delhi (1997)

2. HILDEBRAND, F.B.: METHODS OF APPLIED MATHEMATICS, (2 nd Edn.) Prentice-Hall of India, New Delhi, 1972

REFERENCES :

1. G. Birkhoff & G.C. Rota : Ordinary Differential Equations, Edn. Wiley & Sons 3rd Edn (1978)
2. E.A. Coddington : An Introduction to Ordinary Differential Equations, Printice Hall of India, New Delhi (1974)
3. P. Hartman : Ordinary Differential Equations, John Wiley & Sons (1964)
4. L.S. Pontriyagin : A Course in Ordinary Differential Equations, Hindustan Pub. Corporation, Delhi (1967)
5. F. John : Partial Differential Equations, Narosa Pub. House New Delhi (1986)
6. Phoolan Prasad & : Partial Differential Equations, Renuka Ravindran Wiley Eastern Ltd New Delhi (1985)
7. R. Courant and D.Hilbert : Methods of Mathematical Physics , Vol I, Wiley Eastern Reprint (1975) 8. W.E. Boyce & R.C. Deprima : Elementary Differential Equations, and Boundary Value Problems

John Wiley & Sons, NY, 9th Edition

OBJECTIVES

a) **To study the basic methods of solving partial differential equations.**

b) **To study different methods for solving second order linear and nonlinear pde.**

c) **To study the classification of PDE and to obtain the canonical forms.**

d) **To understand the relation between integral equations and differential equations and to study different methods to solve integral equations.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (35 hours)	Linear equations of first order,Quasilinear equations, method of characteristics, the Lagrange method, Charpit method, Jacobi method, Cauchy problem	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on different methods of solving first order pde	To understand: • Different types of PDE • methods to solve pde • solving non linear problem	Evaluation through test paper and interaction with students

Module I1 (30 hours)	Classification of second order pde, solving wave, heat and Laplace equations, Separation of variables, canonical form, Cauchy problem for second order pde	• Lecture • Discussion • Participative learning • Problem solving	Student seminars to understand the method of solving wave, heat and Laplace equations	To understand: • Methods to solve second order PDE • Solutions of heat, wave and Laplace equations	Evaluation through test paper
Module III (25 Hours)	Integral equations, Fredholm and Volterra equations, Resolvent kernel,Neumann series, Fredholm Schmidt theory	• Lecture • Discussion • Participative learning • Problem solving	• Assignment and problem solving sessions on Integral equations	To understand: • Relation between integral equation and differential equation • Methods tosolve integral equations of different kinds	Evaluation through test paper

Course Outcomes

CO1	To study different types of PDE and methods for solving them.
CO2	To study methods of solving second order PDE, heat, wave and Laplace equation, Cauchy problem
CO3	To understand the relation between differential equation and integral equations, also different methods to solve integral equations.

Faculty in charge:
Ms. Vijitha Mukundan

MTH4E06: Algebraic Number Theory
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the concepts of Algebraic Number Theory.

MODULE I

Symmetric polynomials, Modules, Free abelian groups, Algebraic Numbers, Conjugates and Discriminants, Algebraic Integers, Integral Bases, Norms and Traces, Rings of Integers, Quadratic Fields, Cyclotomic Fields

MODULE II

Historical background, Trivial Factorizations, Factorization into Irreducibles, Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals Historical background, Prime Factorization of Ideals, The norm of an ideal

MODULE III

Lattices, The Quotient Torus, Minkowski theorem, The Space Lst, The Class-Group An Existence Theorem, Finiteness of the Class-Group, Factorization of a Rational Prime, Fermats Last Theorem Some history, Elementary Considerations, Kummers Lemma, Kummers Theorem.

TEXT : I. N. STEWART & D.O. TALL, ALGEBRAIC NUMBER THEORY, (2nd Edn.), Chapman & Hall, (1987)

REFERENCES :

[1] P. Samuel : Theory of Algebraic Numbers, Herman Paris Houghton Mifflin, NY, (1975)
[2] S. Lang : Algebraic Number Theory, Addison Wesley Pub Co., Reading, Mass, (1970)
[3] bf D. Marcus : Number Fields, Universitext, Springer Verlag, NY, (1976)
[4] 4T.I.FR. Pamphlet No: 4 : Algebraic Number Theory (Bombay, 1966)
[5] Harvey Cohn : Advanced Number Theory, Dover Publications Inc., NY, (1980)
[6] Andre Weil : Basic Number Theory, (3rd Edn.), Springer Verlag, NY, (1974)
[7] G.H. Hardy and E.M. Wright : An Introduction to the Theory of Numbers, Oxford University Press.
[8] Z.I. Borevich & I.R.Shafarevich : Number Theory, Academic Press, NY 1966.
[9] Esmonde & Ram Murthy : Problems in Algebraic Number Theory, Springer Verlag 2000

OBJECTIVES

a) **To study the basic concepts of numberfield, quadratic field, Guassian field and their properties.**

b) **To study how factorization into irreducibles hold in different fields.**

c) **To understand the concepts of lattices, the quotient torus and geometric representation of algebraic numbers.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Factorization into Irreducibles, Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals, Prime Factorization of Ideals,	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on numberfields and its properties	To understand: • the factorization into irreducibles • different types of numberfields • the factorization of ideals • properties of ideals	Evaluation through test paper and interaction with students

Module I1 (30 hours)	Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals Historical background, Prime Factorization of Ideals, The norm of an ideal	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to understand prime factorization and quadratic fields	To understand: • Nonunique Factorization into Irreducibles • Factorization of Ideals and norm of an ideal	Evaluation Through test paper
Module III (25 Hours)	Lattices, The Quotient Torus, Minkowski theorem, The Space Lst, The Class-Group An Existence Theorem, Finiteness of the Class-Group, Factorization of a Rational Prime, Kummers Lemma, Kummers Theorem	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion and assignments to understand geometric representation of algebraic numbers	To understand: • The Quotient Torus • The classgroup	Evaluation through test paper

Course Outcomes

CO1	Awareness about different types of numberfield and their properties
CO2	Able to check unique factorization in fields and also can provide examples of nonunique factorizations
CO3	To understand the geometric representation of algebraic numbers

Faculty in charge:
Dr. Vijitha Mukundan

MT4E11 – ADVANCED FUNCTIONAL ANALYSIS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn about duality, compactness and boundedness of spaces.

MODULE I

Duals and Transposes, Duals of Lp [a,b] and C[a,b], weak and weak* convergence, Reflexivity

MODULE II

Definition of Compact Linear Map, spectrum of a compact operator, Riesz Representation Theorems

MODULE III

Bounded Operators and Adjoints , Normal, Unitary and Self Adjoint Operators , Spectrum and Numerical Range , Compact self Adjoint Operator

TEXTBOOK

LIMAYE , B.V, FUNCTIONAL ANALYSIS, (2nd Edn.) New Age International Ltd, Publishers, New Delhi, Bangalore (1996)

REFERENCES

[1]R. Bhatia, Notes on Functional Analysis TRIM series, Hindustan Book Agency

[2]KesavanS, Functional Analysis TRIM series, Hindustan Book Agency

[3] S David Promislow, A First Course in Functional Analysis Wiley Interscience, John wiley & Sons, INC., (2008)

[4]E.Kreyszig, Introductory Functional Analysis with Applications John Wiley & Sons (1978)

OBJECTIVES

- To understand the concept of duality and reflexivity.
- To study spectrum of compact operators.
- To understand the concept of Bounded linear operators and its types.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Dual spaces. Weak convergence Reflexivity	• Discussion • Participative learning • Problem solving • Lecture	Assignments on examples of dual spaces	To study about duality and weak convergence. To learn reflexivity.	Evaluation through test paper.
MODULE II	Compact operators and its spectrum. Riesz Representation theorems.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on compact operators and examples	To learn about spectrum of compact operators	Evaluation through test paper.
MODULE III	Bounded operators. Adjoint, normal, unitary and self adjoint operators. Compact self adjoint operator.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students	To study Self adjoint operators and compactness.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about duality and the concept of reflexivity
CO2	To learn about compact operators
CO3	To learn about Bounded linear operators and self adjoint operators

Faculty in charge:

Ms Geethika P R

MTH4C11: GRAPH THEORY
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the basic concepts of Graph theory.

Module 1

Basic concepts of Graph. Trees, Cut edges and Bonds, Cut vertices, Cayleys Formula, The Connector Problem, Connectivity, Blocks, Construction of Reliable Communication Networks, Euler Tours, Hamilton Cycles, The Chineese Postman Problem, The Travelling Salesman Problem.

Module 2

Matchings, Matchings and Coverings in Bipartite Graphs, Perfect Matchings, The Personnel Assignment Problem, Edge Chromatic Number, Vizings Theorem, The Timetabling Problem, Independent Sets, Ramseys Theorem

Module 3

Vertex Colouring-Chromatic Number, Brooks Theorem, Chromatic Polynomial, Girth and Chromatic Number, A Storage Problem, Plane and Planar Graphs, Dual Graphs, Eulers Formula, Bridges, Kuratowskis Theorem, The Five-Colour Theorem, Directed Graphs, Directed Paths, Directed Cycles.

TEXT : J.A. Bondy and U.S.R.Murty : Graph Theory with applications. Macmillan

References

[1] F. Harary : Graph Theory, Narosa publishers, Reprint 2013.
[2] Geir Agnarsson, Raymond Greenlaw: Graph Theory Modelling, Applications and Algorithms, Pearson Printice Hall, 2007.
[3] John Clark and Derek Allan Holton : A First look at Graph Theory, World Scientific (Singapore) in 1991 and Allied Publishers (India) in 1995
[4] R. Balakrishnan & K. Ranganathan : A Text Book of Graph Theory, Springer Verlag, 2nd edition 2012.

OBJECTIVES

a) **To understand the basic concepts of graphs, Trees, Cut edges and Bonds, Cut vertices, Euler Tours, Hamilton Cycles**

b) **To get familiarize with Matchings and Coverings in Bipartite Graphs, Perfect**

Matching, Independent Sets, Ramseys Theorem

c) **To understand the concept of Vertex Colouring-Chromatic Number, Edge Chromatic Number , The Five-Colour Theorem, Directed Graphs.**

d) **To study more about Chromatic Polynomial, Girth and Chromatic Number**

e) **To understand The Five-Colour Theorem, Directed Graphs, Directed Paths, Directed Cycles.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Basic concepts of graph, Trees, Cut edges and Bonds, Cut vertices, Connectivity, Blocks, Euler Tours, Hamilton Cycles	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic concepts of graph	To understand: • the basics of graph, trees • Concepts of cut edges, cut vertices, Euler tour and Hamilton cycles	Evaluation Through MCQ
Module I1 (30 hours)	Matchings and Coverings, Perfect Matchings, Edge Chromatic Number, Vizings Theorem, Independent Sets, Edge colouring,Ramseys Theorem	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the Personnel Assignment Problem and The Timetabling Problem	To understand: • differentiation of matchings and covering • Concepts of edge colouring and Ramseys theorem	Evaluation Through test paper
Module III (30 Hours)	Vertex Colouring-Chromatic Number, Brooks Theorem, , Plane and Planar Graphs, Dual Graphs, Eulers Formula, Bridges,	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on Storage Problem	To understand: • Vertex colouring and it's important results • Planar	Evaluation through test paper

	Kuratowskis Theorem, The Five-Colour Theorem, Directed Graphs,			graphs, dual graphs and it's important result	

Course Outcomes

CO1	To introduce the concept of basic graph theory, trees, cut vertices and cut edges, Euler tour and Hamilton cycles
CO2	To understand the concept of matchings and covering, Edge colouring.
CO3	To understand the concepts of vertex colouring and it's important results. Planar graphs and dual graphs.

Faculty in charge:
Ms. Linet Roslin Antony

MTH4E09: DIFFERENTIAL GEOMETRY
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the basic concepts of differential geometry.

MODULE I

Graphs and Level Set, Vector fields, The Tangent Space, Surfaces, Vector Fields on Surfaces, Orientation. The Gauss Map .

MODULE II

Geodesics, Parallel Transport, The Weingarten Map, Curvature of Plane Curves, Arc Length and Line Integrals.

MODULE III

Curvature of Surfaces, Parametrized Surfaces, Local Equivalence of Surfaces and Parametrized Surfaces.

TEXT:

J.A.THORPE : ELEMENTARY TOPICS IN DIFFERENTIAL GEOMETRY

REFERENCES :

1) M. de Carmo : Differential Geometry of Curves and Surfaces, Prentice Hall Inc Englewood Cliffs NJ (1976).
2) V. Grilleman and A. Pollack : Differential Topology, Prentice Hall Inc Englewood Cliffs NJ (1974)
3) B. O'Neil : Elementary Differential Geometry, Academic Press NY (1966)
4) M. Spivak : A Comprehensive Introduction to Differential, Geometry, (Volumes 1 to 5), Publish or Perish, Boston (1970, 75)
5) R. Millmen and G. Parker : Elements of Differential Geometry, Prentice Hall Inc Englewood Cliffs NJ (1977)
6) I. Singer and J.A. Thorpe : Lecture Notes on Elementary Topology and Geometry, UTM, Springer Verlag, NY (1967)

7) W.L.Burke: Applied Differential Geometry , Cambridge University Press (1985).

OBJECTIVES

a) **To understand the basic concepts of level sets, surfaces and its curvature, geodesics,and parametrized surfaces .**

b) **To get familiarize with covariant derivatives and its properties.**

c) **To understand the concept of local and global parametrization.**

d) **To study more about parametrized surfaces and local equivalence of surface and parametrized surfaces.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I (30 hours)	Level sets,vector fields, the tangent space, surfaces and the gauss map.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on vector fields and level sets.	To understand: • the basics of surfaces • notion of tangent space and the gauss map	Evaluation Through MCQ
Module II (30 hours)	Geodesics, Parallel transport, The Weingarten map, Arc length and line integrals.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of derivatives of smooth vector field and covariant	To understand: • Local and global parametrization . • Concept of parallel transport.	Evaluation Through test paper

			derivative.		
Module III (30 Hours)	Curvature of surfaces, First and second fundamental forms,Parametrized surfaces and its local equivalence with surfaces.	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on local equivalence of surfaces and parametrized surfaces.	To understand: • Principal, Gaussian, Gauss Kronecker and Mean curvature • Inverse function theorems.	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of graphs and level sets, basics of surfaces and notion of tangent space anf gauss map.
CO2	To understand the concept of parallel transport, local and global parametrization, arc length and line integral.
CO3	To understand the principal ,Gaussian ,Gauss Kronecker and Mean curvature, and parametrized surfaces.

Faculty in charge:
Dr. Nidhin T J

STA 1C 01 INTRODUCTORY STATISTICS

Lecture Hours per week: 4, Credits: 3

Internal: 15, External: 60, Examination 2 Hours

Objectives

To introduce basic concepts of statistics

Module I (7 hrs)

Official statistics: The Statistical system in India: The Central and State Government organizations, functions of the Central Statistical Office (CSO), National Sample Survey Organization (NSSO) and the Department of Economics and Statistics.

Module II (30 hrs)

Introduction to Statistics: Nature of Statistics, Uses of Statistics, Statistics in relation to other disciplines, Abuses of Statistics,Concept of primary and secondary data. Designing a questionnaire and a schedule. Concepts of statistical population and sample from a population, quantitative and qualitative data, Nominal, ordinal and time series data, discrete and continuous data. Presentation of data by table and by diagrams, frequency distributions by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods) and ogives. Measures of central tendency (mean, median, mode, geometric mean and harmonic mean) with simple applications. Absolute and relative measures of dispersion (range, quartile deviation, mean deviation and standard deviation) with simple applications. Co-efficient of variation, Box Plot. Importance of moments, central and non-central moments, and their interrelationships. Measures of skewness based on quartiles and moments; kurtosis based on moments.

Module III (15 hrs)

Correlation and Regression: Scatter Plot, Simple correlation, Simple regression, two regression lines, regression coefficients. Fitting of straight line, parabola, exponential, polynomial (least square method).

Module IV (20 hrs)

Time series: Introduction and examples of time series from various fields, Components of times series,

Additive and Multiplicative models. Trend: Estimation of trend by free hand curve method, method of semi averages, method of moving averages and fitting various mathematical curves. Seasonal Component: Estimation of seasonal component by Method of simple averages, Ratio to Trend. Index numbers: Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher's.

Reference Books:

1) S.C. Gupta and V.K. Kapoor. Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi
2) Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
3) Mukhopadhyay P. (2011): Applied Statistics, 2nded. Revised reprint, Books and Allied
4) Hoel P.G. Introduction to mathematical statistics, Asia Publishing house.
5) Chatfield.C. The Analysis of Time Series: An Introduction, Chapman & Hall
6) Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi.
7) www.mospi.gov.in
8) www.ecostat.kerala.gov.in

OBJECTIVES

1) To learn basic concepts of statistical system in India
2) To understand nature and uses of statistics
3) To understand correlation and regression
4) To expose statistics students to the areas of time series and index numbers

LESSON PLAN

Unit/ session / hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment

Module I 7 Hours	The Statistical system in India: The Central and State Government organizations, functions of the Central Statistical Office (CSO), National Sample Survey Organization (NSSO) and the Department of Economics and Statistics.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars related to the central and government organizations	• To understand central and government organizations in India • To understand the functions of CSO and NSSO	Evaluation through test paper and viva
Module II 30 Hours	Nature of Statistics, Uses of Statistics, Statistics in relation to other disciplines, Abuses of Statistics,Concept of primary and secondary data, Concepts of statistical population and sample from a	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding measures of central tendency	• To understand the nature, uses and abuses of statistics • To understand measures of central tendency and measures of	Evaluation through test paper

	population, Nominal, ordinal and time series data, discrete and continuous data, cumulative frequency distributions and ogives. Measures of central tendency with simple applications, Absolute and relative measures of dispersion with simple applications,Co-efficient of variation, Importance of moments, central and non-central moments, and their interrelationships, Measures of skewness based			dispersion and their applications	

	on quartiles and moments; kurtosis based on moments				
Module III **15 Hours**	Scatter Plot, Simple correlation, Simple regression, two regression lines, regression coefficients. Fitting of straight line, parabola, exponential, polynomial	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to find correlation and regression coefficients	• To understand correlation and regression	Evaluation through test paper
Module IV **20 Hours**	Introduction and examples of time series from various fields, Components of times series, Estimation of trend by free hand curve method, method of semi averages, method of moving	• Lecture • Discussions • Problem solving	• Student seminars related to components of time series	• To understand time series, seasonal indices and index numbers	Evaluation through test paper

	averages and fitting various mathematical curves, Estimation of seasonal component by Method of simple averages, Ratio to Trend,Definition , construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth-Mar shall and Fisher's.				

Course Outcomes

CO1	To understand central and government organizations in India and learn the functions of CSO and NSSO
CO2	To understand the nature, uses and abuses of statistics

CO3	To learn the concepts of correlation and regression
CO4	To understand time series, seasonal indices and index numbers

Teacher in Charge:

Ms.Jiji Pauly

STA 2C 02- PROBABILITY THEORY
Lecture Hours per week:4 , Credits: 3
Internal: 20, External: 80, Examination 3 Hours

Objectives

Give knowledge to conceptualise probabilities of an event including frequentist and axiomatic approach also the idea about mathematical expectation and conditional probability.

Module I (25 hrs)

Introduction to Probability: Random experiment, Sample space, events, classical definition of probability, statistical regularity, field, sigma field, axiomatic definition of probability and simple properties, addition theorem (two and three events), conditional probability of two events, multiplication theorem, independence of events-pair wise and mutual, Bayes theorem and its applications.

Module II (12 hrs)

Random variables: Discrete and continuous, probability mass function (pmf) and probability density function (pdf)-properties and examples, Cumulative distribution function and its properties, change of variables (univariate case only).

Module III (15 hrs)

Mathematical expectations (univaraite): Definition, raw and central moments(definition and relationships), moment generation function and properties, characteristic function (definition and use only), Skewness and kurtosis using moments.

Module IV (20 hrs)

Bivariate random variables: Joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.

Reference Books:

1. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.
2. . S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. . John E Freund, Mathematical Statistics, Pearson Edn, New Delhi
5. Hoel P.G. Introduction to mathematical statistics, Asia Publishing house.

OBJECTIVE

- Ability to distinguish between random and non random experiments.
- Understand the classical and axiomatic definition of probability, also the noation of conditional probability including the concept of Baye's theorem
- Give knowledge related to the concept of uni variate, Bivariate Discrete and continuous random variable including expectation moments and mgf

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **25 Hours**	Random experiment, Sample space, events, classical definition of probability, statistical regularity, field, sigma field, axiomatic definition of probability and simple properties, addition theorem, conditional probability of two events, multiplication theorem, independence of events-pair wise and mutual, Bayes theorem and its applications.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on axiomatic definition of probability and simple properties.	• Understand the basic definition and properties related to probability.	Evaluation through test paper and viva.
Module II	probability mass	• Lecture	• Seminar on	• Understand	Evaluation

12 Hours	function and probability density function properties and examples, Cumulative distribution function and its properties, change of variables.	• Discussion • Participative learning • Problem solving	the topic Cumulative distribution function and its properties	the concept of pmf, pdf and cdf in statistics.	through test paper and viva
Module III **15 Hours**	Mathematical expectations Definition, raw and central moment, mgf and properties, characteristic function, Skewness and kurtosis using moments.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to mathematical expectation, raw and cenral moments, mgf	• Understand the definition of moments and mgf • Enable to find Skewness and kurtosis using moments.	Evaluation through test paper.
Module IV **20 Hours**	Bivariate random variables: Joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.	• Lecture • Discussions • Problem solving	• Student seminars on the topic bivariate Expectations, conditional mean variance, and covariance.	• Give knowledge related to the concept of Bivariate random variable including expectation moments and mgf.	Evaluation through test paper.

Course Outcomes

CO1	Ability to distinguish between random and non-random experiment
CO2	Undestand the probabilities of an events including frequentist and axiomatic approach. Simultaneously learned the notion of conditional probability including the concept of Bayes' Theorem.
CO3	Understand the concept of univariate, Bivariate Discrete and continuous random variable including expectation moments and mgf.

Teacher in Charge:

Ms. Geethu Simon

ST3CO3: STATISTICAL INFERENCE
Lecture Hours per week: 5, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

Introduce different type of sampling distributions and the concept of testing hypotheses.

Module I (25 hrs)

Sampling distributions: Statistic, Sampling distribution of a statistic, Standard error, Sampling from normal distribution, distribution of sample mean, sample variance, chisquare distribution, t distribution, and F distribution (definition, derivations and relationships only).

Module II (20 hrs)

Theory of Estimation: Point Estimation, desirable properties of a good estimator, unbiasedness, consistency, sufficiency, Fisher Neyman factorization theorem, efficiency. Methods of Estimation: Method of maximum likelihood, method of moments

Module III (15 hrs)

Interval Estimation: Interval estimates of mean, difference of means, variance, proportions and difference of proportions. Derivation of exact confidence intervals for means, variance and ratio of variances based on normal, t, chi square and F distributions

Module IV (30 hrs)

Testing of Hypotheses: concept of testing hypotheses, simple and composite hypotheses, null and alternative hypotheses, type I and II errors, critical region, level of significance and power of a test. Neyman Pearson approach: Large sample tests concerning mean equality of means, proportions, equality of proportions, Small sample tests based on t distribution for mean, equality of means and paired t test. Tests based on Fdistribution for ratio of variances. Tests based on Chi square distribution for variance, goodness of fit and for independence of attributes.

Reference Books:

1. V. K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill
4. John E Freund, Mathematical Statistics (6th edn), Pearson Edn, NewDelhi

OBJECTIVES

- Introduce different type of sampling distributions.

- Introduce the concept of random sample from a distribution, sampling distribution of a statistic, standard error of important estimates such as mean and proportions
- knowledge about important inferential aspects such as point estimation, test of hypotheses and associated concepts
- Introduce Neyman Pearson approach in testing of hypotheses.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **25 Hours**	Statistic, Sampling distribution of a statistic, Standard error, Sampling from normal distribution, distribution of sample mean, sample variance, chisquare distribution, t distribution, and F distribution	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on chisquare distribution, t distribution, and F distribution.	• Understand different type of sampling distributions.	Evaluation through test paper
Module II **20 Hours**	Point Estimation, desirable properties of a good estimator, unbiasedness, consistency, sufficiency, Fisher Neyman factorization	• Lecture • Discussion • Participative learning • Problem solving	• Seminar on the topic Method of maximum likelihood and methodof moments.	• Understand point estimation methods.	Evaluation through test paper.

	theorem, Method of maximum likelihood, method of moments.				
Module III **15 Hours**	Interval estimates of mean, difference of means, variance, proportions and difference of proportions. Derivation of exact confidence intervals for means, variance and ratio of variances based on normal, t, chi square and F distributions	• Lecture • Discussion • Participative learning • Problem solving	• Seminar related to the topic difference of means, variance, and difference of proportions.	• Understand Interval estimation methods	Evaluation through Group Discussion.
Module IV **30 Hours**	concept of testing hypotheses, simple and composite hypotheses, null and alternative hypotheses,type I and II errors, critical region, level of significance and power of a test. Large sample tests, proportions, equality of proportions, Small sample tests based on t distribution for	• Lecture • Discussions • Problem solving	• Student seminars in connection with type I and II errors.	• Become familiar with the concept of testing hypotheses and different sample tests.	Evaluation through test paper

	mean, equality of means and paired t test. Tests based on Fdistribution for ratio of variances. Tests based on Chi square distribution for variance, goodness of fit and for independence of attributes.				

Course Outcomes

CO1	Understnd different sampling distribution and its properties.
CO2	Understand the tecniques of estimation and testing hypotheses for mean, variance, proportions, correlation coefficient, association and goodness of fit.
CO3	Knowledge of point and interval estimation proceduers and different method of point estimation.

Teacher in Charge:

Ms. Geethu Simon

ST4CO4 APPLIED STATISTICS

Lecture Hours per week: 5, Credits: 3

Internal: 20, External: 80, Examination 3 Hours

Objectives

To introduce sampling techniques and statistical quality control

Module I (20 hrs)

Census and Sampling, Principal steps in a sample survey, different types of sampling, Organisation and execution of large scale sample surveys, errors in sampling(sampling and non sampling errors), preparation of questionnaire, simple random sampling with and without replacement, Systematic, stratified and cluster sampling

Module II (15 hrs)

Analysis of variance; one way, two way classifications. Null hypothesis, total, between and within sum of squares. Assumptions - ANOVA table..

Module III (30 hrs)

Time series : Components of time series additive and multiplicative models , measurement of trend , moving averages, seasonal indicessimple averageratio to moving average., Index numbers: meaning and definition uses and types - problems in the construction of index numbers -different types of simple and weighted index numbers. Test for an ideal index number - time and factor reversal test.

Module IV (25 hrs)

Statistical Quality Control: Concept of statistical quality control, assignable causes and chance causes, process control, Construction of control charts, 3sigma limits, Control chart for variables -Mean chart and Range chart, Control chart for attributes - pchart, d or np chart and c chart

Reference Books:

1) S.C.Gupta and V. K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand and Sons

2) Grant E L, Statistical quality control, McGraw Hill

3) Duncan A J, Quality Control and Industrial Statistics, Taraporewala and sons

4) Montegomery D C, Introduction to Statistical Quality Control, John Wiley and sons

5) S.P.Gupta: statistical methods

OBJECTIVES

1) To equip students with sampling techniques used in conducting sample surveys.
2) To understand the concepts of ANOVA model
3) To expose the area of time series and index numbers.
4) To provide an insight into quality assessment techniques.

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **20 Hours**	Census and Sampling, Principal steps in a sample survey, different types of sampling, Organisation and execution of large scale sample surveys, sampling and non sampling errors, simple random sampling	• Lecture • Discussion • Participative learning • Problem solving	• Group discussion on sampling and sample survey	To understand sampling techniques used in conducting sample surveys	Evaluation through test paper

	with and without replacement, Systematic, stratified and cluster sampling				
Module II **15 Hours**	Analysis of variance; one way, two way classifications, Null hypothesis, Assumptions - ANOVA table..	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding variance between the samples	To understand the concepts of ANOVA model	Evaluation through test paper and viva
Module III **30 Hours**	Time series, Components of time series, measurement of trend, moving averages, seasonal indices, Index numbers, different types of simple and weighted index numbers, time and factor reversal test.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars related to components of time series	To understand time series, seasonal indices and index numbers	Evaluation through MCQ and Group Discussion
Module IV **25 Hours**	Statistical Quality Control, assignable causes	• Lecture • Discussion s	• Assignment to construct control charts	To understand statistical quality control	Evaluation through test paper

	and chance causes, process control, Construction of control charts, 3sigma limits, Control chart for variables- Mean chart and Range chart,Control chart for attributes pcha rt, d or np chart and c chart	• Problem solving		and its uses	

Course Outcomes

CO1	To understand sampling techniques used in conducting sample surveys
CO2	To understand the concepts of ANOVA model
CO3	To learn the concepts of time series and index numbers
CO4	To provide an insight into quality assessment techniques.

Teacher in Charge:

Ms. Jiji Pauly

MTS1C01: MATHEMATICS I
Lecture Hours per week: 4, Credits: 3
Internal: 15, External: 60, Unty. Exam Dur. : 2 Hours

Objectives

To develop basic concepts of Mathematics that include continuity, differentiation and integration

Module I

Introduction to the derivative, instantaneous velocity, slope of tangent line, differentiating simplest functions, Limits Notion of limit, basic properties, derived properties, continuity, continuity of rational functions, one sided limit, limit involving $\pm\infty$, The derivative as Limit formal definition, examples, differentiability and continuity, Leibnitz notation, Differentiating Polynomials power rule, sum rule etc., Product and quotients product, quotient, reciprocal & integral power rule , Linear Approximation and Tangent Lines equation of tangent line and linear approximation, illustrations

Module II

Rate of change and second derivative linear or proportional change, rates of change, second derivative, The Chain Rule power of a function rule, chain rule, Fractional Power & Implicit Differentiation rational power of a function rule, implicit differentiation, Related rates and parametric curves Related rates, parametric curves, word problems involving related rates, Anti derivatives anti differentiation and indefinite integrals, antidifferentiation rules

Module III

Continuity and Intermediate value theorem IVT: first and second version Increasing and decreasing function Increasing and decreasing test, critical point test, first derivative test, Second derivative and concavity second derivative test for local maxima , minima and concavity , inflection points, Drawing of Graphs graphing procedure, asymptotic behaviour, Maximum Minimum Problems maximum and minimum values on intervals, extreme value theorem, closed interval test, word problems , The Mean Value Theorem The MVT, consequences of MVT, Rolles Theorem, horserace

theorem, L'Hospital rule Preliminary version, strengthened version

Module IV

Summation, distance and velocity, properties of summation, telescoping sum (quick introduction relevant ideas only) Sums and Areas step functions, area under graph and its counterpart in distance velocity problem The definition of Integral signed area , The integral, Riemann sums The Fundamental Theorem of Calculus Arriving at FTC intuitively using distance velocity problem, Fundamental integration Method, proof of FTC, Area under graph, displacements and velocity Definite and Indefinite integral indefinite integral test, properties of definite integral, fundamental theorem of calculus: alternative version (interpretation and explanation in terms of areas): Applications of the Integral Area between graphs, area between intersecting graphs, total changes from rates of change, Volume by slice method the slice method, volume of solid of revolution by Disk method

Text

(1) Calculus I (2/e) : Jerrold Marsden & Alan Weinstein SpringerVerlag New York Inc(1985) ISBN 0387909745 Text

(2) Calculus II (2/e) : Jerrold Marsden & Alan Weinstein SpringerVerlag New York Inc(1985) ISBN 0387909753

References

1. Soo T Tan: Calculus Brooks/Cole, Cengage Learning(2010)ISBN 0534 46579X
2. Gilbert Strang: Calculus Wellesley Cambridge Press(1991)ISBN:09614088 20
3. Ron Larson. Bruce Edwards: Calculus(11/e) Cengage Learning(2018) ISBN: 9781337275347
4. Robert A Adams & Christopher Essex : Calculus Single Variable (8/e) Pearson Education Canada (2013) ISBN: 0321877403
5. Joel Hass, Christopher Heil & Maurice D. Weir : Thomas' Calculus(14/e) Pearson (2018) ISBN 0134438981
6. Jon Rogawski & Colin Adams : Calculus Early Transcendentals (3/e) W. H. Freeman and

Company(2015) ISBN: 1319116450

OBJECTIVES

a) **To develop the concept of first order derivative**

b) **To understand how to calculate second order derivative**

c) **To study Continuity and Intermediate value theorem, drawing of graphs, the Mean value theorems**

d) **To study about Riemann sums, definite and indefinite integral**

LESSON PLAN

Unit/ hours	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 14 hours	First order derivative and its significance, Linear Approximation and Tangent Lines	● Lecture ● Discussion ● Participative learning ● Problem solving	● Peer group discussion on first order derivative	To understand: ●The difference between differentiability and analyticity	Evaluation through test papers
Module 2 **13 Hours**	Second order derivative, fractional derivative, implicit differentiation	● Lecture ● Discussion ● Participative learning ● Problem solving	● Assignments to understand second order derivative	To understand: ●Second order derivative ●Implicit differentiation	Evaluation through test paper
Module 3 **18 Hours**	Continuity and Intermediate value theorem, drawing of graphs, the MVT	● Lecture ● Discussion ● Participative learning	Peer group discussion on drawing graphs	To understand: ● Continuity and IVT	Evaluation Through interaction with

				• Drawing graphs	students
Module4 **19 Hours**	Fundamental theorem of Calculus, Definite and Indefinite integral	• Lecture • Discussion • Problem solving	• Peer group discussion on definite and indefinite integral	To understand: • Fundamental theorem of calculus • definite and indefinite integral	Evaluation through test paper

Course Outcomes

CO1	**To develop the concept of first order derivative, its physical significance and antiderivative**
CO2	**To study derivative of second order, fractional Power & implicit differentiation and antiderivative**
CO3	**To develop the concepts of the MVT, consequences of MVT, Rolles Theorem.**
CO4	**To study fundamental theorem of calculus and calculate volume by slice method**

Teacher in Charge
Ms. Linet Roslin Antony
Dr. Vijitha Mukundan

MTS2C02: MATHEMATICS-2
Lecture Hours per week: 4, Credits: 3
Internal: 15, External: 60, Unty. Exam Dur. : 2 Hours

Objectives

To develop concepts of Mathematics that include hyperbolic functions, numerical integration, matrices and its properties.

Module I

Polar coordinates and Trigonometry – Cartesian and polar coordinates, Inverse functions-inverse function test, inverse function rule, Graphing in polar coordinates- Checking symmetry of graphs given in polar equation, drawings, tangents to graph in polar coordinates Hyperbolic functions- hyperbolic sine, cosine, tan etc., derivatives, antidifferentiation formulas Inverse hyperbolic functions- inverse hyperbolic functions (their derivatives and antiderivatives) Arc length and surface area- Length of curves, Area of surface of revolution about x and y axes

Module II

Improper integrals- integrals over unbounded intervals, comparison test, integrals of unbounded functions, Limit of sequences and Newton's method ε-N definition, limit of powers, comparison test, Newton's method : Numerical Integration- Riemann Sum, Trapezoidal Rule, Simpson's Rule The sum of an infinite series - convergence of series, properties of limit of sequences (statements only), geometric series, algebraic rules for series, the ith term test The comparison test and alternating series- comparison test, ratio comparison test, alternating series, alternating series test, absolute and conditional convergence

Module III

Vector spaces – definition, examples, subspaces, basis, dimension, span Gram-Schmidt Orthogonalization Process- orthonormal bases for R^n , construction of orthonomal basis of R^n Systems of Linear Algebraic Equations- General form, solving systems, augmented matrix, Elementary row operations, Elimination Methods- Gaussian elimination, Gauss– Jordan

elimination, row echelon form, reduced row echelon form, inconsistent system, networks, homogeneous system, over and underdetermined system ,Rank of a Matrix- definition, row space, rank by row reduction, rank and linear system, consistency of linear system, Determinants- definition, cofactor, Properties of determinant- properties, evaluation of determinant by row reducing to triangular form

Module IV

Inverse of a Matrix – finding inverse, properties of inverse, adjoint method, row operations method, using inverse to solve a linear system, The eigenvalue problem- Definition, finding eigenvalues and eigenvectors, complex eigenvalues, eigenvalues and singular matrices, eigenvalues of inverse Powers of Matrices- Cayley Hamilton theorem, finding the inverse, Orthogonal Matrices - symmetric matrices and eigenvalues, inner product, criterion for orthogonal matrix, construction of orthogonal matrix, Diagonalization- diagonalizable matrix-sufficient conditions, orthogonal diagonalizability of symmetric matrix, Quadratic Forms

Text

(1) Calculus I (2/e): Jerrold Marsden & Alan Weinstein Springer Verlag New York Inc(1985) ISBN 0387909745

(2) Calculus II (2/e): Jerrold Marsden & Alan Weinstein Springer Verlag New York Inc(1985) ISBN 0387909753

(3) Advanced Engineering Mathematics(6/e): Dennis G Zill Jones & Bartlett Learning, LLC (2018) ISBN: 978-1-284-10590-2.

References

1 Soo T Tan: Calculus Brooks/Cole, Cengage Learning (2010) ISBN 0-534-46579-X
2 Gilbert Strang: Calculus Wellesley Cambridge Press (1991)ISBN:0-9614088-2-0
3 Ron Larson. Bruce Edwards: Calculus(11/e) Cengage Learning (2018) ISBN: 978-1-337- 27534-7
4 Robert A Adams & Christopher Essex : Calculus Single Variable (8/e) Pearson Education Canada (2013) ISBN: 0321877403
5 Joel Hass, Christopher Heil & Maurice D. Weir : Thomas' Calculus(14/e) Pearson (2018) ISBN 0134438981
6 Advanced Engineering Mathematics(7/e) Peter V O'Neil: Cengage Learning (2012) ISBN:

978-1-
111-42741-2
7 Erwin Kreyszig: Advanced Engineering Mathematics(10/e) John Wiley & Sons (2011) ISBN: 978-
0- 470-45836-5
8 Glyn James: Advanced Modern Engineering Mathematics(4/e) 1 Pearson Education Limited (2011)
ISBN: 978-0-273-71923-6

OBJECTIVES

a) **To develop the concept of derivative and integral of hyperbolic functions and inverse hyperbolic functions.**

b) **To understand how to calculate arc length and area of surface of revolution.**

c) **To study about improper integrals and numerical integration.**

d) **To compute matrix inverse and study some important properties.**

LESSON PLAN

Unit/ hour	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 14 hours	Inverse functions, hyperbolic functions, Arc length and surface area- Length of curves, Area of surface of revolution about x and y axes	● Lecture ● Discussion ● Participative learning ● Problem solving	● Peer group discussion derivative and antiderivative of hyperbolic functions	To understand: ●Hyperbolic functions ●Length of curves ●Surface of revolution	Evaluation through test papers
Module 2 **17 Hours**	Improper integrals, Numerical Integration- Riemann Sum, Trapezoidal Rule,	● Lecture ● Discussion ● Participative learning ● Problem	● Assignments to understand numerical integration	To understand: ●Improper integrals ●Numerical integration	Evaluation through test paper

	Simpson's Rule	solving			
Module 3 **19 Hours**	Vector spaces, Gaussian elimination, Gauss– Jordan elimination, rank of matrix, determinants	• Lecture • Discussion • Participative learning	Peer group discussion on matrix properties	To understand: • Notion of vector spaces • Matrix properties	Evaluation through test papers
Module 4 **14 Hours**	Inverse of a matrix, orthogonal matrix, power of matrices, diagonalization of matrices	• Lecture • Discussion • Problem solving	• Peer group discussion on inverse of a matrix	To understand: • Orthogonal matrix and its properties • Diagonalization of matrices	Evaluation through test paper

Course Outcomes

CO1	**To develop the concept of differentiation and integration of hyperbolic and inverse hyperbolic functions, to calculate arc length and surface of revolution**
CO2	**To study about improper integrals and numerical integration.**
CO3	**To develop the concepts of vector spaces, and basics of matrices**
CO4	**To study how to compute inverse of matrix and diagonalization of the matrices.**

Teacher in Charge

Ms. Linet Roslin Antony
Dr. Vjitha Mukundan

MTS3C03: MATHEMATICS -3
Lecture Hours per week: 5, Credits: 3
Internal: 15, External: 60, Unty. Exam Dur. : 2 Hours

Objectives

To develop some concepts of Mathematics that include partial differentiation, double integral, triple integral their physical significance and contour integral.

Module I

Vector Functions – Vector Valued Functions, Limits, Continuity, and Derivatives, Geometric Interpretation of $r'(t)$, Higher Order Derivatives, Integrals of Vector Functions, Length of a Space Curve, Arc Length as a Parameter, Motion on a Curve, Velocity and Acceleration, Centripetal Acceleration, Curvilinear Motion in the Plane, Curvature and components of Acceleration definition, Curvature of a Circle, Tangential and Normal Components of Acceleration, The Binormal, Radius of Curvature, Partial Derivatives, Functions of Two Variables, Level Curves, Level Surfaces, Higher Order and Mixed Derivatives, Functions of Three or More Variables, Chain Rule, Generalizations, Directional Derivative, The Gradient of a Function, A Generalization of Partial Differentiation, Method for Computing the Directional Derivative, Functions of Three Variables, Maximum Value of the Directional Derivative, Gradient Points in Direction of Most Rapid Increase of f, Tangent planes and Normal Lines, Geometric Interpretation of the Gradient, Tangent Plane, Surfaces Given by $z = f(x, y)$, Normal Line

Module II

Curl and Divergence, Vector Fields, definition of curl and divergence, Physical Interpretations, Line Integrals, definition of smooth, closed and simple closed curves, Line Integrals in the Plane, Method of Evaluation: curve as explicit function and curve given parametrically, Line Integrals in Space, Method of Evaluation, Work, Circulation, Independence of Path Conservative Vector Fields, Path Independence, A Fundamental Theorem, definition of connected, ,simply connected and multiconnected regions, Integrals Around Closed Paths, Test for a Conservative Field, Conservative Vector Fields in 3DSpace, Conservation of Energy, Double Integral: Integrability,

Area, Volume, Properties, Regions of Type I and II, Iterated Integrals, Evaluation of Double Integrals (Fubini theorem), Reversing the Order of Integration, Laminas with Variable Density—Center of Mass, Moments of Inertia, Radius of Gyration, Double Integrals in Polar Coordinates: Polar Rectangles, Change of Variables: Rectangular to Polar Coordinates, Green's Theorem: Line Integrals Along Simple Closed Curves, Green's theorem in plane, Region with Holes, Surface Integral: Surface Area, Differential of Surface Area, Surface Integral, Method of Evaluation, Projection of S into Other Planes, Mass of a Surface, Orientable Surfaces, Integrals of Vector Fields, Flux, Stokes's Theorem: Vector Form of Green's Theorem, Green's Theorem in 3 Space - Stoke's Theorem, Physical Interpretation of Curl

Module III

Triple Integral: Definition, Evaluation by Iterated Integrals, Applications, Cylindrical Coordinates, Conversion of Cylindrical Coordinates to Rectangular Coordinates, Conversion of Rectangular Coordinates to Cylindrical Coordinates, Triple Integrals in Cylindrical Coordinates, Spherical Coordinates, Conversion of Spherical Coordinates to Rectangular and Cylindrical Coordinates, Conversion of Rectangular Coordinates to Spherical Coordinates, Triple Integrals in Spherical Coordinates, Divergence Theorem: Another Vector Form of Green's Theorem, divergence or Gauss' theorem, (proof omitted), Physical Interpretation of Divergence, Change of Variable in Multiple Integral: Double Integrals, Triple Integrals, Complex Numbers: definition, arithmetic operations, conjugate, Geometric Interpretation, Powers and roots: Polar Form, Multiplication and Division, Integer Powers of z , De Moivre's Formula, Roots, Sets in the Complex Plane: neighbourhood, open sets, domain, region etc., Functions of a Complex Variable: complex functions, Complex Functions as Flows, Limits and Continuity, Derivative, Analytic Functions entire functions, Cauchy Riemann Equation: A Necessary Condition for Analyticity, Criteria for analyticity, Harmonic Functions, Harmonic Conjugate Functions, Exponential and Logarithmic function: Exponential Function, Properties, Periodicity, Complex Logarithm, principal value, properties, Analyticity, Trigonometric and Hyperbolic functions: Trigonometric Functions, Hyperbolic Functions, Properties Analyticity, periodicity, zeros etc.

Module IV

Contour integral: definition, Method of Evaluation, Properties, ML- inequality. Circulation and Net Cauchy Goursat Theorem: Simply and Multiply Connected Domains, Cauchy's Theorem, Cauchy–Goursat theorem, Cauchy– Goursat Theorem for Multiply Connected Domains, Independence of Path: Analyticity and path independence, fundamental theorem for contour integral, Existence of Antiderivative, Cauchy's Integral Formula: First Formula, Second Formula - C.I.F. for derivatives. Liouville's Theorem, Fundamental Theorem of Algebra.

Text

(1) Advanced Engineering Mathematics(6/e): Dennis G Zill Jones & Bartlett Learning, LLC (2018) ISBN: 9781284105902

References

1.Soo T Tan: Calculus Brooks/Cole, Cengage Learning (2010) ISBN 0534 46579X
2 Gilbert Strang: Calculus Wellesley Cambridge Press (1991) ISBN:096140882 0
3 Ron Larson. Bruce Edwards: Calculus(11/e) Cengage Learning (2018) ISBN: 9781337275347
4 Robert A Adams & Christopher Essex: Calculus several Variable (7/e) Pearson Education Canada (2010) ISBN: 9780321549297
5 Jerrold Marsden & Anthony Tromba: Vector Calculus (6/e) W. H. Freeman and Company ISBN 9781429215084
6 Peter V O'Neil: Advanced Engineering Mathematics(7/e) Cengage Learning (2012) ISBN: 9781111427412
7 Erwin Kreyszig: Advanced Engineering Mathematics(10/e) John Wiley & Sons (2011) ISBN: 9780470458365
8 Glyn James: Advanced Modern Engineering Mathematics(4/e) Pearson Education Limited (2011) ISBN: 9780273719236

OBJECTIVES

a) **To develop the concept of partial derivative.**

b) To understand how to calculate double and triple integral and various theorems connecting them.

c) To understand the physical significance of curl and divergence.

d) To get an idea about complex functions and analytic functions.

e) To study about contour integral

LESSON PLAN

Unit/ hours	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 21 hours	Vector functions, Motion on a Curve, Curvature and components of Acceleration, Partial derivatives, Directional derivative, Tangent planes and Normal Lines	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on partial derivative	To understand: ●Directional derivative ●Tangent planes ●Normal planes ●Vector functions	Evaluation through test papers
Module 2 **24 Hours**	Curl and divergence, Line integrals, Independence of Path, Double Integral, Green's theorem, Surface Integral, Stoke's theorem	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to understand second order derivative	To understand: ●Physical meaning of curl and divergence ●Double integral ●Line Integrals ●Theorems connecting them	Evaluation through test paper
Module 3 **21 Hours**	Triple Integral, Divergence theorem, Change of Variable in Multiple Integral, complex numbers,	• Lecture • Discussion • Participative learning • Problem	Peer group discussion on change of variables in	To understand: • Triple integral • Change of	Evaluation Through interaction with students

	Powers and roots, Sets in the Complex Plane, Functions of a Complex Variable, Cauchy Riemann Equation, Exponential and Logarithmic function,Trigonometric and Hyperbolic functions	Solving	multiple integral	variable ● Multiple integral ● Complex numbers ● Analytic functions ● C-R equations ● Other important functions	
Module4 **14 Hours**	Contour Integral, Cauchy Goursat Theorem, Independence of Path, Cauchy's Integral Formula	● Lecture ● Discussion ● Problem solving	● Peer group discussion on contour integration	To understand: ● Contour integral ● Integral formula and theorem	Evaluation through test paper

Course Outcomes

CO1	**To develop the concept of partial derivative, directional derivative, tangent planes and normal lines**
CO2	**To study the physical interpretation of divergence and curl, double integral and theorems connecting them.**
CO3	**To study triple integral, change of variables in multiple integral and about complex functions.**
CO4	**To understand the concept of contour integration, integral formula and theorem.**

Teacher in Charge
Ms. Amala Mary George

MTS4C04: MATHEMATICS -4
Lecture Hours per week: 5, Credits: 3
Internal: 15, External: 60, Unty. Exam Dur. : 2 Hours

Objectives

To develop the understanding of solving ODEs, PDEs and the significance of Laplace transform and Fourier series.

Module I

Definitions and Terminology: definition, Classification by Type, Classification by Order, Classification by Linearity, Solution, Interval of Definition, Solution Curve, Explicit and Implicit Solutions, Families of Solutions, Singular Solution, Systems of Differential Equations, Initial Value Problems: First and Second Order IVPs, Existence of solution, Differential Equations as Mathematical Models: some specific differential equation models in biology, physics and chemistry, Solution Curves without Solution Direction Fields Separable Equations definition Method of solution, losing a solution, An Integral Defined Function Linear Equations: definition, standard form, homogeneous and non homogeneous DE, variation of parameter technique, Method of Solution, General Solution, Singular Points, Piecewise Linear Differential Equation, Error Function Exact Equations: Differential of a Function of Two Variables, Criteria for an exact differential, Method of Solution, Integrating Factors, Solutions by Substitution, Homogeneous Equations, Bernoulli's Equation, Reduction to Separation of Variables, A Numerical Method Using the Tangent Line, Euler's Method

Module II

Theory of Linear Equations: Initial Value and Boundary Value Problems, Homogeneous Equations [Differential Operators, Superposition Principle, Linear Dependence and Linear Independence, Wronskian] Nonhomogeneous Equations [Complementary Function, Another Superposition Principle], Reduction of Order a general method to find a second solution of linear second order equation by reducing to linear first order equation, Homogeneous Linear Equations with Constant Coefficients, Auxiliary Equation, Distinct Real Roots , Repeated Real Roots , Conjugate Complex

Roots, Higher Order Equations, Rational Roots, Undetermined Coefficients Method of Undetermined Coefficients for finding out particular solution, Variation of parameter: General solution using Variation of parameter technique, Cauchy Euler Equations Method of solution, Distinct Real Roots, Repeated Real Roots, Conjugate Complex Roots, Linear Models & Boundary Value Problems: Deflection of a Beam, Eigenvalues and Eigenfunctions

Module III

Definition of Laplace Transform definition, examples, linearity, Transforms of some basic functions, Sufficient Conditions for Existence of transform, Inverse Transform and Transforms of Derivative Inverse Transforms: A few important inverse transforms, Linearity, Partial Fractions, Transforms of Derivatives, Solving Linear ODEs, Translation Theorems: Translation on the s axis, first translation theorem, its inverse form, Translation on the t axis, Unit step function, second translation theorem. Its Inverse form, Alternative Form of second translation theorem. Beams, Additional Operational Properties: Derivatives of Transforms, Transforms of Integrals convolution, convolution theorem (without proof) and its inverse form, Volterra Integral Equation, Series Circuits, Transform of a Periodic Function, The Dirac delta Function Unit Impulse: The Dirac Delta Function and its transform

Module IV

Orthogonal Functions: Inner Product, Orthogonal Functions, Orthonormal Sets, Vector Analogy, Orthogonal Series Expansion, Complete Sets, Fourier Series: Trigonometric Series, Fourier Series, Convergence of a Fourier Series, Periodic Extension, Sequence of Partial Sums, Fourier Cosine and Sine Series: Even and Odd Functions., Properties, Cosine and Sine Series, Gibbs Phenomenon, Half Range Expansions, Periodic Driving Force, Separable Partial Differential Equations : Linear Partial Differential Equation, Solution of a PDE, Separation of Variables , Superposition Principle, Classification of Equations (hyperbolic, parabolic, elliptic) . Classical PDE's and BVP's Heat Equation: Wave Equation, Laplace's Equation, Initial Conditions, Boundary Conditions, Boundary Value Problems, Heat Equation: Solution of the BVP

Text

(1) Advanced Engineering Mathematics(6/e): Dennis G Zill Jones & Bartlett Learning, LLC (2018) ISBN: 9781284105902

References

1. Peter V O'Neil: Advanced Engineering Mathematics(7/e) Cengage Learning (2012) ISBN: 9781111427412
2. Erwin Kreyszig: Advanced Engineering Mathematics(10/e) John Wiley & Sons (2011) ISBN: 9780470458365
3. Alan Jeffrey: Advanced Engineering Mathematics Harcourt/Academic Press (2002) ISBN: 012382592X
4. Glyn James: Advanced Modern Engineering Mathematics(4/e) Pearson Education Limited (2011) ISBN: 9780273719236

OBJECTIVES

a) **To understand the methods to solve ODE**

b) **To understand the significance of Laplace transform and Inverse Laplace transform.**

c) **To understand the use of Fourier series.**

d) **To the methods to solve PDE.**

LESSON PLAN

Unit/ hours	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 21 hours	Initial Value Problems. Differential equations, separable equations, linear equations, exact equations, Solutions by Substitution, A numerical method	● Lecture ● Discussion ● Participative learning ● Problem solving	● Peer group discussion on solution of ODE	To understand: ●Methods to solve ODE ●Numerical methods	Evaluation through test papers

Module 2 **22 Hours**	Theory of Linear Equations, Reduction of order, Homogeneous Linear Equations with Constant Coefficients, Undetermined coefficients, variation of parameters, Cauchy-Euler equation, Linear Models & Boundary Value Problems	• Lecture • Discussion • Participative learning • Problem solving	• Assignments to understand variation of parameters	To understand: • The methods to solve homogeneous Linear Equations with Constant Coefficients • Method of Undetermined coefficients and variation of parameter • BVP	Evaluation through test paper
Module 3 **19 Hours**	Laplace transform, Inverse Transform and Transforms of Derivative, Translation theorems, Additional Operational Properties, The Dirac delta Function	• Lecture • Discussion • Participative learning • Problem Solving	Peer group discussion on translation theorems	To understand: • Laplace transform • Inverse Transform • Transforms of Derivative • Translation theorems • The Dirac delta Function	Evaluation Through interaction with students
Module4 **18 Hours**	Orthogonal functions, Fourier series, Fourier Cosine and Sine Series, Separable Partial Differential Equations, Classical PDE's and BVP's, Heat equation	• Lecture • Discussion • Problem solving	• Assignments to understand Fourier Cosine and Sine Series,	To understand: • Orthogonal functions • Fourier series,Fourier Cosine and Sine Series, • Separable Partial Differential Equations, • Classical PDE's and BVP's, Heat equation	Evaluation through test paper

Course Outcomes

CO1	**To develop the methods of solving ODEs.**
CO2	**To study the method to solve higher order ODE**
CO3	**To study the significance and properties of Laplace and Inverse Laplace transforms**
CO4	**To understand the use of Fourier series and some techniques to solve PDEs.**

Teacher in Charge
Ms. Smitha Davis
Ms. Amala Mary George

MTS1 B01 BASIC LOGIC & NUMBER THEORY

Lecture Hours per week: 4, Credits: 4

Internal: 20, External: 80, Examination 2.5 Hours

Objectives

To enable one to think systematically, to make valid arguments in mathematical terms and master several techniques of problem solving.

Module I (15 hrs)

Propositions, Boolean variables, Truth Value, Conjunction, Boolean expression, Disjunction, Negation, Implication, Converse, Inverse and Contra positive, Biconditional statement, Order of Precedence, Tautology Contradiction and Contingency, Logical equivalences- laws of logic, Quantifiers- universal & existential, predicate logic, Arguments- valid and invalid arguments, inference rules, Proof Methods–vacuous proof, trivial proof, direct proof, indirect proof-contrapositive & contradiction, proof by cases , Existence proof-constructive & non constructive, counter example.

Module II (12hrs)

Mathematical induction- well ordering principle, simple applications, weak version of principle of mathematical induction, illustrations, strong version of induction, illustration, Recursion- recursive definition of a function, illustrations, The division algorithm – statement and proof, div & mod operator, card dealing, The two queens puzzle, pigeonhole principle and division algorithm, divisibility relation, illustration ,divisibility properties, union intersection and complement-inclusion-exclusion principle & applications, even and odd integers, Prime and Composite Numbers- definitions, infinitude of primes, The sieve of Eratosthenes, a number theoretic function, prime number theorem, distribution of primes.

Module III (17 hrs)

Greatest Common Divisor-gcd,symbolic definition, relatively prime integers, Duncan's identity, Polya's theorem, infinitude of primes, properties of gcd, linear combination, gcd as linear combination, an alternate definition of gcd, gcd of n positive integers, a linear combination of n positive integers, pairwise relatively prime integers, alternate proof for infinitude of prime, The Euclidean Algorithm- The Euclidean algorithm,

Ajigsaw puzzle, Lame's theorem, The Fundamental Theorem of Arithmetic- Euclid's lemma on division of product by a prime, fundamental theorem of arithmetic, Canonical Decomposition, number of trailing zeros, highest power of a prime dividing $n!$, Distribution of Primes Revisited, Dirichlet's Theorem, Least Common Multiple- definition, canonical decomposition to find lcm, relationship between gcd and lcm, relatively prime numbers and their lcm, Linear Diophantine Equations – LDE in two variables, conditions to have a solution, Aryabhatta's method, number of solutions, general solution, Mahavira's puzzle, hundred fowls puzzle, Monkey and Coconuts Puzzle, Fibonacci numbers and LDE, LDE in more number of variables and their solutions-theorem3.20.

Module IV (20hrs)

Congruences - congruence modulo m, properties of congruence, characterization of congruence, least residue, congruence classes, A Complete Set of Residues Modulo m, properties of congruence, use of congruence to find the remainder on division, Towers of Powers Modulo m, further properties of congruence and their application to find remainder congruences of two numbers with different moduli, Linear Congruence- solvability, uniqueness of solution, incongruent solutions, Modular Inverses, applications, Divisibility Tests-Divisibility Test for 10, Divisibility Test for 5, Divisibility Test for $2i$, Divisibility Tests for 3 and 9, Divisibility Test for 11, Wilson's Theorem- self invertible modulo prime, Wilson's theorem and its converse, Fermat's Little Theorem and its applications, inverse of a modulo p using FLT, application-solution of linear congruences , extension of FLT in various directions, Euler's Theorem-motivation, Euler's Phi Function φ, Euler's Theorem, applications, generalisation of Euler's theorem (koshy).

Textbooks :

1) **Thomas Koshy**: Discrete Mathematics with Applications**,** Elsever Academic Press (2004)
2) **Thomas Koshy**: Elementary Number Theory with Applications (2/e) , Elsever Academic Press (2007)

Reference Books:

1) Susanna S Epp: Discrete Mathematics with Applications(4/e) Brooks/Cole Cengage Learning(2011)
2) Kenneth H. Rosen: Discrete Mathematics and Its Applications(7/e) McGraw-Hill, NY(2007)
3) David M. Burton : Elementary Number Theory(7/e) McGraw-Hill (2011)

4) Gareth A. Jones and J. Mary Jones: Elementary Number Theory, Springer Undergraduate Mathematics Series(1998)
5) Underwood Dudley :Elementary Number Theory(2/e), Dover Publications (2008)
6) James K Strayer: Elementary Number Theory, Waveland Press, inc.(1994)
7) Kenneth H. Rosen: Elementary Number Theory(6/e), Pearson Education(2018)

OBJECTIVES

1) To enable one to think systematically.
2) To express ideas in precise and concise mathematical terms.
3) To learn to make valid arguments.
4) To master different techniques of problem solving.

LESSON PLAN

Unit/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **15 Hours**	Propositions, Logical Equivalences, Quantifiers, Arguments, Proof Methods	• Lecture • Discussion • Participative learning • Problem solving	Peer group discussion on Logical Equivalence	To understand techniques of logic and reasoning	Evaluation through test paper
Module II **12 Hours**	Mathematical Induction,	• Lecture • Discussion	Student seminars to	To understand several	Evaluation through test paper

	Recursion, Division Algorithm, Prime and Composite numbers.	• Participative learning • Problem solving	explain prime and composite numbers.	techniques of problem solving such as recursion and induction.	
Module III **17 Hours**	GCD, Euclidean algorithm, Fundamental theorem of arithmetic, LCM, Linear Diophantine Equations,	• Lecture • Discussion • Participative learning • Problem solving	Assignment to find GCD and LCM	To solve LDE	Evaluation through MCQ
Module IV **20 Hours**	Congruences, Linear congruence, Divisibility test, Wilson's Theorem, Fermat's LittleTheorem,Euler's Theorem.	• Lecture • Discussions • Problem solving	Student seminars to explain the divisibility test for 5 and 11	To solve linear congruences	Evaluation through test paper and viva

Course Outcomes

CO 1	To prove results involving divisibility, greatest common divisor, least common multiple and a few applications.
CO 2	To understand the theory and method of solutions of LDE.
CO	To understand the theory of congruence and a few applications.

3	
CO 4	To solve linear congruent equations.
CO 5	To learn three classical theorems *viz*. Wilson's theorem, Fermat's little theorem and Euler's theorem and a few important consequences.

Teacher in Charge:

Ms. Athira V

MTS2 B02 CALCULUS OF SINGLE VARIABLE-1
Lecture Hours per week: 4, Credits: 4
Internal: 20, External: 80, Examination 2.5 Hours

Objectives

To introduce students to the fundamental ideas of limit, continuity and differentiability and also to some basic theorems of differential calculus.

Module I - Functions and Limits (20 hrs)

Functions and their Graphs- Definition of a Function, Describing Functions, Evaluating Functions, Finding the Domain of a Function, The Vertical Line Test, Piecewise Defined Functions, Even and Odd Functions (quick review), Combining functions- Arithmetic Operations on Functions, Composition of Functions, Graphs of Transformed Functions, Vertical Translations, Horizontal Translations, Vertical Stretching and Compressing, Horizontal Stretching and Compressing, Reflecting , Intuitive introduction to Limits- A Real Life Example, Intuitive Definition of a Limit, One-Sided Limits, Using Graphing Utilities to Evaluate Limits, Techniques for finding Limits Computing Limits- Using the Laws of Limits, Limits of Polynomial and Rational Functions, Limits of Trigonometric Functions, The Squeeze Theorem, Precise Definition of a Limit $\varepsilon - \delta\ definition$, A Geometric Interpretation, Some illustrative examples, Continuous Functions - Continuity at a Number, Continuity at an Endpoint, Continuity on an Interval, Continuity of Composite Functions, Intermediate Value Theorem ,Tangent Lines and Rate of change- An Intuitive Look, Estimating the Rate of Change of a Function from Its Graph, More Examples Involving Rates of Change, Defining a Tangent Line, Tangent Lines, Secant Lines, and Rates of Change The Derivatives Definition, Using the Derivative to Describe the Motion of the Maglev, Differentiation, Using the Graph of f to Sketch the Graph of f' Differentiability, Differentiability and Continuity , The role of derivative in the real world- Motion Along a Line, Marginal Functions in Economics , Differentials and Linear Approximations - increments, Differentials, Error Estimates, Linear Approximations, Error in Approximating Δy by dy.

Module II - Applications of the Derivative (17 hrs)

Extrema of Functions Absolute Extrema of Functions, Relative Extrema of Functions, Fermat's Theorem, Finding the Extreme Values of a Continuous Function on a Closed Interval, An Optimization Problem ,The Mean Value Theorem Rolle's Theorem, The Mean Value Theorem, Some Consequences of the Mean Value Theorem, Determining the Number of Zeros of a Function Increasing and Decreasing Functions definition ,

inferring the behaviour of function from sign of derivative, Finding the Relative Extrema of a Function, first derivative test, Concavity and Inflection points Concavity, Inflection Points, The Second Derivative Test, The Roles of f' and f'' in Determining the Shape of a Graph, Limits involving Infinity; Asymptotes Infinite Limits, Vertical Asymptotes, Limits at Infinity, Horizontal Asymptotes, Infinite Limits at Infinity, Precise Definitions, Curve Sketching The Graph of a Function, Guide to Curve Sketching, Slant Asymptotes , Finding Relative Extrema , Using a Graphing Utility, Optimization Problems – guidelines for finding absolute extrema, Formulating Optimization Problems application involving several real life problems.

Module III - Integration (14 hrs)

Anti derivatives, Indefinite integrals, Basic Rules of Integration, a few basic integration formulas and rules of integration, Differential Equations, Initial Value Problems, Area An Intuitive Look, The Area Problem, Defining the Area of the Region Under the Graph of a Function, technique of approximation, An Intuitive Look at Area , Defining the Area of the Region Under the Graph of a Function, Area and Distance, The Definite Integral Definition of the Definite Integral, Geometric Interpretation of the Definite Integral, The Definite Integral and Displacement, Properties of the Definite Integral , More General Definition of the Definite Integral, The Fundamental Theorem of Calculus, How Are Differentiation and Integration Related?, The Mean Value Theorem for Definite Integrals, The Fundamental Theorem of Calculus: Part I, inverse relationship between differentiation and integration, Fundamental Theorem of Calculus: Part 2, Evaluating Definite Integrals Using Substitution, Definite Integrals of Odd and Even Functions, The Definite Integral as a Measure of Net Change.

Module IV- Applications of Definite Integral (13 hrs)

Areas between Curves A Real Life Interpretation, The Area Between Two Curves, Integrating with Respect to *y*adapting to the shape of the region, What Happens When the Curves Intertwine? Volume – Solids of revolution, Volume by Disk Method, Region revolved about the x-axis, Region revolved about the y-axis , Volume by the Method of Cross Sections, Arc Length and Areas of surfaces of revolution Definition of Arc Length, Length of a Smooth Curve, arc length formula, The Arc Length Function, arc length differentials, Surfaces of Revolution, surface area as surface of revolution,Work Done by a Constant Force, Work Done by a Variable Force, Hook's Law, Moving non rigid matter, Work done by an expanding gas, Moments and Center of Mass Measures of Mass, Center of Mass of a System on a Line, Center of Mass of a System in the Plane, Center of Mass of Laminas.

Textbooks :

1) **Soo T Tan**, Calculus: Brooks/Cole, Cengage Learning (2010)

Reference Books:

1) Joel Hass, Christopher Heil & Maurice D. Weir : Thomas' Calculus(14/e) Pearson (2018)
2) Robert A Adams & Christopher Essex : Calculus Single Variable (8/e) Pearson Education Canada (2013)
3) Jon Rogawski & Colin Adams : Calculus Early Transcendentals (3/e) W. H. Freeman and Company(2015)
4) Anton, Bivens & Davis : Calculus Early Transcendentals (11/e) John Wiley & Sons
5) James Stewart : Calculus (8/e) Brooks/Cole Cengage Learning(2016)
6) Jerrold Marsden & Alan Weinstein : Calculus I and II (2/e) Springer Verlag NY(1985)

OBJECTIVES

1) To get an idea of sketching of curves.
2) To solve some optimization problems of interest in real life.
3) To establish the close connection between the two branches of Calculus: Differential and Integral Calculus

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I (Functions and Limits)	Functions and their Graphs, Combining	Lecture Discussion Participative	• Seminar on real life applications of	To deal with real life measures	Evaluation through test paper and

20 Hours	Functions, Intuitive Introduction to Limits, Techniques for finding Limits, Precise definition of Limits, Continuous Functions, Tangent Lines and Rate of Change , The Derivatives, The Role of Derivative in the Real World, Differential and Linear Approximations	learning Problem solving	Derivatives	like speed and acceleration	group discussion
Module II (Applications of the Derivative) **17 Hours**	Extrema of Functions, The MVT, Increasing and Decreasing Functions, Concavity and Inflection Points, Limit involving Infinity, Curve Sketching, Optimization Problems	Lecture Discussion Participative learning Problem solving	Group discussion on Curve Sketching	To understand several techniques of sketching curves and learning limits	Evaluation through test paper
Module III (Integration) **14 Hours**	Indefinite Integrals, Area, The Definite Integrals, The Fundamental Theorem of Calculus	Lecture Discussion Participative learning Problem solving	Assignment to find integrals of functions	To deal with real life problems in Physics, Chemistry etc.	Evaluation through MCQ

Module IV (Applications of the Definite Integral) **13 Hours**	Areas between Curves, Volume, Arc Length and Areas of Surfaces of Revolution, Work, Moments and Center of Mass	Lecture Problem solving Participative learning Videos	Assignment to find volume of some familiar objects	To explore relationship between Surfaces and Curves	Evaluation through test paper and viva

Course Outcomes

CO1	To learn the practical way of evaluating the definite integral.
CO2	To master integrals which is a powerful tool in solving problems in physics, chemistry, biology, engineering, economics and other fields.
CO3	To deal with real life optimization problems.
CO4	To explore the relationship between moving/changing objects

Teacher in Charge:
Ms. Nima Maria

MTS3 B03 CALCULUS OF SINGLE VARIABLE-2

Lecture Hours per week: 5, Credits: 4

Internal: 20, External: 80, Examination 2.5 Hours

Objectives

To be able to handle vectors in dealing with the problems involving geometry of lines, curves, planes and surfaces in space and have acquired the ability to sketch curves in plane and space given in vector valued form.

Module I-The Transcendental Functions (20 hrs)

The Natural logarithmic function, The Derivative of *ln x*, Laws of Logarithms, The Graph of the Natural Logarithmic Function, The Derivatives of Logarithmic Functions, Logarithmic Differentiation, Integration Involving Logarithmic Functions, Inverse Functions, The Inverse of a Function, The Graphs of Inverse Functions, Which Functions have Inverses?, Finding the Inverse of a Function, Continuity and Differentiability of Inverse Functions,Exponential Functions, The number *e* , Defining the Natural Exponential Function, properties, The Laws of Exponents, The Derivatives of Exponential Functions, Integration of the Natural Exponential Function, General Exponential and Logarithmic Functions, Exponential Functions with Base *a*, Laws of exponents, The Derivatives, Integrals and Graphs of Functions with Base a , Logarithmic Functions with Base *a*, Change of base formula, The Power Rule , The Derivatives of Logarithmic Functions with Base *a*, The Definition of the Number *e* as a Limit, Inverse trigonometric functions, graph, inverse properties,Derivative of inverse trigonometric functions, Integration Involving Inverse Trigonometric Functions, Hyperbolic functions,The Graphs of the Hyperbolic Functions, Hyperbolic Identities, Derivatives and Integrals of Hyperbolic Functions, Inverse Hyperbolic Functions, Representation in terms of Logarithmic Function, Derivatives of Inverse Hyperbolic Functions, An Application Indeterminate forms and l'H*ô*pital rule, The Indeterminate Forms .

Module II - Infinite Sequences and Series (20 hrs)

Improper integrals – definition, Infinite Intervals of Integration, Improper Integrals with Infinite Discontinuities, A Comparison Test for Improper Integrals, Sequences, Limit of a Sequence, Limit Laws, Squeeze Theorem, Bounded Monotonic Sequences, Monotone Convergence Theorem, Series, Defining the Sum, convergence and divergence, Geometric Series, The Harmonic Series, The Divergence Test,

Properties of Convergent Series, The Integral Test – investigation of convergence, Integral Test, The *p*-Series, its convergence and divergence, The Comparison Test, The Limit, Comparison Test, Alternating Series, The Alternating Series Test, its proof, examples, Approximating the Sum of an Alternating Series by *Sn*, Absolute Convergence, Conditionally Convergent, The Ratio Test, The Root Test, Summary of Tests for Convergence and Divergence of Series, Rearrangement of Series.

Module III (17 hrs)

Power Series, Interval of Convergence, radius of convergence, Differentiation and Integration of Power Series, Taylor and Maclaurin Series, Taylor and Maclaurin series of functions, Techniques for Finding Taylor Series ,Plane Curves and Parametric Equations, Why We Use Parametric Equations, Sketching Curves Defined by Parametric Equations, The Calculus of parametric equations, Tangent Lines to Curves Defined by Parametric Equations, Horizontal and Vertical Tangents, Finding second derivative from Parametric Equations, The Length of a Smooth Curve, The Area of a Surface of Revolution, Polar coordinate, The Polar Coordinate System, Relationship Between Polar and Rectangular Coordinates, Graphs of Polar Equations, Symmetry, Tangent Lines to Graphs of Polar Equations, Areas and Arc Lengths in polar coordinates, Areas in Polar Coordinates, area bounded by polar curves, Area Bounded by Two Graphs, Arc Length in Polar Coordinates, Area of a Surface of Revolution, Points of Intersection of Graphs in Polar Coordinates.

Module IV (20hrs)

Lines and Planes in Space, Equations of Lines in Space, Parametric Equation, Symmetric Equation of a Line, Equations of Planes in Space, Standard Equation, Parallel and Orthogonal Planes, The Angle Between Two Planes, The Distance Between a Point and a Plane Surfaces in SpaceTraces, Cylinders, Quadric Surfaces, Ellipsoids, Hyperboloids of One Sheet, Hyperboloids of Two Sheets, Cones, Paraboloids, Hyperbolic Paraboloids,Cylindrical and Spherical Coordinates, The Cylindrical Coordinate System, Converting Cylindrical to Rectangular and vice versa, The Spherical Coordinate System, Converting spherical to Rectangular and vice versa, Vector Valued functions and Space Curves, Curves Defined by Vector Functions, Limits and Continuity, Differentiation and Integration of Vector Valued Function The Derivative of a Vector Function, Higher Order Derivatives, Rules of Differentiation, Integration of Vector Functions, Arc length and Curvature, Arc Length of a space curve, Smooth Curves, Arc Length Parameter, arc length function, Curvature, Formula for finding Curvature, Radius of

Curvature,Velocity and AccelerationVelocity, Acceleration, and Speed; Motion of a Projectile,Tangential and Normal Components of Acceleration, The Unit Normal, principal unit normal vector, Tangential and Normal Components of Acceleration.

Textbooks :

1) **Soo T Tan**: Calculus, Brooks/Cole, Cengage Learning (2010)

Reference Books:

1) Joel Hass, Christopher Heil & Maurice D. Weir : Thomas' Calculus (14/e) Pearson(2018)
2) Robert A Adams & Christopher Essex : Calculus Single Variable (8/e) Pearson Education Canada (2013)
3) Jon Rogawski & Colin Adams : Calculus Early Transcendentals (3/e) W. H. Freeman and Company(2015)
4) Anton, Bivens & Davis : Calculus Early Transcendentals (11/e) John Wiley & Sons, Inc.(2016)
5) James Stewart : Calculus (8/e) Brooks/Cole Cengage Learning(2016)
6) Jerrold Marsden & Alan Weinstein : Calculus I and II (2/e) Springer Verlag NY(1985)

OBJECTIVES

1) To familiarize functions like natural logarithmic function and natural exponential function.
2) To study a related notion of convergence of a series.
3) To get the idea of parametrization of curves, they learn how to calculate the arc length, curvature etc.
4) To introduce coordinate systems which simplify the equation of curves and surfaces.

LESSON PLAN

Unit/ Hours	Topics for student preparation	Procedure (process)	Activity	Learning outcome	Assessment

(Time Required)	(input)	Student centric Method of teaching		(output)	
Module I **20 Hours**	The Natural logarithmic function, Inverse Functions, Exponential Functions, General Exponential and Logarithmic Functions, Inverse trigonometric functions, Hyperbolic functions, Indeterminate forms and l'Hôpital rule	Lecture Discussion Participative learning Problem solving	Group discussion on l'Hôpital rule	To master natural logarithmic function and natural exponential function.	Evaluation through test paper
Module II **20 Hours**	Improper integrals, Sequences, Series, The Integral Test, The Comparison Test, Alternating Series, Absolute Convergence	Lecture Discussion Participative learning Problem solving	Student seminars related to Integral Test and Comparison Test	To deal with power series - their region of convergence, differentiation and integration etc	Evaluation through test paper
Module III **20 Hours**	Power Series, Taylor and Maclaurin Series, Plane Curves and Parametric	Lecture Discussion Participative learning	Assignment in conversion between different	To learn how to calculate the arc length, curvature etc.	Evaluation through testpaper and Viva

	Equations, The Calculus of parametric equations, Polar coordinate, Areas and Arc Lengths in polar coordinates	Problem solving	coordinate systems.	using parametrizatio n	
Module IV **20 Hours**	Lines and Planes in Space, Surfaces in Space, Cylindrical and Spherical Coordinates, Vector Valued functions and Space Curves, Differentiation and Integration of VectorValued Function, Arc length and Curvature, Velocity and Acceleration, Tangential and Normal Components of Acceleration	Lecture Discussions Problem solving	Student seminars to familiarize vector-valued functions in real life.	To acquire the ability to sketch curves in plane and space given in vector valued form.	Evaluation through testpaper

Course Outcomes

CO1	To model a wide variety of phenomenon of interest in science, engineering, mathematics and economics.
CO2	To handle the convergence of series with different tests.
CO3	To acquire the ability to sketch curves in plane.
CO4	To deal with the problems involving geometry of lines, curves, planes and surfaces in space.

Teacher in Charge:

Ms. Nima Maria

MTS4 B04 LINEAR ALGEBRA
Lecture Hours per week: 5, Credits: 4
Internal: 20, External: 80, Examination 2.5 Hours

Objectives

To introduce students to the fundamental ideas of linear system of equations, vector spaces and linear transformations.

Module I (17hrs)

Introduction to Systems of Linear Equations- linear equation in n variables, linear system of m equations in n variables, solution, Linear Systems in Two and Three Unknowns, solution by geometric analysis, consistent and inconsistent systems, linear system with no, one, and infinite number of solutions, augmented matrix and elementary row operations ,Gaussian elimination Considerations in Solving Linear Systems, Echelon Forms, reduced row echelon form, Elimination Methods, Gauss–Jordan elimination, Gaussian elimination, Homogeneous Linear Systems, Free Variables, Free Variable Theorem for Homogeneous Systems, Gaussian Elimination and Back Substitution, Some Facts about Echelon Forms , Matrices and Matrix operations Matrix Notation and Terminology, row vector , column vector , square matrix of order n , Operations on Matrices , Partitioned Matrices, Matrix Multiplication by Columns and by Rows, Matrix Products as Linear Combinations, linear combination of column vectors, Column Row Expansion, Matrix Form of a Linear System, Transpose of a Matrix, Trace of a Matrix , Inverses and algebraic properties of matrices Properties of Matrix Addition and Scalar Multiplication, Properties of Matrix Multiplication, Zero Matrices and Properties, Identity Matrices, Inverse of a Matrix, Properties of Inverses, Solution of a Linear System by Matrix Inversion, Powers of a Matrix , Matrix Polynomials, Properties of the Transpose , Elementary matrices and a method for finding $A-1$row equivalence, elementary matrix, Row Operations by Matrix Multiplication, invertibility of elementary matrices, invertibility and equivalent statements, A Method for Inverting Matrices, Inversion Algorithm, illustrations, More on linear systems and invertible matrices Number of Solutions of a Linear System, Solving Linear Systems by Matrix Inversion, Linear Systems with a Common Coefficient Matrix, Properties of Invertible Matrices, equivalent statements for unique solution of $Ax = b$, determining consistency , Diagonal, Triangular and Symmetric matricesDiagonal Matrices, Inverses and Powers of Diagonal Matrices, Triangular Matrices. Properties of Triangular Matrices, Symmetric Matrices, algebraic properties of symmetric matrices, Invertibility of Symmetric Matrices ,Matrix transformation definition, Properties of Matrix Transformations, standard matrix, A Procedure for Finding Standard Matrices

,Determinants by cofactor expansion minors, cofactors, cofactor expansion, Definition of a General Determinant, A Useful Technique for Evaluating 2 × 2 and 3 × 3 Determinants ,Evaluating determinants by row reduction a few basic theorems, elementary row operations and determinant, determinant of elementary matrices, determinant by row reduction .

Module II (18hrs)

Real vector space - Vector Space Axioms, examples, Some Properties of Vectors ,Subspaces -definition, criteria for a subset to be a subspace, examples, Building Subspaces, linear combination, spanning, Solution Spaces of Homogeneous Systems as subspace, The Linear Transformation Viewpoint , kernel, different set of vectors spanning the subspace, Linear Independence- Linear Independence and Dependence, illustrations , A Geometric Interpretation of Linear Independence, Wronskian, linear independence using wronskian , Coordinates and basisCoordinate Systems in Linear Algebra, Basis for a Vector Space, finite and infinite dimensional vector spaces, illustrations, Coordinates Relative to a Basis, Uniqueness of Basis Representation ,Dimension- Number of Vectors in a Basis , dimension, Some Fundamental Theorems, dimension of subspaces.

Module III (22 hrs)

Change of basis- Coordinate Maps, Change of Basis, Transition Matrices, Invertibility of Transition Matrices, An Efficient Method for Computing Transition Matrices for $\mathbb{R}n$, Transition to the Standard Basis for $\mathbb{R}n$, Row space, Column space and Null space- vector spaces associated with matrices, consistency of linear system, Bases for Row Spaces, Column Spaces, and Null Spaces, basis from row echelon form, Basis for the Column Space of a Matrix, row equivalent matrices and relationship between basis for column space, Bases Formed from Row and Column Vectors of a Matrix , Rank Nullity and Fundamental matrix spaces- equality of dimensions of row and column spaces, Rank and Nullity, Dimension Theorem for Matrices, The Fundamental Spaces of a Matrix, rank of a matrix and its transpose, A Geometric Link Between the Fundamental Spaces, orthogonal complement,, invertibility and equivalent statements, Applications of Rank, Over determined and Underdetermined Systems , Basic matrix transformations in $R2$ and $R3$ -Reflection Operators, Projection Operators, Rotation Operators, Rotations in $\mathbb{R}3$, Dilations and Contractions, Expansions and Compressions, Shears, Orthogonal Projections onto LinesThrough the Origin, Reflections About Lines Through the Origin ,Properties of matrix transformation- Compositions of Matrix Transformations, OnetoOne Matrix Transformations, Kernel and Range, fundamental relationship between invertibility of a matrix and its matrix transformation, Inverse of a OnetoOne Matrix Operator.

Module IV (23 hrs)

Geometry of matrix operators-Transformations of Regions, Images of Lines Under Matrix Operators, Geometry of Invertible Matrix Operators, Elementary matrix and its matrix transformation, consequence ,Eigen values and Eigen Vectors- definition, Computing Eigenvalues and Eigenvectors, characteristic equation, alternative ways of describing eigen values, Finding Eigenvectors and Bases for Eigenspaces, Eigenvalues and Invertibility, Eigenvalues of General Linear Transformations, Diagonalization-The Matrix Diagonalization Problem, linear independence of eigen vectors and diagonalizability, Procedure for Diagonalizing a Matrix, Eigenvalues of Powers of a Matrix, Computing Powers of a Matrix, Geometric and Algebraic Multiplicity ,Inner Product – definition of General inner product, Euclidean inner product (or the standard inner product) on $\mathbb{R}n$, norm of a vector, properties , a few examples , Angle and orthogonality in Inner product spaces- only the definition of orthogonality in a real inner product space and examples,Gram–Schmidt Process -definition of Orthogonal and Orthonormal Sets, examples, linear independence of orthogonal set, orthonormal basis, Coordinates Relative to Orthonormal Bases ,The Gram–Schmidt Process , illustrations- examples , Extending Orthonormal Sets to Orthonormal Bases ,Orthogonal Matrices- definition, characterisation of orthogonal matrices, properties of orthogonal matrices, Orthogonal Matrices as Linear Operators, a geometric interpretation , Orthogonal Diagonalization -The Orthogonal Diagonalization Problem, Conditions for Orthogonal Diagonalizability, Properties of Symmetric Matrices, Procedure for Orthogonally Diagonalizing an n × n Symmetric Matrix, Spectral Decomposition.

Textbooks :

1) Howard Anton & Chris Rorres **,** Elementary Linear Algebra: Application Version(11/e)

Reference Books:

1) Jim DeFranza, Daniel Gagliardi: Introduction to Linear Algebra with Applications Waveland Press, Inc(2015)

2) Otto Bretscher: Linear Algebra with Applications(5/e) Pearson Education, Inc (2013)

3) Ron Larson, Edwards, David C Falvo : Elementary Linear Algebra(6/e) Houghton Mifflin Harcourt Publishing Company(2009)

4) David C. Lay, Steven R. Lay, Judi J. McDonald: Linear Algebra and its Application (5/e) Pearson Education, Inc(2016)

5) Martin Anthony, Michele Harvey: Linear Algebra: Concepts and Methods Cambridge University Press(2012)

6) Jeffrey Holt: Linear Algebra with Applications W. H. Freeman and Company (2013)

OBJECTIVES

1) To understand the modern view of a matrix as a linear transformation
2) To solve system of linear equations
3) To understand the concepts of vector space

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **17 Hours**	Introduction to Systems of Linear Equations, Gaussian elimination, Matrices and Matrix operations, Inverses and algebraic properties of matrices, Elementary matrices and a method for finding A-1, More on linear systems and invertible matrices, Diagonal, Triangular and Symmetric matrices, Matrix transformation, Determinants by cofactror expansion, Evaluating determinants by row reduction	• Lecture • Discussion • Participative learning • Problem solving	• Assignment to find inverse of matrices	To solve System of Linear Equations	Evaluation through test paper
Module II	Real vector	• Lecture • Discussio	• Group	To deal with	Evaluation through test

18 Hours	spaces, Subspaces, Linear Independence, Coordinates and basis, Dimension	n • Participative learning • Problem solving	discussion on properties of vector spaces	vector spaces- their properties, dimensions etc	paper and viva
Module III **22 Hours**	Change of basis, Row space , Column space and Null space, Rank Nullity and Fundamental matrix spaces, Basic matrix transformations in R2 and R3 , Properties of matrix transformation	• Lecture • Discussion • Participative learning • Problem solving	• Seminar on Row space, Column space and Null space	To deal with matrix transformations	Evaluation through MCQ
Module IV **23 Hours**	Geometry of matrix operators, Eigen values and Eigen Vectors, Diagonalization, Inner Product, Angle and orthogonality in Inner product spaces, Gram-Schmidt Process, Orthogonal Matrices, Orthogonal Diagonalization	• Lecture • Discussions • Problem solving	• Assignment to find Eigen values and Eigen vectors	To understand Inner product spaces and orthogonality	Evaluation through test paper

Course Outcomes

CO1	To learn the practical method of finding out the eigenvalues from the characteristic equation.
CO2	To learn fundamentals of linear algebra to apply it in several different fields such as data communication, computer graphics, modeling etc.
CO3	To study about invertibility of square matrix
CO4	To learn matrix transformations in vector spaces

Teacher in Charge:
Ms. Anjana Rajan

MAT5B06 : ABSTRACT ALGEBRA

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To introduce the basic concept of the nature of abstract algebra also gives the idea of group and ring.

Module I (20 hrs)

Binary operations, Isomorphic binary structures, Groups, Sub groups

Module II (25 hrs)

Cyclic groups, Groups and permutations, Orbits, cycles and Alternating groups

Module III (15 hrs)

Cosets and Theorem of Lagrange, Homomorphisms

Module IV (30hrs)

Rings and Fields, Integral Domains, The Field of Quotients of an Integral Domain

Textbooks :

John B. Fraleigh : A First Course in Abstract Algebra, 7th Ed., Pearson.

Reference Books:

1. Joseph A. Gallian : Contemporary Abstract Algebra. Narosa Pub. House.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: Basic Abstract Algebra, 2nded., Cambridge University
3. Artin : Algebra, PHI.
4. Durbin : Modern Algebra : An Introduction, 5th ed., Wiley.

OBJECTIVES

1) To enable one to determine whether the given binary operation on a given set forms a group.
2) To understand the concept of subgroups.
3) To describe all elements of a cyclic group using generators.
4) To enable one to understand the homomorphism and Theorem of Lagrange.
5) To understand the concept of rings, fields and integral domains.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **20 Hours**	Binary operations, Isomorphic binary structures, Groups; Sub groups	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Binary operation.	• Enable to understand the concept of Groups.	Evaluation through test paper
Module II **25 Hours**	Cyclic groups, Groups and permutations, Orbits, cycles and Alternating groups	• Lecture • Discussion • Participative learning • Problem solving	• Assignments on permutation and orbits.	• enable one to compute the expression of permutation and permutation multiplication • Enable to understand different type of groups.	Evaluation through test paper
Module III **15 Hours**	Cosets and Theorem of Lagrange, Homomorphism	• Lecture • Discussion • Participativ	• Seminar and assignment on properties of	• Understand the theorem Lagrange and	Evaluation through test paper

		e learning ● Problem solving	homomorphism ● Peer group discussion on Cosets.	homomorphisam.	
Module IV **30 Hours**	Rings and Fields, Integral Domains, The Field of Quotients of an Integral Domain	● Lecture ● Discussion ● Participative learning ● Problem solving	● Seminar on the topic Rings and fields.	● To understand the concept of rings and fields ● Learn the concept of Integral domain.	Evaluation through test paper and viva

Course Outcomes

CO1	Understand the concept of binary operation on a given set.
CO2	To get the idea of groups, rings, fields and integral domain.
CO3	Understand different type of groups like cyclic and alternating groups
CO4	Understand the homomorphism and Theorem of Lagrange

Teacher in Charge:

Ms. Geethu simon

MAT5B07: BASIC MATHEMATICAL ANALYSIS

Lecture Hours per week: 6, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To develop ability to analyze and prove statements of mathematics using logical arguments.

Module I (20 hrs)

A quick review of sets and functions, Mathematical induction, Finite and infinite sets, Real Numbers, The algebraic property of real numbers.

Module II (24 hrs)

Absolute value and real line, The completeness property of R, Applications of supremum property, Intervals, Nested interval property and uncountability of R.

Module III (30 hrs)

Sequence of real numbers, Sequence and their limits, Limit theorems, Monotone sequences, Subsequence and Bolzano – Weirstrass theorem, Cauchy criterio,Properly divergent sequences, Open and closed sets.

Module IV (34 hrs)

COMPLEX NUMBERS: Sums and Products, Basic Algebraic properties, Further properties, Vectors and Moduli, Complex Conjugates, Exponential form, Product and powers in exponential form, Arguments of products and quotients, Roots of complex numbers, Regions in the complex plane, Functions of complex variable, Limits, Theorems on limits, Limits involving the points at infinity, Continuity.

Textbooks:

1) **Robert G. Bartle & Donald R. Sherbert**: Introduction to Real Analysis, 3rded., Wiley.
2) **J.W. Brown and Ruel V. Churchill**: Complex Variables and Applications, 8th Ed., McGraw Hill.

Reference Books:

1) J.M. Howie : Real Analysis, Springer 2007.
2) Ghorpade and Limaye : A Course in Calculus and Real Analysis, Springer, 2006.
3) K.A. Ross : Elementary Real Analysis : The Theory of Calculus, Springer Indian Reprint.
4) J.V. Deshpande : Mathematical Analysis and Applications, Narosh Pub. House.
5) M.R. Spiegel : Complex Variables, Schaum's Outline Series.

OBJECTIVES

1) To learn to prove Archimedean property, density theorem, existence of a positive square root for positive numbers and so on and the learning will help them to appreciate the beauty of logical arguments.
2) To learn how monotone convergence theorem can be used in establishing the divergence of the harmonic series, how it helps in the calculation of square root of positive numbers and how it establishes the existence of the transcendental number e.
3) To understand the concept of open and closed sets, their properties, their characterization and so on.
4) To familiarize the use of geometry, comparison between real and complex calculus-areas

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **20 Hours**	A quick review of sets and functions ,Mathematical induction, Finite and	• Lecture • Discussion • Participative learning • Problem	Group discussion on Algebraic properties of R.	To generate the ability to analyze and	Evaluation through test paper

	infinite sets Real Numbers, The algebraic property of real numbers.	solving		prove statements of Mathematics.	
Module II **24 Hours**	Absolute value and real line, The completeness property of R, Applications of supremum property Intervals, Nested interval property and uncountability of R.	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Completeness Property of R.	To master different techniques of finding limits.	Evaluation through test paper
Module III **30 Hours**	Sequence of real numbers, Sequence and their limits, Limit theorems, Monotone sequences, Subsequence and Bolzano – Weirstrass theorem, Cauchy criterio, Properly divergent sequences, Open and closed sets.	• Lecture • Discussion • Participative learning • Problem solving	• Assignment in Limit Theorems. • Discussion on Open and Closed Sets.	To familiarize with different kinds of sequences.	Evaluation through testpaper and Viva
Module IV **34 Hours**	Sums and Products, Basic Algebraic properties, Further properties, Vectors and Moduli,	• Lecture • Discussions • Problem solving	Student seminars to familiarize properties of Complex Numbers.	To understand areas where real and complex calculus agree and where they	Evaluation through testpaper

	Complex Conjugates, Exponential form, Product and powers in exponential form, Arguments of products and quotients, Roots of complex numbers, Regions in the complex plane, Functions of complex variable, Limits, Theorems on limits, Limits involving the points at infinity, Continuity.			differ.	

Course Outcomes

CO1	To appreciate the beauty of logical arguments and embolden them to apply it in similar and unknown problems.
CO2	To establish the divergence and convergence of different sequences and series.
CO3	To understand some basic topological properties of real number system.

CO4	To demystify student's belief that complex variable theory is incomprehensible.

Teacher in Charge:

Ms. Nima Maria

MAT5B08: DIFFERENTIAL EQUATIONS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To find out ways and means for solving differential equations.

Module I (24 hrs)

Some Basic Mathematical Models: Direction Fields, Solutions of some Differential equations, Classification of Differential Equations, Historical Remarks, First order differential equations: Linear equations with variable coefficients, Separable equations, Modeling with first order equations, Differences between linear and non linear equations, Exact equations and integrating factors, The existence and uniqueness theorem.

Module II (29 hrs)

Second Order Linear Differential Equations: Homogeneous equation with constant coefficients, Fundamental solutions of Linear Homogeneous equations, Linear independence and Wronskian, Complex roots of characteristic equations, Repeated roots Reduction of order, Non homogeneous equations, Method of Undetermined coefficients, Variation of parameters, Mechanical and Electrical vibrations, Systems of First Order Linear equations: Introduction, Basic theory of systems of first order Linear Equations.

Module III (17 hrs)

Definition of Laplace Transforms , Solution of Initial Value Problem , Step functions , Impulse functions, The Convolution Integral.

Module IV (20 hrs)

Two point Boundary value problems , Fourier Series, The Fourier Convergence Theorem, Even and odd functions , Separation of variables; Heat conduction in a rod , The Wave equation, Vibrations of an elastic string.

Textbooks:

1) Thomas / Finney : Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1) Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.
2) H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,Universal Book Stall, New Delhi.

OBJECTIVES

1) To learn to solve DEs that are in linear, separable and in exact forms and also to analyze the solution.
2) To be familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.
3) To acquire the knowledge of solving a differential equation using Laplace method.
4) To get familiarized with Fourier series and its applications.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **24 Hours**	Some Basic Mathematical Models, First order differential equations	• Lecture • Discussion • Participative learning	Assignment on solving first order differential equations.	To learn to solve DEs that are in linear, separable and in	Evaluation through test paper

		• Problem solving		exact forms and also to analyze the solution.	
Module II **29 Hours**	Second Order Linear Differential Equations, Systems of First Order Linear equations	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Completeness Property of R.	To be familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.	Evaluation through test paper
Module III **17 Hours**	Laplace Transforms	• Lecture • Discussion • Participative learning • Problem solving	Assignment in solving Differential equations using Laplace transforms.	To acquire the knowledge of solving a differential equation using Laplace method.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Partial Differential Equations and Fourier Series	• Lecture • Discussions • Problem solving	Student seminars in applications of Fourier Series.	To get familiarized with Fourier series and its applications.	Evaluation through testpaper

Course Outcomes

CO1	Students could identify a number of areas where the modelling process results in a differential equation.
CO2	They will realize the basic differences between linear and non linear DEs and also basic results that guarantees a solution in each case.
CO3	They will become familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.
CO4	Students acquire the knowledge of solving a differential equation using Laplace method which is especially suitable to deal with problems arising in engineering field.

Teacher in Charge:

Ms. Nima Maria

Ms. Geethu Simon

MAT5D02: MATHEMATICS FOR NATURAL SCIENCES

Lecture Hours per week: 2 Credits: 2

Internal: 10, External: 40, Examination 2 Hours

Objectives

To get introduced to statistical measures and analysis.

Module I (20 hrs)

The idea of sets, Operation on sets, Relations and functions, Variables and graphs, Frequency distributions, The Mean, Median, Mode and other measures of central tendency, Dispersion or variation, The Range, The Mean deviation, The Semi‑inter quartile range, The 10‑90 Percentile range.

Module II (16 hrs)

The standard deviation, Properties of Standard Deviation, The variance, Short methods of computing standard deviation, Moments, Moments for grouped data, relation between moments, Computation of moment for grouped data. Skewness and Kurtosis.

Textbooks :

Murray R. Spiegel : Statistics, 2nd Edn., Schaum's Outline Series.

Reference Books:

1) Hogg & Craig: Introduction to Mathematical Statistics.
2) Freund & Walpole: Mathematical Statistics

OBJECTIVES

1) To understand different measures of tendency.
2) To analyse data using measures like SD, Skewness and Kurtosis

LESSON PLAN

Unit/ Hours	Topics for student	Procedure (process)	Activity	Learning outcome	Assessment

(Time Required)	preparation (input)	Student centric Method of teaching		(output)	
Module I 18 Hours	Sets, Frequency Distribution, Measures of Tendency	• Lecture • Discussion • Participative learning • Problem solving	Assignment on different measures of tendency.	To understand which measure is better for different kinds of data.	Evaluation through test paper and viva
Module II 12 Hours	Standard Deviation, Moments, Skewness and Kurtosis.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars on Skewness and Kurtosis on different datas.	To visualize how the data behaves.	Evaluation through test paper

Course Outcomes

CO1	Students get an understanding about the use of some statistical tools.
CO2	They learn to analyze data using different measures.

Teacher in Charge:

Ms. Geethu Simon

MAT5B05: VECTOR CALCULUS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To Provide skils to visualize and manipulate multivariable and vector values functions. Also enable students to evaluate multiple integrals.

Module I (15 hrs)

Functions of several variables, Limits and Continuity, Partial derivatives, Differentiability linearization and differentials, Chain rule, Partial derivatives with constrained variables.

Module II (20 hrs)

Directional derivatives, gradient vectors and tangent planes, Extreme value and saddle points, Lagrange multipliers, Taylor's formula, Double Integrals, Double integrals in polar form.

Module III (25 hrs)

Triple integrals in Rectangular Coordinates, Triple integrals in cylindrical and spherical coordinates, Substitutions in multiple integrals, Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields.

Module IV (30hrs)

Green's theorem in the plane, Surface area and surface integrals, Parametrized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).

Textbooks :

Thomas / Finney : Calculus, 9th ed., LPE, Pearson Education.

Reference Books:

1. Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.

2. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed.,

OBJECTIVES

1) To enable one to apply the basic concepts of partial derivatives.
2) To learn to find multiple integrals.
3) To understand concept of the integrals of the functions and vector fields over parametrized surfaces and compute them in simple examples.
4) To calculate directional derivatives and gradients.
5) To learn application of greens theorem and stokes theorem.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **15 Hours**	Functions of several variables, Limits and Continuity, Partial derivatives, Differentiability linearization and differentials, Chain rule, Partial derivatives with constrained variables.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Partial derivatives.	• Enable to find partial derivatives.	Evaluation through test paper
Module II **20 Hours**	Directional derivatives, gradient vectors and tangent planes, Extreme value and saddle	• Lecture • Discussion • Participative learning	• Assignments in finding Directional derivatives	• Enable to evaluate double integrals.	Evaluation through test paper

	points, Lagrange multipliers, Taylor's formula, Double Integrals, Double integrals in polar form.	• Problem solving	and double integrals.		
Module III **25 Hours**	Triple integrals in Rectangular Coordinates, Triple integrals in cylindrical and spherical coordinates, Substitutions in multiple integrals, Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain vector fields, work and circulation	Understand triple integrals and vector fields.	Evaluation through MCQ and Group Discussion
Module IV **30 Hours**	Green's theorem in the plane, Surface area and surface integrals, Parametrized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to Surface integrals.	Learn the application of greens theorem and stokes theorem in multiple integrals.	Evaluation through test paper

Course Outcomes

CO1	Understand the basic concept of partial derivatives.
CO2	Enable to calculate multiple integrals.
CO3	Understand the concept of a conservative vector field

CO4	Learn the application of greens theorem and stokes theorem in multiple integrals and understand how they are generalizations of the Fundamental theorem of calculus.

Teacher in Charge:

Ms. Anjana Rajan

MAT6B10 : COMPLEX ANALYSIS

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To learn basic concepts of complex analysis and its applications.

Module I : Analytic Functions (15 hrs)

Derivatives, Differentiation formula, Cauchy‑Riemann Equations, Polar coordinates, Analytic functions, Harmonic functions , Elementary functions , The exponential function, Logarithmic function, Complex exponents, Trigonometric functions, Hyperbolic functions, Inverse Trigonometric and Hyperbolic functions.

Module II : Integrals (25 hrs)

Derivatives of functions ω(t); Indefinite integral of ω(t); Contours, Contour integrals, Antiderivatives, Cauchy ‑Goursat theorem (without proof), Simply and multiply connected domains, Cauchy's integral formula and its extension, Liouville's theorem and fundamental theorem of algebra, Maximum modulus principle.

Module III : Series (25 hrs)

A quick review of convergence of sequence and series of complex numbers,Taylor series, Laurents series (withoutproof), Applications,Power series: Absolute and uniform convergence,Continuity of sum of powerseries, Differentiation and integration of power series, Multiplication and division of power series.

Module IV : Residues (25 hrs)

Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, Three types of isolated singular points, Residues at poles, Zeroes of analytic functions, Zeroes and poles,Applications of residues, Evaluation of improper integrals, Jordan's Lemma (statement only), Definite integrals involving sines and cosines.

Textbooks :

1) **James Ward Brown and Ruel V. Churchill** : Complex Variables and Applications (8th Edn.),

McGraw Hill.

Reference Books:

1) Mark J.Ablowitz and Anthanassios S. Fokas: Complex Variables, Cambridge Text, 2nd Edn
2) S. Ponnusamy : Foundation of Complex Analysis : Narosa.
3) Murray R. Spiegel: Complex Variables, Schaum's Outline series.
4) J.M. Howie: Complex Analysis: Springer India Reprint
5) Stewart & Tall: Complex Analysis, CUP

OBJECTIVES

1) To develop differentiability and analyticity of complex valued functions
2) To develop complex integration
3) To represent an analytic function as power series.
4) To classify the singular points using Laurent series and develop the concept of residues and its applications.

LESSON PLAN

Unit/ session / hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **15 Hours**	Derivatives, Cauchy-Riemann Equations,Analytic functions,Harmon	• Lecture • Discussion • Participative learning • Problem	• Assignments in finding harmonic conjugates	To understand the difference between differentiability and	Evaluation through test paper

	ic functions , Exponential , Logarithmic, Trigonometric , Hyperbolic , Inver seTrigonometric a nd Hyperbolic functions	solving		analyticity	
Module II 25 Hours	Derivatives ofω(t) , Indefinite integral of ω(t); Contours, Contour integrals, Antiderivatives, Cauchy‑Goursat theorem , Simplya nd multiply conne cted domains, Cau chy's integralformula a nd its extension, Liouville's theore m and fundamenta l theorem of algebr a, Maximum mod ulus principle.	• Lecture • Discussi on • Participati ve learning • Problem solving	• Group discussion on contour integrals	To understand integration of complex functions and related theorems	Evaluation through test paper and viva
Module III	Convergence of sequence and serie	• Lecture • Discussi	• Student seminar to	To understand Taylor series	Evaluation through

25 Hours	s of complex num bers,Taylor series, Laurents series , Absolute and Uniform convergence, Continuity of sum of powerseries, Differentiation and integration of power series, Multiplication and division of power series.	on ● Participati ve learning ● Problem solving	explain absolute and uniform convergence of power series	and Laurent series	Test paper and Group Discussion
Module IV **25 Hours**	Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, Three t ypes of isolated singular points, Residues a t poles, Zeroes of analytic functions , Zeroes and poles, Applications of re sidues, Evaluation of improper integral	● Lecture ● Discussi ons ● Problem solving	● Assignments in finding isolated singular points and residues	To understand isolated singular points, residues and applications of residues	Evaluation through test paper

	s, Jordan's Lemma , Definite integral involving sines an d cosines.				

Course Outcomes

CO1	To understand difference between differentiability and analyticity of complex valued functions.
CO2	To learn indefinite integrals of complex valued functions.
CO3	Learn to express an analytic function as a power series.
CO4	To understand the concepts of singular points, residues, and applications of residues.

Teacher in Charge:

Ms. Athira V

MAT6B13(E02) : LINEAR PROGRAMMING

Lecture Hours per week: 3, Credits: 2

Internal: 20, External: 80, Examination 3 Hours

Objectives

Formulate our real life problem into a mathematical model also different techniques to solve LPP are introduced.

Module I (16 hrs)

Formulation, Convex sets, General LLP

Module II (14 hrs)

Simplex Method, Duality

Module III (18 hrs)

The transportation problem, The assignment Problems

Textbooks :

Gupta and Manmohan - Linear Programming And Theory of Games

Reference Books:

1. . K. V. Mital&Manmohan: Optimization methods in Operations Research and Systems Analysis, 3rdEdn., New Age International publishers.
2. DipakChatterjee: Linear Programming and Game Theory, Prentice Hall of India.

OBJECTIVE

1. Enable to formulate LPP from real life problem
2. Conceptulize the feasible region, feasible solution, optimal solution etc.
3. Solve the LPP with two variables using graphical method
4. Solve the LPP using simplex method
5. Formulate the dual problem from primal
6. Solve transportation problem and the assignment Problems which are relevent in daily life.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **16 Hours**	Formulation, Convex sets, General LLP	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on formulation of lpp. • Seminar on the topic convex sets.	• Understand to formulate lpp.	Evaluation through test paper
Module II **14 Hours**	Simplex Method, Duality	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in solving LPP using simplex method.	• Understand to solve lpp in finite number of steps using simplex method.	Evaluation through test paper and viva
Module III **18 Hours**	The transportation problem, The assignment Problems	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to solve transportation problems and assignment problems	• Enable one to solve transportation problem and the assignment Problems which are relevent in daily life.	Evaluation through Test paper and Group Discussion

Course Outcome

CO1	Enable one to formulate LPP from real life problem.

CO2	Solve the LPP with two variables using graphical method
CO3	Solve the LPP using simplex method
CO4	Solve transportation problem and the assignment Problems which are relevent in daily life.

Teacher in Charge:

Ms. Anjana Rajan

MAT6B12 : NUMBER THEORY AND LINEAR ALGEBRA

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To study about the integers and integer valued functions. Also introduce the concept of vector fields and linear transformations.

Module I (30 hrs)

Divisibility theory in the integers – the division algorithm, the greatest common divisor, the Euclidean algorithm, the Diophantine equation ax + by = c. Primes and their distribution. The fundamental theorem of arithmetic.The sieve of Eratosthenes. The theory of congruences.Basic properties of congruence.Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem

Module II (25 hrs)

Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors.The greatest integer function.Euler's phi-function.Euler's generalization of Fermat's theorem.Properties of the phi-function.

Module III (15 hrs)

Vectorspaces-examples, linearcombinations, spanning, linearindependence, base, finite dimensional vector spaces.

Module IV (20 hrs)

Linear mappings- Linear transformations, examples, nullspace, rank –nullity theorem, linear isomorphism

Textbooks :

1. David M. Burton : Elementary Number Theory, Sixth Edn., TMH.

2. T. S. Blynth and E.F. Robertson: Basic Linear Algebra, second Edn springer under graduate mathematics series 2009

Reference Books:

1. C.Y. Hsiung : Elementary Theory of Numbers. Allied Publishers.
2. Neville Robbins : Beginning Number Theory, Second Ed. Narosa.
3. George E. Andrews : Number Theory, HPC.
4. Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.
5. Frank Ayres, Jr. : Matrices, Schaum's Outline Series, Asian Student edition.
6. Devi Prasad : Elementary Linear Algebra, Narosa Pub. House

OBJECTIVE

1. Enable to find gcd using Euclidean algorithm.
2. To understand the solution of diophantine equations.
3. Enable to solve system of congruence using chinese remainder theorem.
4. To learn Wilson's theorem, Fermat's little theorem and Euler's theorem
5. Understand the concept of vector space and its basis.
6. Understand the concept of linear transformation and application of rank nullity theorem.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **30 Hours**	The division algorithm, Gcd, the Euclidean algorithm, the Diophantine equation. Primes and their distribution. The fundamental theorem of arithmetic. The sieve of	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on gcd and euclidean algorithm. • Assignment in finding solution of system of congruence using chinese remainder	• Understand the linear congruence and the method for finding its solutions.	Evaluation through test paper

	Eratosthenes. The theory of congruences. Basic properties of congruence. Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem.		theorem		
Module II **25 Hours**	Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors. The greatest integer function. Euler's phi-function. Euler's generalization of Fermat's theorem. Properties of the phi-function.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding sum and number of divisors • Seminar on the topic Euler's phi-function and Properties of the phi-function.	• Understand fermat's theorem, wilson's theorem, euler's theorem and its applications.	Evaluation through test paper and viva
Module III **15 Hours**	Vectorspaces-examples, linearcombinations, spanning, linearindependence, base, finite dimensional vector spaces.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to vector space and its example.	• Understand the definition of vector space and its basis.	Evaluation through MCQ and Group Discussion
Module IV **20 Hours**	Linear mappings-Linear transformations, examples, nullspace, ranknullity theorem, linear isomorphism.	• Lecture • Discussions • Problem solving	• Student seminars inconnection with Linear transformation and its	• Become familiar with the concept of Linear transformations and rank	Evaluation through test paper

			example.	nullity theorem.	

Course Outcomes

CO1	To prove results involving divisibility, greatest common divisor, least commonmultiple and a few applications.
CO2	Enable to solve system of congruence and diophantine equation
CO3	To learn the theorems viz. Wilson's theorem, Fermat's little theorem and Euler's theorem and its applications.
CO4	To Lean if a set of vectors is a vector space or a basis for a vetor space.
CO5	Understand the concept of linear transformation and application of rank nullity theorem.

Teacher in Charge:

Ms. Anjana Rajan

MAT6B11 : NUMERICAL METHODS

Lecture Hours per week: 5, Credits: 4

Internal: 30, External: 120, Examination 3 Hours

Objectives

To provide techniques and algorithms to find approximate numerical solution to problems in several areas of mathematics.

Module I : Solution of Algebraic and Transcendental Equation (23 hrs)

Introduction, Bisection Method, Method of false position, Iteration method, Newton-Raphson Method, Ramanujan's method, The Secant Method, Finite Differences, Forward differences, Backward differences, Central differences, Symbolic relations and separation of symbols, Differences of a Polynomial.

Module II : Interpolation (23 hrs)

Newton's formulae for intrapolation, Central difference interpolation formulae, Gauss' Central Difference Formulae, Interpolation with unevenly spaced points, Langrange's interpolation formula, Divided differences and their properties, Newton's General interpolation formula, Inverse interpolation, Numerical Differentiation and Integration, Introduction, Numerical differentiation (using Newton's forward and backward formulae), Numerical Integration, Trapizoidal Rule, Simpson's 1/3-Rule , Simpson's 3/8-Rule.

Module III : Matrices and Linear Systems of equations (22 hrs)

Solution of Linear Systems – Direct Methods, Gauss elimination, Gauss-Jordan Method, Modification of Gauss method to compute the inverse, LU Decomposition, LU Decomposition from Gauss elimination, Solution of Linear Systems – Iterative methods, The eigen value problem, Eigen values of Symmetric Tridiazonal matrix.

Module IV : Numerical Solutions of Ordinary Differential Equations (22 hrs)

Introduction, Solution by Taylor's series, Picard's method of successive approximations, Euler's method, Modified Euler's Method, Runge-Kutta method, Predictor-Corrector Methods, Adams-Moulton Method, Milne's method.

Textbooks:

1) **S.S. Sastry** : Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

Reference Books:

1) S. SankaraRao : Numerical Methods of Scientists and Engineer, 3rd ed., PHI.
2) F.B. Hidebrand : Introduction to Numerical Analysis, TMH.
3) J.B. Scarborough : Numerical Mathematical Analysis, Oxford and IBH

OBJECTIVES

1) To understand several methods such as bisection method, fixed point iteration method, regula falsi method etc.
2) To understand the concept of interpolation.
3) To solve system of linear equations using matrices.
4) To learn to find numerical approximations to solutions of initial value problems.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **23 Hours**	Solution of Algebraic and Transcendental	• Lecture • Discussion • Participative	• Assignment in different methods to	To learn to solve equations	Evaluation through test paper

	Equation, Finite differences	learning • Problem solving	solve equations • Seminars in Finite differences	using different techniques.	
Module II **23 Hours**	Interpolation, Numerical Differentiation, Numerical Integration	• Lecture • Discussion • Participative learning • Problem solving	Assignments in different techniques.	To find derivatives and integrals at a point using numerical techniques.	Evaluation through test paper
Module III **22 Hours**	Matrices and Linear Systems of equations	• Lecture • Discussion • Participative learning • Problem solving	Seminar on which technique is better and easier.	To learn to use matrices to solve system of linear equations.	Evaluation through testpaper and Viva
Module IV **22 Hours**	Numerical Solutions of Ordinary Differential Equations	• Lecture • Discussions • Problem solving	Assignment related to IVP	To find out numerical approximations to solutions of initial value problems.	Evaluation through testpaper

Course Outcome

CO1	Understand several methods such as bisection method, fixed point iteration method, regula falsi method etc. to find out the approximate numerical solutions of algebraic and transcendental equations with desired accuracy.

CO2	Understand the concept of interpolation and also learn some well known interpolation techniques.
CO3	Understand a few techniques for numerical differentiation and integration and also realize their merits and demerits.
CO4	Find out numerical approximations to solutions of initial value problems and also to understand the efficiency of various methods.
CO5	Learn to solve system of linear equations using matrices.

Teacher in Charge:

Ms. Nima Maria

MAT6B09: REAL ANALYSIS

Lecture Hours per week: 5, Credits: 5

Internal: 30, External: 120, Examination 3 Hours

Objectives

To teach one how to combine different definitions, theorems and techniques to solve problems.

Module I : Continuous Functions (25 hrs)

Continuous functions, Continuous functions on intervals, Uniform continuity

Module II : Riemann Integral (25 hrs)

Riemann Integral, Riemann Integrable Functions, The fundamental theorem, Substitution theorem and application, Approximate Integration

Module III : Sequence and series of functions (20 hrs)

A quick review of series of real numbers, Pointwise and uniform convergence, Interchange of limit and continuity, Series of functions .

Module IV (20 hrs)

Improper Integrals : Improper integrals of the first kind, Improper integrals of the second kind,Cauchy Principal value, Improper Integrals of the third kind.

Beta and Gamma functions : Beta Functions, Gamma Functions, Relation between Beta and Gamma Functions

Textbooks:

1) **G. Bartle, Donald R. Sherbert** : Introduction to Real Analysis (3rd Edn.)
2) **R.R. Goldberg** : Methods of Real Analysis.
3) **Narayanan & Manicavachagom Pillay** : Calculus, Vol. II

Reference Books:

1) J.V. Deshpande: Mathematical Analysis and Applications, Narosa Pub. House.
2) Torence Tao : Analysis I, TRIM 37, Hindustan Book Agency.
3) K.A. Ross: Elementary Real Analysis : Theory of Calculus, Springer.
4) K.G. Binmore: Mathematical Analysis, CUP

OBJECTIVES

1) To state the definition of continuous functions, formulate sequential criteria for continuity and prove or disprove continuity of functions using this criteria.
2) To develop the notion of Riemann integrability of a function using the idea of tagged partitions and calculate the integral value of some simple functions using the definition.
3) To prove convergence and divergence of sequences of functions and series.
4) To learn the properties of and relationship among two important improper integrals.

LESSON PLAN

Unit/ Hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **25 Hours**	Continuous Functions, Uniform Continuity	• Lecture • Discussion • Participative learning • Problem	Assignment regarding difference in Continuity and Uniform	To understand several deep and fundamental results of	Evaluation through test paper

		solving	Continuity.	continuous functions on intervals.	
Module II **25 Hours**	Riemann Integral	• Lecture • Discussion • Participative learning • Problem solving	Student seminars related to Riemann Intregrability.	To understand a few basic and fundamental results of integration theory.	Evaluation through test paper
Module III **20 Hours**	Sequence and series of functions	• Lecture • Discussion • Participative learning • Problem solving	Assignment on convergence of series and sequences of functions.	To understand the difference between pointwise and uniform convergence of sequences and series of functions.	Evaluation through testpaper and Viva
Module IV **20 Hours**	Improper Integrals, Beta and Gamma functions	• Lecture • Discussions • Problem solving	Seminars related to Improper Integrals and Principal Value.	To understand the notion of improper integrals, their convergence, principal value and evaluation.	Evaluation through testpaper

Course Outcomes

CO1	To understand several deep and fundamental results of continuous functions on intervals such as boundedness theorem, maximum-minimum theorem, intermediate value theorem, preservation of interval theorem and so on.
CO2	To develop the notion of Riemann integrability of a function using the idea of tagged partitions and calculate the integral value of some simple functions using the definition.
CO3	To learn and find out examples/counter examples to prove or disprove the validity of several mathematical statements that arise naturally in the process/context of learning.
CO4	To learn the properties of and relationship among two important improper integrals namely beta and gamma functions that frequently appear in mathematics, statistics, science and engineering.

Teacher in Charge:

Ms. Nima Maria

MTH1C01: ALGEBRA I
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of abstract algebra.

MODULE I

Plane Isometries, Direct products & finitely generated Abelian Groups, Factor Groups, Factor-Group Computations and Simple Groups, Group action on a set, Applications of G-set to counting

MODULE II

Isomorphism theorems, Series of groups, (Omit Butterfly Lemma and proof of the Schreier Theorem), Sylow theorems, Applications of the Sylow theory, Free Groups

MODULE III

Group Presentations, Rings of polynomials, Factorization of polynomials over a field, Non Commutative examples, Homomorphism and factor rings

TEXT:

JOHN B. FRALEIGH, A FIRST COURSE IN ABSTRACT ALGEBRA(7th Edn.), Pearson Education Inc., 2003.

REFERENCES :

[1] N. Bourbaki: Elements of Mathematics: Algebra I, Springer; 1998.

[2] Dummit and Foote: Abstract algebra(3rd edn.); Wiley India; 2011.

[3] P.A. Grillet: Abstract algebra(2nd edn.); Springer; 2007

[4] I.N. Herstein: Topics in Algebra(2nd Edn); John Wiley & Sons, 2006.

[5] T.W. Hungerford: Algebra; Springer Verlag GTM 73(4th Printing); 1987.

[6] N. Jacobson: Basic Algebra-Vol. I; Hindustan Publishing Corporation(India), Delhi; 1991.

[7] T.Y. Lam: Exercises in classical ring theory(2nd edn); Springer; 2003.

[8] C. Lanski: Concepts in Abstract Algebra; American Mathematical Society; 2010.

[9] N.H. Mc Coy: Introduction to modern algebra, Literary Licensing, LLC; 2012.

[10] S. M. Ross: Topics in Finite and Discrete Mathematics; Cambridge; 2000.

[11] J. Rotman: An Introduction to the Theory of Groups(4th edn.); Springer, 1999.

OBJECTIVES

a) **To understand the basic concepts of groups, factor groups, simple groups and group action on a set.**

b) **To get familiarize with Isomorphism theorems and its properties.**

c) **To understand the concept of sylow theorems and its applications.**

d) **To study more about rings of polynomials and factorization of polynomials over a field.**

e) **To understand homomorphism and factor ring.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Plane Isometries, Abelian groups, Factor groups, Simple groups, group action on a set	● Lecture ● Discussion ● Participative learning ● Problem solving	● Peer group discussion on groups and its properties	To understand: ●the basics of different types of groups ●notion of group action on a set	Evaluation Through MCQ
Module I1 (30 hours)	Isomorphism theorems, Sylow theorems and its applications	● Lecture ● Discussion ● Participative learning ● Problem solving	● Student seminars to explain the properties of Isomprhism ● Peer group discussion on Sylow theorems	To understand: ●Isomorphism theorems and their significance ●Sylow theorems and its applications	Evaluation Through test paper

Module III (30 Hours)	Ring of polynomials, factorization of a polynomial over a field, homomorphism and factor rings	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of homomorphism and factor rings	To understand: • homomorphism and factor rings • factorization of a polynomial over a field convergence	Evaluation through test paper

Course Outcomes

CO1	To get the idea of different types of groups and group action on a set
CO2	To understand the concept of isomorphism theorems and their significance, Sylow theorems and its applications
CO3	To understand factorization of a polynomial over a field, homomorphism and factor rings

Faculty in charge:
Dr. Nidhin T J

MTH1C05 – DISCRETE MATHEMATICS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To understand concepts in graph theory, lattices and automata.

MODULE I

Order Relations, Lattices; Boolean Algebra Definition and Properties, Boolean Functions.

MODULE II

Basic concepts, Subgraphs, Degree of vertices, Paths and connectedness, Automorphism of a simple graph, Operations on graphs, Vertex cuts and Edge cuts, Connectivity and Edge connectivity, Trees-Definition, Characterization and Simple properties, Eulerian graphs, Planar and Non planar graphs, Euler formula and its consequences, K5 and K3,3 are non planar graphs, Dual of a plane graph.

MODULE III

Automata and Formal Languages: Introduction to the theory of Computation, Finite Automata.

TEXTBOOKS

TEXT 1: R. BALAKRISHNAN and K. RANGANATHAN, A TEXT BOOK OF GRAPH THEORY, Springer-Verlag New York, Inc., 2000.

TEXT 2: K. D JOSHI, FOUNDATIONS OF DISCRETE MATHEMATICS, New Age International(P) Limited, New Delhi, 1989.

TEXT 3: PETER LINZ, AN INTRODUCTION TO FORMAL LANGUAGES AND AUTOMATA (2nd Edn.), Narosa Publishing House, New Delhi, 1997.

REFERENCES

[1] J. C. Abbot: Sets, lattices and Boolean Algebras; Allyn and Bacon, Boston; 1969.

[2] J. A. Bondy, U.S.R. Murty: Graph Theory; Springer; 2000.

[3] S. M. Cioaba and M.R. Murty: A First Course in Graph Theory and Combinatorics; Hindustan Book Agency; 2009.

[4] J. A. Clalrk: A first look at Graph Theory; World Scientific; 1991.

OBJECTIVES

- To understand the definition of Boolean algebra and Boolean functions along with various properties.
- To study graph and its types with suitable examples.
- To learn about connectivity of graphs.
- To understand the definition of trees and learn various theorems related to it.
- To study about language, grammar and types of acceptors.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Lattices; Boolean Algebra Definition and Properties, Boolean Functions	• Discussion • Participative learning • Problem solving	Seminars by students	To study about Boolean algebra and Boolean functions.	Evaluation through test paper.
MODULE II	Graph definition with examples, isomorphism, connected graphs, planar graphs, trees and eulerian graphs	• Lecture • Discussion • Participative learning • Problem solving	Assignments on isomorphism of graphs. Discussion about various definitions.	To learn basics about graphs and trees. To study about planarity and connectivity.	Evaluation through test paper.
MODULE III	Definition of automata. Languages and Grammars. DFA and NFA	• Lecture • Discussion • Participative learning • Problem solving	Discussion on applications of automata. Working out exercise problems on DFA and NFA	To know the basic about automata. To learn about DFA and NFA	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about Boolean algebra and Boolean functions.
CO2	To learn basics about graphs and trees. To study about planarity and connectivity.
CO3	To know the basic about automata. To learn about DFA and NFA

Faculty in Charge
Ms. Smitha Davis

Dr. Nidhin T J

MT1C02: LINEAR ALGEBRA
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of Linear Algebra.

MODULE I

Vector Spaces & Linear Transformations

MODULE II

Linear Transformations (continued) and Elementary Canonical Forms

MODULE III

Elementary Canonical Forms (continued), Inner Product Spaces

TEXT:

HOFFMAN K. and KUNZE R., LINEAR ALGEBRA (2nd Edn.), Prentice Hall of India, 199

REFERENCES :

[1] P. R. Halmos: Finite Dimensional Vector spaces; Narosa Pub House, New Delhi; 1980.

[2] A. K. Hazra: Matrix: Algebra, Calculus and generalised inverse- Part I; Cambridge International Science Publishing; 2007.

[3] I. N. Herstein: Topics in Algebra; Wiley Eastern Ltd Reprint; 1991.

[4] S. Kumaresan: Linear Algebra-A Geometric Approach; Prentice Hall of India; 2000.

[5] S. Lang: Linear Algebra; Addison Wesley Pub.Co.Reading, Mass; 1972.

[6] S. Maclane and G. Bikhrkhoff: Algebra; Macmillan Pub Co NY; 1967.

[7] N. H. McCoy and R. Thomas: Algebra; Allyn Bacon Inc NY; 1977.

[8] R. R. Stoll and E.T.Wong: Linear Algebra; Academic Press International Edn; 1968.

[9] G. Strang: linear algebra and its applications(4th edn.); Cengage Learning; 2006.

OBJECTIVES

a) **To understand the concept of vector spaces, basis and dimension.**

b) **To study about linear transformations and its properties.**

c) **To understand the concept of functionals and dual space**

d) **To study the relation between linear transformations and corresponding matrices.**

e) **To study about inner product spaces.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Vector spaces, subspace, basis, dimension, properties, linear transformations	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on properties of vector spaces	To understand: •the basics of vector spaces, basis •notion of linear transformation •properties of linear transformation	Evaluation through test papers and interaction with students
Module I1 (35 hours)	linear transformations, functionals, dual space and elementary canonical transformations	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of linear transformations	To understand: •More about linear transformation •Significance of dual space	Evaluation through test paper
Module III (25	canonical transformations inner product spaces,	• Lecture • Discussion • Participative learning	• Seminar and assignment on inner product	To understand: • Inner product spaces	Evaluation through test paper

Hours)		• Problem solving	spaces	and their relevance • Orthogonal compliment and direct sums of vector spaces	

Course Outcomes

CO1	To understand the concept of vector spaces, their basis, dimension and linear transformations
CO2	To understand more about linear transformations and some of its important properties, elementary canonical forms
CO3	To introduce the concept of Inner product spaces, orthogonal compliment and direct sums of vector spaces

Faculty in charge:
Ms. Linet Roslin Antony

MT1C05: NUMBER THEORY

Number of hours of Lectures per week: 5

Number of Credits: 4

Objectives

To understand the basic concepts of Number Theory.

Module 1

Arithmetical functions and Dirichlet multiplication; Averages of arithmetical functions

Module 2

Some elementary theorems on the distribution of prime numbers

Module 3

Quadratic residues and quadratic reciprocity law ,Cryptography, Public key.

TEXT 1 : APOSTOL T.M., INTRODUCTION TO ANALYTIC NUMBER THEORY, Narosa Publishing House, New Delhi, 1990.

TEXT 2: KOBLITZ NEAL A., COURSE IN NUMBER THEROY AND CRYPTOGRAPHY, SpringerVerlag, NewYork, 1987.

References

[1] A. Beautelspacher: Cryptology; Mathematical Association of America (Incorporated); 1994

[2] H. Davenport: The higher arithmetic(6th Edn.); Cambridge Univ.Press; 1992

[3] G. H. Hardy and E.M. Wright: Introduction to the theory of numbers; Oxford International Edn; 1985

[4] A. Hurwitz & N. Kritiko: Lectures on Number Theory; Springer Verlag ,Universitext; 1986

[5] T. Koshy: Elementary Number Theory with Applications; Harcourt / Academic Press; 2002

[6] D. Redmond: Number Theory; Monographs & Texts in Mathematics No: 220; Marcel Dekker Inc.; 1994

[7] P. Ribenboim: The little book of Big Primes; Springer-Verlag, New York; 1991
[8] K.H. Rosen: Elementary Number Theory and its applications(3rd Edn.); Addison Wesley Pub Co.; 1993

[9] W. Stallings: Cryptography and Network Security-Principles and Practices; PHI; 2004

[10] D.R. Stinson: Cryptography- Theory and Practice(2nd Edn.); Chapman & Hall / CRC (214. Simon Sing : The Code Book The Fourth Estate London); 1999

[11] J. Stopple: A Primer of Analytic Number Theory-From Pythagorus to Riemann; Cambridge Univ Press; 2003

[12] S.Y. Yan: Number Theroy for Computing(2nd Edn.); Springer-Verlag; 2002

OBJECTIVES

a) **To understand the basic arithmetical functions and its averages.**

b) **To get familiarize with theorems on the distribution of prime numbers.**

c) **To understand quadratic residues, quadratic reciprocity law.**

d) **To study about basics of cryptography .**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Arithmetical functions and Dirichlet multiplication; Averages of arithmetical functions	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on various arithmetic functions.	To understand: • Arithmetical functions • Dirichlet multiplication and derivatives of arithmetical functions • Averages of arithmetical functions.	Evaluation Through Test paper

Module I1 (30 hours)	Some elementary theorems on the distribution of prime numbers	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain theorems on distribution of prime numbers.	To understand: • Equivalent forms of prime number theorem. • Partial sums of Mobius function.	Evaluation Through test paper
Module III (30 Hours)	Quadratic residues and quadratic reciprocity law, Cryptography, Public key	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on legendre's symbol, its properties and Gauss lemma.	To understand: • Quadratic Residues and Quadratic reciprocity law,jacobi's symbol. • Basics of cryptography, types of crypto-system and its cryptanalysis.	Evaluation through test paper

Course Outcomes

CO1	To introduce the Arithmetical functions,Dirichlet multiplication and derivatives of arithmetical functions,Averages of arithmetic.
CO2	To understand the Equivalent forms of prime number theorem, Partial sums of Mobius function.
CO3	To understand the quadratic residues and quadratic reciprocity law, jacobi's symbol , basics of cryptography, types of cryptosystem and its cryptanalysis.

Faculty in charge:
Ms. Smitha Davis

MT1C03: REAL ANALYSIS I
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of real analysis.

MODULE I

Basic Topololgy, Finite, Countable and Uncountable sets Metric Spaces, Compact Sets, Perfect Sets, Connected Sets. Continuity - Limits of function, Continuous functions, Continuity and compactness, continuity and connectedness, Discontinuities, Monotonic functions, Infinite limits and Limits at Infinity

MODULE II

Differentiation The derivative of a real function, Mean Value theorems, The continuity of Derivatives, L Hospitals Rule, Derivatives of Higher Order, Taylors Theorem, Differentiation of Vector valued functions. The Riemann Stieltjes Integral, - Definition and Existence of the integral, properties of the integral, Integration and Differentiation

MODULE III

The Riemann Stieltjes Integral (Continued) - Integration of Vector vector-valued Functions, Rectifiable curves. Sequences and Series of Functions - Discussion of Main problem, Uniform convergence, Uniform convergence and continuity, Uniform convergence and Integration, Uniform convergence and Differentiation. Equicontinuous Families of Functions, The Stone Weierstrass

TEXT:

RUDIN W., PRINCIPLES OF MATHEMATICAL ANALYSIS (3rd Edn.), Mc. Graw-Hill, 1986.

REFERENCES :

[1] H. Amann and J. Escher: Analysis-I; Birkhuser; 2006.

[2] T. M. Apostol: Mathematical Analysis(2nd Edn.); Narosa; 2002.

[3] R. G. Bartle: Elements of Real Analysis(2nd Edn.); Wiley International Edn.; 1976.

[4] R. G. Bartle and D.R. Sherbert: Introduction to Real Analysis; John Wiley Bros; 1982.

[5] J. V. Deshpande: Mathematical Analysis and Applications- an Introduction; Alpha Science International; 2004.

OBJECTIVES

a) **To understand the basic concepts of Topology: Finite, Countable and Uncountable sets, Metric spaces, Compact sets, Perfect sets, Connected sets.**

b) **To develop the notion of continuity of functions in R^K.**

c) **To understand the concept of differentiation of real valued and complex valued functions.**

d) **To study about Riemann Stieltjes Integral and Rectifiable curves.**

e) **To understand the convergence of sequence and series of functions.**

f) **To understand the relation between uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Basic topology, Continuous functions, continuity and compactness, continuity and connectedness, discontinuities	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic topology and continuity of functions	To understand: •the basics of topology •notion of continuity •difference between continuity and	Evaluation Through MCQ

				uniform continuity	
Module I1 (30 hours)	Differentiation, derivatives of higher order, differentiation of vector valued functions, Riemann Stieltjes Integral	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the properties of differentiation and integration	To understand: • differentiation of vector valued functions • integration of vector valued functions	Evaluation Through test paper
Module III (25 Hours)	Convergence of sequence and series of functions, uniform convergence and continuity, uniform convergence and differentiation, uniform convergence and integration	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on properties of convergence of functions	To understand: • Convergence of sequence and series of functions • Differentiate between convergence and uniform convergence	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of basic topology, difference between continuous and uniformly continuous functions and its properties.
CO2	To understand the concept of differentiation of vector valued functions and integration of functions.
CO3	To understand the difference between pointwise convergence and uniform convergence of sequence of functions, convergence of series of functions

Faculty in charge:
Dr. Vijitha Mukundan

MTH2C06: ALGEBRA II
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the ideas and concepts of insolvability of the quintic.

MODULE I

Prime and Maximal Ideals, Introduction to Extension Fields, Algebraic Extensions (Omit Proof of the Existence of an Algebraic Closure), Geometric Constructions. [27, 29, 31, 32]

MODULE II

Finite Fields, Automorphisms of Fields, the Isomorphism Extension Theorem, Splitting Fields, Separable Extensions. [33, 48, 49, 50, 51]

MODULE III

Galois Theory, Illustration of Galois Theory, Cyclotomic Extensions, Insolvability of the Quintic. [53, 54, 55, 56]

TEXT: John B. Fraleigh: A FIRST COURSE IN ABSTRACT ALGEBRA (7th Edn), Pearson Education Inc., 2003.

REFERENCES :

[1] N. Bourbaki: Elements of Mathematics: Algebra I, Springer; 1998

[2] Dummit and Foote: Abstract algebra (3rd Edn); Wiley India; 2011

[3] M.H. Fenrick: Introduction to the Galois correspondence (2nd Edn); Birkhuser; 1998

[4] P.A. Grillet: Abstract algebra (2nd Edn); Springer; 2007

[5] I.N. Herstein: Topics in Algebra (2nd Edn); John Wiley & Sons, 2006.

[6] T.W. Hungerford: Algebra; Springer Verlag GTM 73 (4th Printing); 1987

[7] C. Lanski: Concepts in Abstract Algebra; American Mathematical Society; 2010

[8] R. Lidl and G. Pilz Applied abstract algebra(2nd edn.); Springer; 1998

[9] N.H. Mc Coy: Introduction to modern algebra, Literary Licensing, LLC; 2012

[10] J. Rotman: An Introduction to the Theory of Groups (4th Edn); Springer; 1999

[11] I. Stewart: Galois theory(3rd edn.); Chapman & Hall/CRC; 2003

OBJECTIVES

a) **To understand the basic concepts of Prime and Maximal Ideals.**

b) **To get familiarize with Algebraic Extensions.**

c) **To understand the Automorphisms of fields, Separable Extensions and Splitting Fields.**

d) **To study about the Galois Theory, Cyclotomic Extensions and the Insolvability of the Quintic.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Prime and Maximal Ideals, Introduction to Extension Fields, Algebraic Extensions, Geometric Constructions.	● Lecture ● Discussion ● Participative learning ● Problem solving	● Peer group discussion on prime and maximal ideals and algebraic extensions	To understand: ●the basics of extension fields ●geometric constructions	Evaluation through MCQ
Module I1 (30 hours)	Finite Fields, Automorphisms of Fields, the Isomorphism Extension Theorem, Splitting Fields, Separable Extensions.	● Lecture ● Discussion ● Participative learning ● Problem solving	● Student seminars to explain about separable extensions	To understand: ●Isomorphism Extension Theorem Splitting and Separable Extensions	Evaluation through test paper
Module III (30 hours)	Galois Theory, Illustration of Galois Theory, Cyclotomic Extensions, Insolvability of the Quintic.	● Lecture ● Discussion ● Participative learning ● Problem solving	● Seminar and assignment on Cyclotomic Extensions	To understand: ● Galois Theory ● Insolvability of the Quintic	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of finite and extension fields, geometric constructions etc.
CO2	To understand the concept of Isomorphism Extension Theorem, Splitting and Separable Extensions.
CO3	To understand Galois theory and the Insolvability of the Quintic

Faculty in charge:
Ms. Linet Roslin Antony

MTH2C09: ODE AND CALCULUS OF VARIATIONS
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic concepts of ordinary differential equations and its applications.

MODULE I

Power Series Solutions and Special functions; Some Special Functions of Mathematical Physics.

MODULE II

Some special functions of Mathematical Physics (continued), Systems of First Order Equations; Non linear Equations

MODULE III

Oscillation Theory of Boundary Value Problems, The Existence and Uniqueness of Solutions, The Calculus of Variations.

TEXT:

SIMMONS, G.F., DIFFERENTIAL EQUATIONS WITH APPLICATIONS AND HISTORICAL NOTES (3rd Edn.), New Delhi, 1974.

REFERENCES :

[1] G. Birkhoff and G.C. Rota: Ordinary Differential Equations(3rd Edn.); Edn. Wiley & Sons; 1978

[2] W.E. Boyce and R.C. Diprima: Elementary Differential Equations and boundary value problems (2nd Edn.); John Wiley & Sons, NY; 1969

[3] A. Chakrabarti: Elements of ordinary Differential Equations and special functions; Wiley Eastern Ltd., New Delhi; 1990

[4] E.A. Coddington: An Introduction to Ordinary Differential Eqution; Printice Hall of India, New Delhi; 1974

[5] R.Courant and D. Hilbert: Methods of Mathematical Physics- vol I; Wiley Eastern Reprint; 1975

[6] P. Hartman: Ordinary Differential Equations; John Wiley & Sons; 1964 [7] L.S. Pontriyagin : A course in ordinary Differential Equations Hindustan Pub. Corporation, Delhi; 1967

[8] I. Sneddon: Elements of Partial Differential Equations; McGraw-Hill International, Edn.;1957

OBJECTIVES

a) **To study how to compute power series solution of first order ODE.**

b) **To get familiarize with some special functions of Mathematical Physics.**

c) **To study the methods to solve systems of first order equations.**

d) **To study more about qualitative properties of solutions.**

e) **To understand the concept of calculus of variations.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Power series solutions of first order ODEs, special functions in Mathematical Physics	• Lecture • Discussion • Participative learning • Problem solving	• Problem solving sessions in groups. • Discussing the solutions obtained	To understand: • the basics of solutions of ODE • significance of special functions	Evaluation Through test papers
Module I1 (30 hours)	Solve systems of first order and nonlinear equations	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain nonlinear equations	To understand: • the method to solve systems of first order equations • theory of solutions of nonlinear equations	Evaluation through test paper
Module III (25 Hours)	Existence and uniqueness of solutions, calculus of variations	• Lecture • Discussion • Participative learning • Problem solving	• Assignment on existence and uniqueness of solutions • Discussion in peer groups on Calculus of Variations	To understand: • the applications in Calculus of variations • the qualitative nature of solutions	Evaluation through test paper

Course Outcomes

CO1	To understand the power series solutions of ordinary differential equations and the significance of special functions.
CO2	To know more about special functions, systems of first order equations and nonlinear equations
CO3	To understand the qualitative nature of solutions and calculus of variation.

Faculty in charge:
Dr. Vijitha Mukundan

MTH2C10 – OPERATIONS RESEARCH

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn various methods to solve an LPP and study about game theory and networking.

MODULE I

Convex Functions; Linear Programming

MODULE II

Linear Programming (contd.); Transportation Problem

MODULE III

Integer Programming; Sensitivity Analysis; Flow and Potential in Networks; Theory of Games

TEXTBOOK

K.V. MITAL; C. MOHAN., OPTIMIZATION METHODS IN OPERATIONS RESEARCH AND SYSTEMS ANALYSIS(3rd. Edn.), New Age International(P) Ltd., 1996.

REFERENCES

[1] R.L. Ackoff and M.W. Sasioni: Fundamentals of Operations Research; Wiley Eastern Ltd. New Delhi; 1991

[2] C.S. Beightler, D.T. Philiphs and D.J. Wilde: Foundations of optimization(2nd Edn.); Prentice Hall of India, Delhi; 1979

[3] G. Hadley: Linear Programming; Addison-Wesley Pub Co Reading, Mass; 1975

[4] G. Hadley: Non-linear and Dynamic Programming; Wiley Eastern Pub Co. Reading, Mass; 1964

OBJECTIVES

- To learn about convex function and few theorems related to it.
- To study LPP and simplex method to solve it.

- ❖ Understand and solve transportation problems.
- ❖ To study about the sensitivity analysis.
- ❖ To learn flow and networks.
- ❖ To understand the problems related to game theory.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Convex functions. Definition of LPP.	● Discussion ● Participative learning ● Problem solving ● Lecture	Assignments on LPP	To study about convex functions and definition of LPP	Evaluation through test paper.
MODULE II	Simplex method to solve LPP. Transportation problem. VAM and MODI method to solve transportation problem.	● Lecture ● Discussion ● Participative learning ● Problem solving	Assignments on simplex method and solving of transportation method	To learn to solve LPP using simplex method. To solve Transportation problem.	Evaluation through test paper.
MODULE III	Integer programming and sensitivity analysis. Networking. Introduction to Game theory.	● Lecture ● Discussion ● Participative learning ● Problem solving	Seminar by students on sensitivity analysis. Methods to solve flow and network. Game theory problem solving.	Discussion on sensitivity analysis. To solve networks and problems on game theory.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about convex functions
CO2	To learn about methods to solve LPP and transportation problems
CO3	To know about sensitivity in LPP and methods to solve networks. To understand game theory.

Faculty in charge:

Ms. Smitha Davis

Dr. Nidhin T J

MTH2C07: REAL ANALYSIS II
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the advanced concepts of real analysis.

MODULE I

The Real Numbers: Sets, Sequences and Functions, Sigma Algebra, Borel sets, Lebesgue Measure, Lebesgue Measurable Functions

MODULE II

Lebesgue Integration, Lebesgue Integration: Further topics

MODULE III

Differentiation and Integration, The L^p spaces : Completeness and Approximation

TEXT:

H. L.Royden ,P. M. FitzpatrickH.L. REAL ANAYLSIS (4th Edn.), Prentice Hall of India, 2000.

REFERENCES :

[1] K B. Athreya and S N Lahiri:,Measure theory,Hindustan Book Agency,New Delhi,(2006).

[2] R G Bartle:, The Elements of Integration and Lebsgue Mesure , Wiley(1995).

[3] S K Berberian: ,measure theory and Integration,The Mc Millan Company,New York,(1965).

[4] L M Graves: ,The Theory of Functions of Real Variable Tata McGraw-Hill Book Co(1978)

[5] P R Halmos: , Measure Theory, GTM ,Springer Verlag [6] W Rudin:, Real and Complex Analysis,Tata McGraw Hill,New Delhi,2006

[7] I K Rana:,An Introduction to Measure and Integration,Narosa Publishing Company,New York.

[8] Terence Tao: ,An Introduction to Measure Theory,Graduate Studies in Mathematics,Vol 126 AMS

OBJECTIVES

a) **To understand the basic concepts of Sigma Algebra, Borel sets.**

b) **To understand Lebesgue Measure and Lebesgue Measurable Functions and its properties**

c) **To understand the concept of Lebesgue Integration,**

d) **To perform differentiation and Integration**

e) **To study about the L^p spaces : Completeness and Approximation**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Sets, Sequences and Functions, Sigma Algebra, Borel sets, Lebesgue Measure, Lebesgue Measurable Functions	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Lebesgue measure and Lebesgue measurable functions	To understand: •the basics of sigma algebra •notion of Lebesgue measure and measurable functions	Evaluation through interaction with students and test papers
Module I1 (30 hours)	Lebesgue Integration	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars on some topics of Lebesgue integration	To understand: •Concepts of Lebesgue integration	Evaluation through test paper
Module II1 (30 hours)	Differentiation and Integration, The L^p spaces : Completeness and	• Lecture • Discussion • Participative learning	• Assignments on Differentiatio	To understand: •Concepts of L^pspaces	Evaluation through test paper

	Approximation	• Problem solving	n and Integration		

Course Outcomes

CO1	To introduce the concept of Sigma Algebra, Borel sets, Lebesgue Measure, Lebesgue Measurable Functions
CO2	To understand the concept of Lebesgue integration, the L^p spaces : Completeness and Approximation
CO3	To understand the concept of differentiation and integration.

Faculty in charge:
Dr. Nidhin T J

MTH2C08: TOPOLOGY
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the motivation and concepts of topology.

MODULE I

A Quick Revision of Chapter 1,2 and 3. Topological space, basic concepts [Chapter 4 and Chapter5 Section 1, Section 2(excluding 2.11 and 2.12) and Section 3 only]

MODULE II

Making Functions Continuous, quotient spaces, spaces with special properties [Chapter 5 Section 4 and Chapter 6]

MODULE III

Separation axioms: Hierarchy of separation axioms, Compactness and separation axioms, The Urysohn characterization of normality, Tietze characterization of normality.[Chapter 7 Section 1 to 3 and Section 4 up to and including 4.6]

TEXT:

JOSHI K D, INTRODUCTION TO GENERAL TOPOLOGY (Revised Edn.), New Age International (P) Ltd., New Delhi, 1983

Inc., 2003.

REFERENCES :

[1] M A Armstrong: Basic Topology, Springer- Verlag New York; 1983.

[2] J Dugundji: Topology; Prentice hall of India; 1975.

[3] M Gemignani: Elementary Topology; Addison Wesley Pub Co Reading Mass, 1971

[4] M G Murdeshwar: General Topology(2nd Edn);Wiley Eastern Ltd, 1990

[5] G F Simmons: Introduction to Topology and modern analysis; McGraw-Hill international student Edn;1963.

OBJECTIVES

a) **To understand the basic concepts of Topological Spaces.**

b) **To get familiarize with making functions continuous, Quotient Spaces.**

c) **To understand the separation axioms, Hierarchy of separation axioms, compactness and separation axioms.**

d) **To study the Urysohn characterization of normality, Tietze characterization of normality.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Topological Spaces, Basic concepts	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic topology and topological space	To understand: ●the basics of topology ●topological spaces ●different types of topologies	Evaluation Through MCQ
Module I1 (30 hours)	Making functions continuous, quotient spaces, spaces with special properties	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about making functions continuous	To understand: ●Compact Lindeloff spaces ●Connectedness Local Connectedness	Evaluation Through test paper

				Path Connectedness	
Module III (30 Hours)	Separation axioms: Hierarchy of separation axioms, compactness and separation axioms, The Urysohn characterization of normality, Tietze characterization of normality	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on separation axioms	To understand: • Separation axioms • Urysohn characterization of normality	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of basic topology, topological space, different types of topologies.
CO2	To understand the concept of making functions continuous, quotient spaces
CO3	To understand the separation axioms, the Urysohn characterization of normality, Tietz characterization of normality

Faculty in charge:
Ms. Smitha Davis

MTH3C12: COMPLEX ANALYSIS
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the ideas and concepts of analytic functions and singularities..

MODULE I

The extended plane and its spherical representation, Power series, Analytic functions, Analytic functions as mappings, Mobius transformations, Riemann-Stieltijes integrals [Chapt. I Section 6; Chapt. III Sections 1, 2 and 3; Chapter IV Section 1]

MODULE II

Power series representation of analytic functions, Zeros of an analytic function, The index of a closed curve, Cauchy's Theorem and Integral Formula, The homotopic version of Cauchys Theorem and simple connectivity, Counting zeros; the Open Mapping Theorem and Goursats Theorem.

MODULE III

The classification of singularities, Residues, The Argument Principle and The Maximum Principle, Schwarz's Lemma, Convex functions and Hadamards three circles theorem [Chapt. V: Sections 1, 2, 3; Chapter VI Sections 1, 2, 3]

TEXT: JOHN B. CONWAY, FUNCTIONS OF ONE COMPLEX VARIABLE (2nd Edn.);
Springer International Student Edition; 1992.

REFERENCES :

[1] H. Cartan: Elementary Theory of analytic functions of one or several variables;
Addison - Wesley Pub. Co.; 1973
[2] T.W. Gamelin: Complex Analysis; Springer-Verlag, NY Inc.; 2001
[3] T.O. Moore and E.H. Hadlock: Complex Analysis, Series in Pure Mathematics - Vol. 9; World Scientific; 1991
[4] L. Pennisi: Elements of Complex Variables (2nd Edn.); Holf, Rinehart & Winston; 1976
[5] R. Remmert: Theory of Complex Functions; UTM , Springer-Verlag, NY; 1991
[6] W. Rudin: Real and Complex Analysis (3rd Edn.); Mc Graw - Hill International Editions; 1987
[7] H. Sliverman: Complex Variables; Houghton Mifflin Co. Boston; 1975 [11] I. Stewart: Galois theory (3rd edn); Chapman & Hall/CRC; 2003

OBJECTIVES

a) **To understand the basic concepts of** Power series, Analytic functions, Analytic functions as mappings and Mobius transformations.

b) **To get familiarize with** Riemann-Stieltijes integrals**.**

c) **To understand the** Power series representation of analytic functions, Zeros of an analytic function, The index of a closed curve, Cauchy's Theorem and Integral Formula and the classification of singularities.

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (30 hours)	The extended plane and its spherical representation, Power series, Analytic functions, Analytic functions as mappings, Mobius transformations, Riemann-Stieltijes integrals	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on Power series and Analytic functions	To understand: • Analytic functions as mappings • Riemann-Stieltijes integrals	Evaluation through MCQ
Module I1 (30 hours)	Power series representation of analytic functions, Zeros of an analytic function, The index of a closed curve, Cauchy's Theorem and Integral Formula, The homotopic version of Cauchys Theorem and simple connectivity, Counting zeros; the Open Mapping Theorem and Goursat's Theorem.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain about Power series representation of analytic functions	To understand: • Cauchy's Theorem and Integral Formula • Open Mapping Theorem and Goursat's Theorem.	Evaluation through test paper

Module III (30 hours)	The classification of singularities, Residues, The Argument Principle and The Maximum Principle, Schwarz's Lemma, Convex functions and Hadamard's three circles theorem.	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on classification of singularities	To understand: • Maximum Principle, Schwarz's Lemma, Convex functions	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of Power series and Analytic functions
CO2	To understand the concept of Cauchy's Theorem and Integral Formula, Open Mapping Theorem and Goursat's Theorem.
CO3	To understand the Argument Principle, the Maximum Principle and Schwarz's Lemma.

Faculty in charge:
Ms. Linet Roslin Antony

MTH3E02 – CRYPTOGRAPHY

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To understand concepts in Cryptosystems, it's working and Hash functions.

MODULE I

Classical Cryptography: Some Simple Cryptosystems, Shift Cipher, Substitution Cipher, Affine Cipher, Vigenere Cipher, Hill Cipher, Permutation Cipher, Stream Ciphers. Cryptanalysis of the Affine, Substitution, Vigenere, Hill and LFSR Stream Cipher.

MODULE II

Shannons Theory:- Elementary Probability Theory, Perfect Secrecy, Entropy, Huffmann Encodings, Properties of Entropy, Spurious Keys and Unicity Distance, Product Cryptosystem.

MODULE III

Block Ciphers: Substitution Permutation Networks, Linear Cryptanalysis, Differential Cryptanalysis , Data Encryption Standard (DES), Advanced Encryption Standard (AES). Cryptographic Hash Functions: Hash Functions and Data integrity, Security of Hash Functions, iterated hash functions- MD5, SHA 1, Message Authentication Codes, Unconditionally Secure MAC s.

TEXTBOOKS

Douglas R. Stinson, Cryptography Theory and Practice, Chapman & Hall, 2nd Edition.

REFERENCES

[1] Jeffrey Hoffstein: Jill Pipher, Joseph H. Silverman, An Introduction to Mathemaical Cryptography, Springer International Edition

.

[2] H. Deffs & H. Knebl: Introduction to Cryptography, Springer Verlag, 2002.

[3] Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone: Handbook of Applied Cryptography, CRC Press, 1996.

[4] William Stallings: Cryptography and Network Security Principles and Practice, Third Edition, Prentice-hall India, 2003.

OBJECTIVES

- To understand various cryptosystems and its crpytanalysis.

- To learn Shannons Theory AES and DES in detail
- To learn about Huffmann encodiungs and product cryptosystem.
- To understand block ciphers and its construction.
- To study in detail about Hash functions and its variations.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I (15 hours)	Crpytosystem definition, Important cryptosystems and its Cryptanalysis	• Discussion • Participative learning • Problem solving	Discussions Lectures and Quizzes	To study about Cryptosystems and its constructions and breaking.	Evaluation through test paper.
MODULE II (18 hours)	Concepts of perfect secrecy, Shannon's theory, Unicity distance and spurious keys and product cryptosystem	• Lecture • Discussion • Participative learning • Problem solving	. Discussion about perfect secrecy .	To learn Shannon's theory, constructions and product cryptosystem.	Evaluation through test paper.
MODULE III (22 hours)	Block Ciphers, DES, AES, Hash functions, iterated hash functions, MAC's	• Lecture • Discussion • Participative learning • Problem solving	Discussion on Hash functions and block ciphers	Construction of DES, AES, Iterated Hash functions	Evaluation through MCQ.

COURSE OUTCOME

CO1	To study about classical cryptosystems and its cryptanalysis.
CO2	To learn Shannon's theory and perfect secrecy To study about product cryptosystems
CO3	To know about construction of various block ciphers To learn about iterated hash functions

Faculty in Charge

Ms. Smitha Davis

MTH3C13 – FUNCTIONAL ANALYSIS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To understand various linear spaces and their corresponding properties.

MODULE I

Linear Spaces; normed spaces;first examples: Linear spaces, Normed spaces;first examples, Holder's inequality, Minkowski's ineaquality, Topological and geometric notions, Quotient normed space, Completeness;completion.

MODULE II

Hilbert spaces: Basic notions; first examples, Cauchy- Schwartz inequality and Hilbertian norm,Bessels inequality,Complete systems, Gram-Schmidt orthogonalization procedure, orthogonal bases, Parseval' identity; Projection; orthogonal decompositions; Separable case, The distance from a point to a convex set, Orthogonal decomposition; linear functionals; Linear functionals in a general linear space, Bounded linear functionals, Bounded linear functionals in a Hilbert space, An example of a non separable Hilbert space

MODULE III

The dual space; The Hahn Banach Theorem and its first consequences, corollaries of the Hahn Banach theorem, Examples of dual spaces. Bounded linear Operators; Completeness of the space of bounded linear operators, Examples of linear operators, Compact operators, Compact sets, The space of compact operators, Dual operators ,Operators of finite rank, Compactness of the integral operators in L2, Convergence in the space of bounded operators, Invertible operators

TEXTBOOK

YULI EIDELMAN, VITALI MILMAN & ANTONIS TSOLOMITIS; FUNCTIONAL ANALYSIS AN INTRODUCTION; AMS, Providence, Rhode Island 2004

REFERENCES

[1] B. V. Limaye: Functional Analysis, New Age International Ltd, New Delhi, 1996.

[2] G. Bachman and L. Narici: Functional Analysis; Academic Press, NY; 1970

[3] J. B. Conway: Functional Analysis; Narosa Pub House, New Delhi; 1978

[4] J. Dieudonne: Foundations of Modern analysis; Academic Press; 1969

OBJECTIVES

- To define normed spaces with examples and its completeness.
- To study about quotient spaces.
- To understand Hilbert spaces and its completeness along with examples
- To study about Projection and linear functionals.
- To understand the concept of duality of these spaces.
- To learn about compact linear operators.

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Normed spaces and examples. Quotient space. Completeness.	• Discussion • Participative learning • Problem solving • Lecture	Assignments on examples of normed spaces	To study about normed spaces and its completeness. To define quotient spaces.	Evaluation through test paper.
MODULE II	Hilbert spaces. Projection and Bounded linear functionals. Seperability.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on Projection mapping. Seminar by students on examples	To learn about Hilbert spaces, Projection and linear functionals along with its properties	Evaluation through test paper.
MODULE III	Dual spaces and examples. Hahn Banach theorem. Operators and its properties	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students Assignment on examples of operators.	To study Dual Spaces and operators. To learn about Hahn Banach theorem.	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about normed spaces and its properties
CO2	To learn about Hilbert spaces, Projection and Linear functionals.
CO3	To study about duality.

Faculty in charge:

Ms. Amala Mary George

MTH3C11 – MULTIVARIABLE CALCULUS AND GEOMETRY

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To understand concepts in Differential Geometry

MODULE I

Functions of Several Variables Linear Transformations, Differentiation, The Contraction Principle, The Inverse Function Theorem, the Implicit Function Theorem.

MODULE II

What is a curve? Arc-length, Reparametrization, Closed curves, Level curves versus parametrized curves. Curvature, Plane curves, Space curves What is a surface, Smooth surfaces, Smooth maps, Tangents and derivatives, Normals and orientability.

MODULE III

Level surfaces, Ruled surfaces and surfaces of revolution, Applications of the inverse function theorem, Lengths of curves on surfaces, Equiareal maps and a theorem of Archimedes, The second fundamental form, The Gauss and Weingarten maps, Normal and geodesic curvatures. Gaussian and mean curvatures, Principal curvatures of a surface.

TEXTBOOKS

TEXT 1 : RUDIN W., PRINCIPLES OF MATHEMATICAL ANALYSIS, (3rd Edn.), Mc. Graw Hill, 1986.

TEXT 2: ANDREW PRESSLEY, ELEMENTARY DIFFERENTIAL GEOMETRY(2nd Edn.), Springer-Verlag, 2010.

REFERENCES

[1] M. P. do Carmo: Differential Geometry of Curves and Surfaces;

[2] W. Klingenberg: A course in Differential Geometry;

[3] J. R. Munkres: Analysis on Manifolds; Westview Press; 1997

[4] C. C. Pugh: Real Mathematical Analysis, Springer; 2010

[5] M. Spivak: A Comprehensive Introduction to Differential Geometry-Vol. I; Publish

or Perish, Boston; 1970

[6] M. Spivak: Calculus on Manifolds; Westview Press; 1971

[7] V.A. Zorich: Mathematical Analysis-I; Springer; 2008

OBJECTIVES

- To understand functions of several variables and its differentiation
- To study curves, level curves and curvature.
- To learn about surfaces and its properties as normal, orientablity and tangents.
- To understand the definition Guass Weingarten maps
- To study about Guassian, mean curvatures

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	The Contraction Principle, The Inverse Function Theorem, the Implicit Function Theorem.	• Discussion • Participative learning • Problem solving	Seminars by students	To study about Functions of Several Variables Linear Transformations and its properties	Evaluation through test paper.
MODULE II	Arc-length, Reparametrization, Level curves versus parametrized curves. Curvature, Tangents and derivatives, Normals and orientability.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on Tangents and derivatives. Discussion about various definitions.	To learn basics about Curves, Level curves, curvature, Smooth maps,Tangents, Normals.	Evaluation through MCQ

MODULE III	Level surfaces, Applications of the inverse function theorem, Normal and geodesic curvatures. Gaussian and mean curvatures, Principal curvatures of a surface.	• Lecture • Discussion • Participative learning • Problem solving	Discussion on Surfaces and its properties.	To know the about Level, ruled surfaces, Guassian, mean, principal curvatures. The Gauss and Weingarten maps,	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about functions of several variables
CO2	To learn about the analytical and geometric concepts of curves and its variations To study about cuvature and sufaces
CO3	To know The Gauss and Weingarten maps, To learn Guassian and mean curvature.

Faculty in Charge

Dr. Nidhin T J

MTH3C14: PDE and Integral Equations
Number of hours of Lectures per week: 5
Number of Credits: 4

Objectives

To understand the basic theory of PDE and Integral Equations.

MODULE I

First-order equations: Introduction, Quasilinear equations, The method of characteristics, Examples of the characteristics method, The existence and uniqueness theorem, The Lagrange method, Conservation laws and shock waves, The eikonal equation, General nonlinear equations, Exercises. Second-order linear equations in two indenpendent variables: Introduction, Classification, Canonical form of hyperbolic equations, Canonical form of parabolic equations, Canonical form of elliptic equations, Exercises ,The one-dimensional wave equation: Introduction, Canonical form and general solution, The Cauchy problem and d'Alemberts formula, Domain of dependence and region of influence, The Cauchy problem for the nonhomogeneous wave equation, Exercises

MODULE II

The method of separation of variables: Introduction, Heat equation: homogeneous boundary condition, Separation of variables for the wave equation, Separation of variables for nonhomogeneous equations, The energy method and uniqueness, Further applications of the heat equation, Exercises Elliptic equations: Introduction, Basic properties of elliptic problems, The maximum principle, Applications of the maximum principle, Greens identities, The maximum principle for the heat equation, Separation of variables for elliptic problems, Poissons formula, Exercises Greens functions and integral representations:Introduction, Greens function for Dirichlet problem in the plane, Neumanns function in the plane, The heat kernel, Exercises

MODULE III

Integral Equations: Introduction, Relations between differential and integral equations, The Green's functions, Fredholom equations with separable kernels, Illustrative examples, Hilbert- Schmidt

Theory, Iterative methods for solving Equations of the second kind. The Newmann Series, Fredholm Theory

TEXT 1: AN INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS, YEHUDA PINCHOVER AND JACOB RUBINSTEIN, Cambridge University Press

TEXT 2: HILDEBRAND, F.B., METHODS OF APPLIED MATHEMATICS (2nd Edn.), Prentice-Hall of India, New Delhi, 1972.

REFERENCES :

[1] Amaranath T.:Partial Differential Equations, Narosa, New Delhi, 1997.
[2] A. Chakrabarti: Elements of ordinary Differential Equations and special functions; Wiley Eastern Ltd, New Delhi; 1990
[3] E.A. Coddington: An Introduction to Ordinary Differential Eqution Printice Hall of India ,New Delhi; 1974
[4] R. Courant and D.Hilbert: Methods of Mathematical Physics-Vol I; Wiley Eastern Reprint; 1975
[5] P. Hartman: Ordinary Differential Equations; John Wiley & Sons; 1964
[6] F. John: Partial Differential Equations; Narosa Pub House New Delhi; 1986
[7] Phoolan Prasad Renuka Ravindran: Partial Differential Equations; Wiley Eastern Ltd, New Delhi; 1985
[8] L.S. Pontriyagin: A course in ordinary Differential Equations; Hindustan Pub. Corpporation, Delhi; 1967
[9] I. Sneddon: Elements of Partial Differential Equations; McGraw-Hill International Edn.;1957

OBJECTIVES

a) **To study the basic concepts of solving partial differential equations analytically.**

b) **To study different methods for solving second order linear and nonlinear pde**

c) **To understand the relation between integral equations and differential equations and to study different methods to solve integral equations.**

d) **To understand the nature of solutions of PDEs.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (35 hours)	Quasilinear equations, method of characteristics, the Lagrange method, general nonlinear equations	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on solutions of pde and transversality condition	To understand: • the nature of solution of PDE • graphical method to solve pde • the nature of solution of nonlinear PDE	Evaluation through test paper and interaction with students
Module I1 (30 hours)	Separation of variables, canonical form, energy method and elliptic equations	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to understand the method of separation of variables	To understand: • Methods to solve second order PDE • Solutions of elliptic equations • Energy method	Evaluation Through test paper
Module III (25 Hours)	Integral equations, Fredholm and Volterra equations, Resolvent kernel,Neumann series, Fredholm Schmidt theory	• Lecture • Discussion • Participative learning • Problem solving	• Assignment and problem solving sessions on Integral equations	To understand: • Relation between integral equation and differential equation • Methods to solve integral	Evaluation through test paper

				equations of different kinds	

Course Outcomes

CO1	To study solutions of PDE and to understand the nature of solutions via characteristic curves, graphical method.
CO2	To study methods of solving second order PDE, elliptic PDEs and energy method
CO3	To understand the relation between differential equation and integral equations, also different methods to solve integral equations.

Faculty in charge:
Dr. Vijitha Mukundan

MTH4E06: Algebraic Number Theory
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the concepts of Algebraic Number Theory.

MODULE I

Symmetric polynomials, Modules, Free abelian groups, Algebraic Numbers, Conjugates and Discriminants, Algebraic Integers, Integral Bases, Norms and Traces, Rings of Integers, Quadratic Fields, Cyclotomic Fields

MODULE II

Historical background, Trivial Factorizations, Factorization into Irreducibles, Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals Historical background, Prime Factorization of Ideals, The norm of an ideal

MODULE III

Lattices, The Quotient Torus, Minkowski theorem, The Space Lst, The Class-Group An Existence Theorem, Finiteness of the Class-Group, Factorization of a Rational Prime, Fermats Last Theorem Some history, Elementary Considerations, Kummers Lemma, Kummers Theorem.

TEXT : I. N. STEWART & D.O. TALL, ALGEBRAIC NUMBER THEORY, (2nd Edn.), Chapman & Hall, (1987)

REFERENCES :

[1] P. Samuel : Theory of Algebraic Numbers, Herman Paris Houghton Mifflin, NY, (1975)
[2] S. Lang : Algebraic Number Theory, Addison Wesley Pub Co., Reading, Mass, (1970)
[3] bf D. Marcus : Number Fields, Universitext, Springer Verlag, NY, (1976)
[4] 4T.I.FR. Pamphlet No: 4 : Algebraic Number Theory (Bombay, 1966)
[5] Harvey Cohn : Advanced Number Theory, Dover Publications Inc., NY, (1980)
[6] Andre Weil : Basic Number Theory, (3rd Edn.), Springer Verlag, NY, (1974)
[7] G.H. Hardy and E.M. Wright : An Introduction to the Theory of Numbers, Oxford University Press.
[8] Z.I. Borevich & I.R.Shafarevich : Number Theory, Academic Press, NY 1966.
[9] Esmonde & Ram Murthy : Problems in Algebraic Number Theory, Springer Verlag 2000

OBJECTIVES

a) **To study the basic concepts of numberfield, quadratic field, Guassian field and their properties.**

b) **To study how factorization into irreducibles hold in different fields.**

c) **To understand the concepts of lattices, the quotient torus and geometric representation of algebraic numbers.**

LESSON PLAN

Unit/ session/ hours (time required)	**Topics to be taught (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 (35 hours)	Factorization into Irreducibles, Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals, Prime Factorization of Ideals,	● Lecture ● Discussion ● Participative learning ● Problem solving	● Peer group discussion on numberfields and its properties	To understand: ●the factorization into irreducibles ●different types of numberfields ●the factorization of ideals ●properties of ideals	Evaluation through test paper and interaction with students

Module I1 (30 hours)	Examples of Nonunique Factorization into Irreducibles, Prime Factorization, Euclidean Domains, Euclidean Quadratic fields Ideals Historical background, Prime Factorization of Ideals, The norm of an ideal	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to understand prime factorization and quadratic fields	To understand: • Nonunique Factorization into Irreducibles • Factorization of Ideals and norm of an ideal	Evaluation Through test paper
Module III (25 Hours)	Lattices, The Quotient Torus, Minkowski theorem, The Space Lst, The Class-Group An Existence Theorem, Finiteness of the Class-Group, Factorization of a Rational Prime, Kummers Lemma, Kummers Theorem	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion and assignments to understand geometric representation of algebraic numbers	To understand: • The Quotient Torus • The class group	Evaluation through test paper

Course Outcomes

CO1	Awareness about different types of numberfield and their properties
CO2	Able to check unique factorization in fields and also can provide examples of nonunique factorizations
CO3	To understand the geometric representation of algebraic numbers

Faculty in charge:
Dr. Vijitha Mukundan

MTH4C15 – ADVANCED FUNCTIONAL ANALYSIS

Number of hours of lectures per week : 5 hrs

Number of credits : 4

OBJECTIVE

To learn about the fundamental and basic theorems in functional analysis.

MODULE I

Spectrum, Fredholm Theory of Compact operators; Classification of spectrum, Fredholm Theory of Compact operators. Self adjoint operators; General properties, Self adjoint compact operators, spectral theory, Minimax principle, Applications to integral operators.

MODULE II

Order in the space of self-adjoint operators, properties of the ordering; Projection operators; properties of projection in linear spaces, Orthoprojections. Functions of Operators spectral decomposition; Spectral decomposition, The main inequality, Construction of the spectral integral, Hilbert Theorem.

MODULE III

The fundamental theorems and the basic methods; Auxiliary results, The Banach open mapping Theorem, The closed graph Theorem, The Banach- Steinhaus theorem, Bases in Banach spaces, Linear functionals; the Hahn Banach theorem, Separation of Convex sets. Banach Algebras; Preliminaries, Gelfand's theorem on maximal ideals

TEXTBOOK

YULI EIDELMAN, VITALI MILMAN & ANTONIS TSOLOMITIS; FUNCTIONAL ANALYSIS AN INTRODUCTION; AMS, Providence, Rhode Island 2004

REFERENCES

[1] B. V. Limaye: Functional Analysis, New Age International Ltd, New Delhi, 1996.

[2] R. Bhatia: Notes on Functional Analysis TRIM series, Hindustan Book Agency

[3] Kesavan S: Functional Analysis TRIM series, Hindustan Book Agency

[4] S David Promislow: A First Course in Functional Analysis, John wiley & Sons, INC., (2008)

OBJECTIVES

- To define spectrum and learn its properties.
- To learn about self adjoint operators and compact operators.
- To learn orthoprojections and spectral decomposition.
- To understand important theorems and its applications

LESSON PLAN

Unit/Session (hours required)	**Topics to be taught (input)**	**Procedure(process) Student centric method of teaching**	**Activity**	**Learning Outcome (output)**	**Assessment**
MODULE I	Spectrum definition. Self adjoint operators. Minmax principle	• Discussion • Participative learning • Problem solving • Lecture	Assignments on properties of spectrum and compactness	To study about spectrum and its properties. Understand self adjoint operators	Evaluation through test paper.
MODULE II	Orthoprojections. Spectral decomposition and Hilbert theorem.	• Lecture • Discussion • Participative learning • Problem solving	Assignments on Ortho projections. Construction of spectral integral.	To learn about projections and orthoprojections. To formulate the spectral integral.	Evaluation through test paper.
MODULE III	Open Mapping theorem. Closed graph theorem. Hahn Banach theorem. Gelfand's theorem.	• Lecture • Discussion • Participative learning • Problem solving	Seminar by students on Corollaries of Hahn Banach theorem	To study Hahn Banach theorem and its corollaries	Evaluation through test paper.

COURSE OUTCOME

CO1	To study about spectrum and self adjoint operators
CO2	To learn about orthoprojection and spectral integral.
CO3	To learn Hahn Banach theorem and its corollaries.

Faculty in charge:

Ms. Amala Mary George

MTH4C11: GRAPH THEORY
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the basic concepts of Graph theory.

Module 1

Basic concepts of Graph. Trees, Cut edges and Bonds, Cut vertices, Cayleys Formula, The Connector Problem, Connectivity, Blocks, Construction of Reliable Communication Networks, Euler Tours, Hamilton Cycles, The Chineese Postman Problem, The Travelling Salesman Problem.

Module 2

Matchings, Matchings and Coverings in Bipartite Graphs, Perfect Matchings, The Personnel Assignment Problem, Edge Chromatic Number, Vizings Theorem, The Timetabling Problem, Independent Sets, Ramseys Theorem

Module 3

Vertex Colouring-Chromatic Number, Brooks Theorem, Chromatic Polynomial, Girth and Chromatic Number, A Storage Problem, Plane and Planar Graphs, Dual Graphs, Eulers Formula, Bridges, Kuratowskis Theorem, The Five-Colour Theorem, Directed Graphs, Directed Paths, Directed Cycles.

TEXT : J.A. Bondy and U.S.R.Murty : Graph Theory with applications. Macmillan

References

[1] F. Harary : Graph Theory, Narosa publishers, Reprint 2013.
[2] Geir Agnarsson, Raymond Greenlaw: Graph Theory Modelling, Applications and Algorithms, Pearson Printice Hall, 2007.
[3] John Clark and Derek Allan Holton : A First look at Graph Theory, World Scientific (Singapore) in 1991 and Allied Publishers (India) in 1995
[4] R. Balakrishnan & K. Ranganathan : A Text Book of Graph Theory, Springer Verlag, 2nd edition 2012.

OBJECTIVES

a) **To understand the basic concepts of graphs, Trees, Cut edges and Bonds, Cut vertices, Euler Tours, Hamilton Cycles**

b) **To get familiarize with Matchings and Coverings in Bipartite Graphs, Perfect**

Matching, Independent Sets, Ramseys Theorem

c) **To understand the concept of Vertex Colouring-Chromatic Number, Edge Chromatic Number , The Five-Colour Theorem, Directed Graphs.**

d) **To study more about Chromatic Polynomial, Girth and Chromatic Number**

e) **To understand The Five-Colour Theorem, Directed Graphs, Directed Paths, Directed Cycles.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 (30 hours)	Basic concepts of graph, Trees, Cut edges and Bonds, Cut vertices, Connectivity, Blocks, Euler Tours, Hamilton Cycles	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on basic concepts of graph	To understand: •the basics of graph, trees •Concepts of cut edges, cut vertices, Euler tour and Hamilton cycles	Evaluation Through MCQ
Module I1 (30 hours)	Matchings and Coverings, Perfect Matchings, Edge Chromatic Number, Vizings Theorem, Independent Sets, Edge colouring,Ramseys Theorem	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain the Personnel Assignment Problem and The Timetabling Problem	To understand: •differentiation of matchings and covering •Concepts of edge colouring and Ramseys theorem	Evaluation Through test paper
Module III (30 Hours)	Vertex Colouring-Chromatic Number, Brooks Theorem, , Plane and Planar Graphs, Dual Graphs, Eulers Formula, Bridges,	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on Storage Problem	To understand: • Vertex colouring and it's important results • Planar	Evaluation through test paper

	Kuratowskis Theorem, The Five-Colour Theorem, Directed Graphs,			graphs, dual graphs and it's important result	

Course Outcomes

CO1	To introduce the concept of basic graph theory, trees, cut vertices and cut edges, Euler tour and Hamilton cycles
CO2	To understand the concept of matchings and covering, Edge colouring.
CO3	To understand the concepts of vertex colouring and it's important results. Planar graphs and dual graphs.

Faculty in charge:
Ms. Linet Roslin Antony

MTH4E09: DIFFERENTIAL GEOMETRY
Number of hours of Lectures per week: 5
Number of Credits: 3

Objectives

To understand the basic concepts of differential geometry.

MODULE I

Graphs and Level Set, Vector fields, The Tangent Space, Surfaces, Vector Fields on Surfaces, Orientation. The Gauss Map .

MODULE II

Geodesics, Parallel Transport, The Weingarten Map, Curvature of Plane Curves, Arc Length and Line Integrals.

MODULE III

Curvature of Surfaces, Parametrized Surfaces, Local Equivalence of Surfaces and Parametrized Surfaces.

TEXT:

J.A.THORPE : ELEMENTARY TOPICS IN DIFFERENTIAL GEOMETRY

REFERENCES :

1) M. de Carmo : Differential Geometry of Curves and Surfaces, Prentice Hall Inc Englewood Cliffs NJ (1976).
2) V. Grilleman and A. Pollack : Differential Topology, Prentice Hall Inc Englewood Cliffs NJ (1974)
3) B. O'Neil : Elementary Differential Geometry, Academic Press NY (1966)
4) M. Spivak : A Comprehensive Introduction to Differential, Geometry, (Volumes 1 to 5), Publish or Perish, Boston (1970, 75)
5) R. Millmen and G. Parker : Elements of Differential Geometry, Prentice Hall Inc Englewood Cliffs NJ (1977)
6) I. Singer and J.A. Thorpe : Lecture Notes on Elementary Topology and Geometry, UTM, Springer Verlag, NY (1967)

7) W.L.Burke: Applied Differential Geometry , Cambridge University Press (1985).

OBJECTIVES

a) **To understand the basic concepts of level sets, surfaces and its curvature, geodesics,and parametrized surfaces .**

b) **To get familiarize with covariant derivatives and its properties.**

c) **To understand the concept of local and global parametrization.**

d) **To study more about parametrized surfaces and local equivalence of surface and parametrized surfaces.**

LESSON PLAN

Unit/ session/ hours (time required)	Topics to be taught (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I (30 hours)	Level sets,vector fields, the tangent space, surfaces and the gauss map.	● Lecture ● Discussion ● Participative learning ● Problem solving	● Peer group discussion on vector fields and level sets.	To understand: ●the basics of surfaces ●notion of tangent space and the gauss map	Evaluation Through MCQ
Module II (30 hours)	Geodesics, Parallel transport, The Weingarten map, Arc length and line integrals.	● Lecture ● Discussion ● Participative learning ● Problem solving	● Student seminars to explain the properties of derivatives of smooth vector field and covariant	To understand: ●Local and global parametrization . ●Concept of parallel transport.	Evaluation Through test paper

			derivative.		
Module III (30 Hours)	Curvature of surfaces, First and second fundamental forms,Parametrized surfaces and its local equivalence with surfaces.	• Lecture • Discussion • Participative learning • Problem solving	• Seminar and assignment on local equivalence of surfaces and parametrized surfaces.	To understand: • Principal, Gaussian, Gauss Kronecker and Mean curvature • Inverse function theorems.	Evaluation through test paper

Course Outcomes

CO1	To introduce the concept of graphs and level sets, basics of surfaces and notion of tangent space anf gauss map.
CO2	To understand the concept of parallel transport, local and global parametrization, arc length and line integral.
CO3	To understand the principal ,Gaussian ,Gauss Kronecker and Mean curvature, and parametrized surfaces.

Faculty in charge:
Dr. Nidhin T J

STA 1C 01 INTRODUCTORY STATISTICS

Lecture Hours per week: 4, Credits: 3

Internal: 15, External: 60, Examination 2 Hours

Objectives

To introduce basic concepts of statistics

Module I (7 hrs)

Official statistics: The Statistical system in India: The Central and State Government organizations, functions of the Central Statistical Office (CSO), National Sample Survey Organization (NSSO) and the Department of Economics and Statistics.

Module II (30 hrs)

Introduction to Statistics: Nature of Statistics, Uses of Statistics, Statistics in relation to other disciplines, Abuses of Statistics,Concept of primary and secondary data. Designing a questionnaire and a schedule. Concepts of statistical population and sample from a population, quantitative and qualitative data, Nominal, ordinal and time series data, discrete and continuous data. Presentation of data by table and by diagrams, frequency distributions by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods) and ogives. Measures of central tendency (mean, median, mode, geometric mean and harmonic mean) with simple applications. Absolute and relative measures of dispersion (range, quartile deviation, mean deviation and standard deviation) with simple applications. Co-efficient of variation, Box Plot. Importance of moments, central and non-central moments, and their interrelationships. Measures of skewness based on quartiles and moments; kurtosis based on moments.

Module III (15 hrs)

Correlation and Regression: Scatter Plot, Simple correlation, Simple regression, two regression lines, regression coefficients. Fitting of straight line, parabola, exponential, polynomial (least square method).

Module IV (20 hrs)

Time series: Introduction and examples of time series from various fields, Components of times series,

Additive and Multiplicative models. Trend: Estimation of trend by free hand curve method, method of semi averages, method of moving averages and fitting various mathematical curves. Seasonal Component: Estimation of seasonal component by Method of simple averages, Ratio to Trend. Index numbers: Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher's.

Reference Books:

1) S.C. Gupta and V.K. Kapoor. Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi
2) Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
3) Mukhopadhyay P. (2011): Applied Statistics, 2nded. Revised reprint, Books and Allied
4) Hoel P.G. Introduction to mathematical statistics, Asia Publishing house.
5) Chatfield.C. The Analysis of Time Series: An Introduction, Chapman & Hall
6) Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi.
7) www.mospi.gov.in
8) www.ecostat.kerala.gov.in

OBJECTIVES

1) To learn basic concepts of statistical system in India
2) To understand nature and uses of statistics
3) To understand correlation and regression
4) To expose statistics students to the areas of time series and index numbers

LESSON PLAN

Unit/ session / hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment

Module I **7 Hours**	The Statistical system in India: The Central and State Government organizations, functions of the Central Statistical Office (CSO), National Sample Survey Organization (NSSO) and the Department of Economics and Statistics.	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars related to the central and government organizations	• To understand central and government organizations in India • To understand the functions of CSO and NSSO	Evaluation through test paper and viva
Module II **30 Hours**	Nature of Statistics, Uses of Statistics, Statistics in relation to other disciplines, Abuses of Statistics,Concept of primary and secondary data, Concepts of statistical population and sample from a	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding measures of central tendency	• To understand the nature, uses and abuses of statistics • To understand measures of central tendency and measures of	Evaluation through test paper

	population, Nominal, ordinal and time series data, discrete and continuous data, cumulative frequency distributions and ogives. Measures of central tendency with simple applications, Absolute and relative measures of dispersion with simple applications,Co-efficient of variation, Importance of moments, central and non-central moments, and their interrelationships, Measures of skewness based			dispersion and their applications	

	on quartiles and moments; kurtosis based on moments				
Module III **15 Hours**	Scatter Plot, Simple correlation, Simple regression, two regression lines, regression coefficients. Fitting of straight line, parabola, exponential, polynomial	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to find correlation and regression coefficients	• To understand correlation and regression	Evaluation through test paper
Module IV **20 Hours**	Introduction and examples of time series from various fields, Components of times series, Estimation of trend by free hand curve method, method of semi averages, method of moving	• Lecture • Discussions • Problem solving	• Student seminars related to components of time series	• To understand time series, seasonal indices and index numbers	Evaluation through test paper

	averages and fitting various mathematical curves, Estimation of seasonal component by Method of simple averages, Ratio to Trend,Definition , construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth-Mar shall and Fisher's.				

Course Outcomes

CO1	To understand central and government organizations in India and learn the functions of CSO and NSSO
CO2	To understand the nature, uses and abuses of statistics

CO3	To learn the concepts of correlation and regression
CO4	To understand time series, seasonal indices and index numbers

Teacher in Charge:

Ms. Nima Maria

STA 2C 02- PROBABILITY THEORY
Lecture Hours per week:4 , Credits: 3
Internal: 20, External: 80, Examination 3 Hours

Objectives

Give knowledge to conceptualise probabilities of an event including frequentist and axiomatic approach also the idea about mathematical expectation and conditional probability.

Module I (25 hrs)

Introduction to Probability: Random experiment, Sample space, events, classical definition of probability, statistical regularity, field, sigma field, axiomatic definition of probability and simple properties, addition theorem (two and three events), conditional probability of two events, multiplication theorem, independence of events-pair wise and mutual, Bayes theorem and its applications.

Module II (12 hrs)

Random variables: Discrete and continuous, probability mass function (pmf) and probability density function (pdf)-properties and examples, Cumulative distribution function and its properties, change of variables (univariate case only).

Module III (15 hrs)

Mathematical expectations (univaraite): Definition, raw and central moments(definition and relationships), moment generation function and properties, characteristic function (definition and use only), Skewness and kurtosis using moments.

Module IV (20 hrs)

Bivariate random variables: Joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.

Reference Books:

1. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.
2. . S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. . John E Freund, Mathematical Statistics, Pearson Edn, New Delhi
5. Hoel P.G. Introduction to mathematical statistics, Asia Publishing house.

OBJECTIVE

- Ability to distinguish between random and non random experiments.
- Understand the classical and axiomatic definition of probability, also the noation of conditional probability including the concept of Baye's theorem
- Give knowledge related to the concept of uni variate, Bivariate Discrete and continuous random variable including expectation moments and mgf

LESSON PLAN

Unit/ session/ hours (Time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module I **25 Hours**	Random experiment, Sample space, events, classical definition of probability, statistical regularity, field, sigma field, axiomatic definition of probability and simple properties, addition theorem, conditional probability of two events, multiplication theorem, independence of events-pair wise and mutual, Bayes theorem and its applications.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on axiomatic definition of probability and simple properties.	• Understand the basic definition and properties related to probability.	Evaluation through test paper and viva.
Module II	probability mass	• Lecture	• Seminar on	• Understand	Evaluation

12 Hours	function and probability density function properties and examples, Cumulative distribution function and its properties, change of variables.	• Discussion • Participative learning • Problem solving	the topic Cumulative distribution function and its properties	the concept of pmf, pdf and cdf in statistics.	through test paper and viva
Module III **15 Hours**	Mathematical expectations Definition, raw and central moment, mgf and properties, characteristic function, Skewness and kurtosis using moments.	• Lecture • Discussion • Participative learning • Problem solving	• Assignments related to mathematical expectation, raw and cenral moments, mgf	• Understand the definition of moments and mgf • Enable to find Skewness and kurtosis using moments.	Evaluation through test paper.
Module IV **20 Hours**	Bivariate random variables: Joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.	• Lecture • Discussions • Problem solving	• Student seminars on the topic bivariate Expectations, conditional mean variance, and covariance.	• Give knowledge related to the concept of Bivariate random variable including expectation moments and mgf.	Evaluation through test paper.

Course Outcomes

CO1	Ability to distinguish between random and non-random experiment
CO2	Undestand the probabilities of an events including frequentist and axiomatic approach. Simultaneously learned the notion of conditional probability including the concept of Bayes' Theorem.
CO3	Understand the concept of univariate, Bivariate Discrete and continuous random variable including expectation moments and mgf.

Teacher in Charge:

Ms. Athira V

Ms. Anjana Rajan

STA 3C 03- PROBABILITY DISTRIBUTIONS AND SAMPLING THEORY

Lecture Hours per week: 4, Credits: 3

Internal: 15, External: 60, Examination 2 Hours

Objectives

To introduce the standard and sampling distributions , also the different type of sampling methods.

Module I (30 hrs)

Standard distributions*:* Discrete type-Bernoulli, Binomial, Poisson, Geometric, Negative Binomial (definition only), Uniform (mean, variance and mgf). Continuous type-Uniform, exponential and Normal (definition, properties and applications);Gamma (mean, variance, mgf); Lognormal, Beta, Pareto and Cauchy (Definition only)

Module II (25 hrs)

Limit theorems*:* Chebyshev's inequality, Sequence of random variables, parameter and Statistic, Sample mean and variance, Convergence in probability (definition and example only), weak law of large numbers (iid case), Bernoulli law of large numbers, Convergence in distribution (definition and examples only), Central limit theorem (Lindberg levy-iid case)

Module III (10 hrs)

Sampling methods: Simple random sampling with and without replacement, systematic sampling (Concept only), stratified sampling (Concept only), Cluster sampling(Concept only)

Module IV (25 hrs)

Sampling distributions: Statistic, Standard error, Sampling from normal distribution, distribution of sample mean, sample variance, chi-square distribution, t distribution, and F distribution (definition, derivations and relationships only).

Reference Books:

1. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.
2. S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. John E Freund, Mathematical Statistics, Pearson Edn, NewDelhi

5. Cochran W.G. (1984):Sampling Techniques(3rdEd.), Wiley Eastern

OBJECTIVES

1. Enable one to identify and classify different type of standard distribution.
2. To understand the weak law of large numbers, Bernoulli law of large numbers, Central limit theorem and its applications.
3. Describe different type of sampling methods.

   Enable one to understand different type of sampling distribution.

LESSON PLAN

Unit/ session/ hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I **30 Hours**	Bernoulli, Binomial, Poisson, Geometric, Negative Binomial , Uniform, exponential , Normal, Gamma, Lognormal, Beta, Pareto and Cauchy distribution.	• Lecture • Discussion • Participative learning • Problem solving	• Peer group discussion on discrete and Continuous distribution.	• Enable to understand different type of distribution.	Evaluation through test paper
Module II **25 Hours**	Chebyshev's inequality, Sequence of random variables, parameter and Statistic, Sample mean and variance, Convergence in probability, weak law of large numbers, Bernoulli law of large numbers, Convergence in distribution , Central limit theorem	• Lecture • Discussion • Participative learning • Problem solving	• Assignment on the topic sample mean and variance.	• Understand the weak law of large numbers, Bernoulli law of large numbers, Central limit theorem and its applications	Evaluation through test paper

	(Lindberg levy-iid case)				
Module III **10 Hours**	Sampling methods: Simple random sampling with and without replacement, systematic sampling, stratified sampling, Cluster sampling	• Lecture • Discussion • Participative learning • Problem solving.	• Seminar on different type of sampling methods.	• Understand the sampling methods and its relevants.	Evaluation through test paper.
Module IV **25 Hours**	Sampling distributions: Statistic, Standard error, Sampling from normal distribution, distribution of sample mean, sample variance, chi-square distribution, t distribution, and F distribution.	• Lecture • Discussion • Participative learning. • Problem solving.	• Peer group discussion on t distribution, and F distribution.	• understand different sampling distributions.	Evaluation through test paper and viva.

Course Outcomes

CO1	Enable one to identify and classify different type of standard distribution.
CO2	Understand the weak law of large numbers, Bernoulli law of large numbers, Central limit theorem and its applications.
CO3	Understand to Describe different type of sampling methods.
CO4	Enable one to understand different type of sampling distribution.

Teacher in Charge:

Anjana Rajan.

STA 4C 04 - STATISTICAL INFERENCE AND QUALITY CONTROL

Lecture Hours per week: 4, Credits: 3

Internal: 15, External: 60, Examination 2 Hours

Objectives

To learn basic concepts of statistical inference and quality control

Module I (30 hrs)

Estimation theory: Parametric space, sample space, point estimation. Nayman Factorization criteria, Requirements of good estimator: Unbiasedness, Consistency, Efficiency, Sufficiency and completeness. Minimum variance unbiased (MVU) estimators. Cramer-Rao inequality ,Minimum Variance Bound (MVB) estimators. Methods of estimation: Maximum likelihood estimation and Moment estimation methods , Properties of maximum likelihood estimators ,Least squares and minimum variance ,Interval estimation: Confidence interval (CI);CI for mean and variance of Normal distribution; Confidence interval for binomial proportion and population correlation coefficient when population is normal.

Module II (35 hrs)

Testing of Hypothesis: Level of significance, Null and Alternative hypotheses, simple and composite hypothesis ,Types of Errors, Critical Region, Level of Significance, Power and p-values. Most powerful tests, Neyman-Pearson Lemma , Uniformly Most powerful tests. Large sample tests: Test for single mean, equality of two means, Test for single proportion, equality of two proportions. Small sample tests: t-test for single mean, unpaired and paired t-test. Chi-square test for equality of variances, goodness of fit, test of independence and association of attributes. Testing means of several populations: One Way ANOVA, Two Way ANOVA

Module III (10 hrs)

Non-parametric methods: Advantages and drawbacks; Test for randomness, Median test, Sign test, Mann-Whiteny U test and Wilcoxon test; Kruskal Wallis test

Module IV (15 hrs)

Quality Control: General theory of control charts, causes of variations in quality, control limits, sub-grouping, summary of out-of-control criteria. Charts of variables - X bar chart, R Chart and sigma chart. Charts of attributes – c-charts, p-chart and np-chart.

Reference Books:

1) Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.
2) Gupta, S.P. Statistical Methods. Sultan Chand and Sons: New Delhi. .
3) S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
4) Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rdEdn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
5) John E Freund, Mathematical Statistics, Pearson Edn, NewDelhi
6) Grant E L, Statistical quality control, McGraw Hill
7) Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.

OBJECTIVES

1) To understand point estimation and interval estimation
2) To learn the basic concepts and results of the theory of testing statistical hypothesis.
3) To study non parametric tests.
4) To understand statistical quality control and control charts

LESSON PLAN

Unit/ session / hours (Time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module I 30	Point estimation, Properties of estimators,	• Lecture • Discussion	• Group discussion on methods	Understand point estimation	Evaluation through test paper

Hours	Factorisation theorem, Crammer -Rao inequality, Methods of estimation: methods of moments , method of maximum likelyhood, Interval estimation, confidence interval for population mean and varience	• Participative learning • Problem solving	of estimation	and properties of good estimators	
Module II 35 Hours	Level of significance, Null and Alternative hypotheses, simple and composite hypothesis ,Types of Errors, Critical Region, Level of Significance, Most powerful tests, Neyman-Pearson Lemma , Uniformly Most	• Lecture • Discussion • Participative learning • Problem solving	• Assignments in finding level of significance	Understand large sample tests and small sample tests	Evaluation through test paper and viva

	powerful tests. Large sample tests: Test for single mean, equality of two means, Test for single proportion, equality of two proportions. Small sample tests: t-test for single mean, unpaired and paired t-test. Chi-square test for equality of variances, goodness of fit, test of independence and association of attributes.,Testing means of several populations: One Way ANOVA, Two Way ANOVA				
Module III **10 Hours**	Advantages and drawbacks of non parametric tests, Test for randomness,Medi	• Lecture • Discussion • Participative	• Group discussion on advantages and	Understand various nonparametric tests	Evaluation through Test paper and Group Discussion

	an test, Sign test, Mann-Whiteny U test and Wilcoxon test; Kruskal Wallis test	learning • Problem solving	drawbacks of non parametric tests		
Module IV **15 Hours**	General theory of control charts, causes of variations in quality, control limits, sub-grouping, summary of out-of-control criteria. Charts of variables - X bar chart, R Chart and sigma chart. Charts of attributes - c-charts, p-chart and np-chart.	• Lecture • Discussions • Problem solving	• Seminar on control charts of variables and attributes	Understand statistical quality control and its uses	Evaluation through test paper

Course Outcomes

CO1	To understand point estimation and interval estimation
CO2	To learn the basic concepts and results of the theory of testing statistical hypothesis
CO3	To study non parametric tests.
CO4	To understand statistical quality control and control charts

Teacher in Charge:

Athira V

MSc Psychology Integrated Course

PSY1IB01: Basic themes in Psychology – I

Credits: 3
Hours: 3 /week
Total: 48 hours

OBJECTIVES:

To generate interest in Psychology

To make familiar the basic concept of the field of Psychology with an emphasis on applications of Psychology in everyday life.

To understand the basics of various theories in Psychology.

To provide basic knowledge about systems and processes like attention, learning and Consciousness.

Module 1 Introduction

Psychology: A working definition.

Origin of Psychology: Philosophical origins; Early Indian and Greek thoughts, major ideas of Descartes, Locke. Biological origins; Darwin, Genetics.

Brief history of modern scientific Psychology: Structuralism, functionalism, behavioral, psychoanalytic, humanistic, cognitive perspectives, Gestalt psychology.

Scope of different branches of Psychology.

Module 2 Attention and Sensation

Attention: selective and sustained attention; Factors affecting attention; Phenomena associated with attention-span of attention, division of attention, distraction of attention.

Sensation and perception: Difference between sensation and perception: Concept of psycho physics: Absolute threshold, Difference threshold, Weber's law; subliminal perception.

Colour Vision- Theories of Colour vision, Colour Blindness, Colour Weakness

Hearing -Theories of auditory perception.

Module 3 Perception

Perceiving forms, patterns and objects: perceptual set, feature analysis, bottom-up processing, top- down processing.

Depth Perception

Perceptual organization; Gestalt principles, figure and ground segregation, phi-phenomenon.

Perceptual constancies: size, shape, brightness constancies

Visual illusions

Module 4 States of Consciousness

Nature of consciousness; Biological rhythms: circadian rhythms; Sleep and waking cycle: stages of sleep; functions of sleep; functions of REM sleep; sleep disorders, Dreams: psychodynamic, physiological and cognitive views.

Altered states of consciousness: Hypnosis; Meditation. Altering consciousness with

drugs- Brief outline on psychoactive drugs.

REFERENCES

Baron, R.A. (2004). Psychology, 5th edn. New Delhi: Pearson education.

Bootzin, R., & Bower, G.H. (1991). *Psychology today- An Introduction*. 7th edn. New York: Mc Graw Hill Inc.

Commer, R. & Gould, E. (2011). *Psychology around Us*. New Delhi: John Wiley & Sons Inc.

Coon,D.& Mitterer,J.O.(2013). *Introduction to Psychology: Gateways to Mind and Behavior*, 13th edn. Wadsworth Cengage Learning

Feldman, R. (2011). *Understanding Psychology*,10th edn. New Delhi: Tata McGraw Hill.

Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. (1993). *Introduction to Psychology*, 7th edn. New Delhi: Tata McGraw Hill.

Weiten, W. (2002). *Psychology: Themes and Variations*. 5th edn. New York:

Brooks/Cole Publishing co.

Additional References:

Gerrig, R. J (2013) *Psychology and Life* .20th edn. Boston: Pearson

Kuppuswamy, B. (1990). *Elements of ancient Indian Psychology*. 3rd edn. New Delhi: Konark Publishers Pvt. Ltd.

Mishra, B.K. (2008). *Psychology: The study of Human Behavior*. New Delhi: Prentice Hall of Ind

LESSON PLAN

Module	Topics to be taught	Method of Teaching	Activity	Learning outcome	Method of Evaluation
Module 1	Definition of Psychology, Origin of Psychology: Philosophical origins; Early Indian and Greek thoughts, major ideas of Descartes, Locke. Biological origins; Darwin, Genetics. Brief history of modern scientific Psychology: Structuralism, functionalism, behavioral, psychoanalytic, humanistic, cognitive perspectives, Gestalt psychology. Scope of different branches of Psychology.	a. Lecture b. Group discussion c. Topic Presentation d. Debate	Group discussion and presentation of ideas on different schools of Psychology Debate on the concepts underlying Indian Psychology	● Forming a basic idea about Psychology ● Generating interest in the subject ● Getting brief idea regarding the history of Psychology	Classroom question answer session Descriptive class test
Module 2	Attention: selective and sustained attention; Factors affecting attention; Phenomena associated with attention-span of attention, division of attention, distraction of attention. Sensation and	a. Lecture b. Discussion c. Video presentation	Different concepts regarding attention and sensation were presented with the help of videos	● Getting introduced to the basic processes such as Attention and Sensation	Descriptive class test Classroom question answer session

	perception: Difference between sensation and perception: Concept of psycho physics: Absolute threshold, Difference threshold, Weber's law; subliminal perception. Colour Vision- Theories of Colour vision, Colour Blindness, Colour Weakness Hearing -Theories of auditory perception.				
Module 3	Perceiving forms, patterns and objects: perceptual set, feature analysis, bottom-up processing, top-down processing. Depth Perception Perceptual organization; Gestalt principles, figure and ground segregation, phi-phenomenon. Perceptual constancies: size, shape, brightness constancies Visual illusions	a. Lecture b. Group discussion c. Seminar Presentation d. Video Presentation	Topics are assigned to each student and seminar presentations are to be done. Discussion is carried out after every presentation.	● Knowing in detail, the process of Perception through presentation and discussion	Viva Class test
Module 4	Nature of consciousness; Biological rhythms: circadian rhythms; Sleep and waking cycle: stages of sleep; functions of sleep; functions of REM sleep; sleep disorders,	a. Lecture b. Group Discussion c. Seminar Presentation	Assignments are given to submit notes on different topics.	● Detailed idea on consciousness, altered states of consciousness, sleep etc.	Descriptive Class test Classroom question answer session Assignment submission

	Dreams: psychodynamic, physiological and cognitive views. Altered states of consciousness: Hypnosis; Meditation. Altering consciousness with drugs- Brief outline on psychoactive drugs.				

PSY2IB01: Basic Themes in Psychology- II

Credits: 3
Hours : 3 /week
Total: 48 hours

OBJECTIVES:

Understand how psychology was developed and became the field of science as we know it now

Understand basic psychological processes like sensation &perception, states of consciousness and learning

Students will be able to know how complex is human mind and each individual is unique

Apply the learnt information in the practical day today life

Able to analyze states of consciousness and can apply various techniques like meditation and mindfulness to improve their own and other's consciousness

Module 1 Learning

Concept of learning, Nature of learning, learning curve., Trial and error learning,

Classical conditioning: Basic experiment and basic terms; Principles of Classical conditioning- Acquisition, Higher order conditioning, Extinction, spontaneous recovery, Generalization and Discrimination. Applications of classical conditioning.

Operant conditioning; Basic experiment of Skinner; Reinforcement, Punishment, Schedules of reinforcement. Shaping and Chaining; Applications of operant conditioning.

Cognitive learning: Cognitive map; latent learning; sign learning.

Observational learning/ Modeling

Module 2 Memory

Key processes in memory: Encoding, Storage and Retrieval.

Atkinson-Shiffrin Model; sensory memory, short term memory and long- term memory; Levels of processing.

STM; Iconic memory; Working memory, Alan Baddeley's components of working memory; Chunking; Rehearsal-maintenance rehearsal, rote rehearsal, elaborative rehearsal.

LTM; Types of LTM-procedural memory, declarative memory-semantic memory, episodic memory; Flash-bulb memory, tip of the tongue phenomenon.

Implicit and explicit memory-priming. Measuring memory; Recall, Recognition, Relearning.

Retrieval cues; Encoding specificity principle; Context dependent memory, State dependent memory; Serial position effect; Reconstructive memory; Source Monitoring; Eyewitness testimony; False memory; Metamemory.

Forgetting: Curve of forgetting; Reasons of forgetting-ineffective coding, decay, interference, retrieval failure, motivated forgetting; Repression.

Strategies for remembering; Rehearsal, Elaboration, Organization (Mnemonics).

Module 3 Motivation

Motivation; A model of Motivation; Sources of Motivation-Drives, Incentives, Instincts.

Theories of motivation: Drive theory; Incentive theory; Hierarchy of needs theory; Arousal theory- Yerkes-Dodson's Law; Goal setting theory; Evolutionary theory; Cognitive theories-Balance theory, Cognitive dissonance theory, Expectancy theory, Attribution theory.

Types of Motives; Biological motives and learned motives.

The motivation of hunger and eating: Biological factors in the regulation of hunger; Environmental factors in the regulation of hunger: Sexual motivation; Hormones and human sexual behaviour; Sexual orientation.

Achievement motivation: Individual differences; situational determinants of achievement behaviour; Measuring achievement motivation.

Aggressive motive; Power motive; Affiliation motive; Intrinsic and extrinsic motivation.

Module 4 Emotion

Emotion: The elements of emotional experience; The cognitive component, The physiological component; The behavioural component; Primary emotions; Positive emotions.

Emotion and the brain; Physiology and emotion; fight or flight, sudden death, lie detectors.

Expression of emotions; Facial expressions, non-verbal cues and body language; Assessment of emotions.

Theories of emotion: James-Lang theory; Cannon-Bard theory; Opponent process theory; Cognitive appraisal theories of emotion-Schachter's two-factor theory and Lazarus's theory of cognitive appraisal; Facial feedback hypothesis; Evolutionary theories of emotion.

REFERENCES

Baron, R.A. (2004). Psychology, 5th edn. New Delhi: Pearson education.

Bootzin, R., & Bower, G.H. (1991). *Psychology today- An Introduction*. 7th edn. New York: Mc Graw Hill Inc.

Commer, R. & Gould, E. (2011). *Psychology around Us*. New Delhi: John Wiley & Sons Inc.

Coon,D.& Mitterer,J.O.(2013). *Introduction to Psychology: Gateways to Mind and Behavior*, 13th edn. Wadsworth Cengage Learning

Feldman, R. (2011). *Understanding Psychology*,10th edn. New Delhi: Tata McGraw Hill.

Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. (1993). *Introduction to Psychology*, 7th edn. New Delhi: Tata McGraw Hill.

Weiten, W. (2002). *Psychology: Themes and Variations*. 5th edn. New York: Brooks/Cole Publishing co.

Additional References:

Gerrig, R. J (2013) *Psychology and Life* .20th edn. Boston: Pearson

Mishra, B.K. (2008). *Psychology: The study of Human Behavior*. New Delhi: Prentice Hall of Ind

LESSON PLAN

Module	Topics to be taught	Method of Teaching	Activity	Learning Outcome	Method of evaluation
Module 1	Concept of learning, Nature of learning, learning curve., Trial and error learning, Classical conditioning: Basic experiment and basic terms; Principles of Classical conditioning- Acquisition, Higher order conditioning, Extinction, spontaneous recovery, Generalization and Discrimination. Applications of classical conditioning. Operant conditioning; Basic experiment of Skinner; Reinforcement, Punishment, Schedules of reinforcement. Shaping and Chaining; Applications of operant conditioning. Cognitive learning: Cognitive map; latent learning; sign learning. Observational learning/ Modeling	a. Lecture b. Group discussion c. Topic Presentation	Group discussion and presentation of ideas on classical conditioning, operant conditioning, cognitive theory of learning and observational learning.	● Understanding the basic theories of Learning and applying to the daily life situations	Classroom question answer session Descriptive class test
Module 2	Key processes in memory: Encoding, Storage and Retrieval.	a. Lecture b. Discussion	Different theories of memory and	Getting a detailed idea regarding the theories of memory	Descriptive class test Classroom

	Atkinson-Shiffrin Model; sensory memory, short term memory and long- term memory; Levels of processing. STM; Iconic memory; Working memory, Alan Baddeley's components of working memory; Chunking; Rehearsal-maintenance rehearsal, rote rehearsal, elaborative rehearsal. LTM; Types of LTM-procedural memory, declarative memory-semantic memory, episodic memory; Flash-bulb memory, tip of the tongue phenomenon. Implicit and explicit memory-priming. Measuring memory; Recall, Recognition, Relearning. Retrieval cues; Encoding specificity principle; Context dependent memory, State dependent memory; Serial position effect; Reconstructive memory; Source Monitoring; Eyewitness testimony; False memory; Metamemory. Forgetting: Curve of forgetting; Reasons of forgetting-ineffective coding, decay, interference, retrieval failure, motivated forgetting; Repression. Strategies for remembering; Rehearsal, Elaboration, Organization (Mnemonics).		forgetting are learnt through discussion	and forgetting	question answer session
Module 3	Motivation; A model of Motivation; Sources of Motivation-Drives, Incentives, Instincts. Theories of motivation: Drive theory; Incentive theory; Hierarchy of needs theory; Arousal theory-Yerkes-Dodson's Law; Goal setting theory; Evolutionary	a. Lecture b. Group discussion c. Seminar Presentation d. Video Presentation	Topics are assigned to each student and seminar presentations are to be done. Discussion is carried out after every	Knowing in detail, motivation and associated theories through presentation and discussion	Viva Class test MCQ

	theory; Cognitive theories-Balance theory, Cognitive dissonance theory, Expectancy theory, Attribution theory. Types of Motives; Biological motives and learned motives. The motivation of hunger and eating: Biological factors in the regulation of hunger; Environmental factors in the regulation of hunger: Sexual motivation; Hormones and human sexual behaviour; Sexual orientation. Achievement motivation: Individual differences; situational determinants of achievement behaviour; Measuring achievement motivation. Aggressive motive; Power motive; Affiliation motive; Intrinsic and extrinsic motivation.		presentation.		
Module 4	Emotion: The elements of emotional experience; The cognitive component, The physiological component; The behavioural component; Primary emotions; Positive emotions. Emotion and the brain; Physiology and emotion; fight or flight, sudden death, lie detectors. Expression of emotions; Facial expressions, non-verbal cues and body language; Assessment of emotions. Theories of emotion: James-Lang theory; Cannon-Bard theory; Opponent process theory; Cognitive appraisal theories of emotion-Schachter's two-factor theory and Lazarus's theory of cognitive appraisal; Facial feedback hypothesis; Evolutionary	a. Lecture b. Group Discussion c. Seminar Presentation	Assignments are given to submit notes on different topics.	Detailed idea on emotion and the associated theories.	Descriptive Class test Classroom question answer session Assignment submission

	theories of emotion.				

PSY1ICO1: Human Physiology

Credits: 3
Hours: 4 /week
Total: 72 hours

OBJECTIVES:

This course familiarizes the student of Psychology with the most essential and fundamental aspects of cell biology and basics of genetics that are essential for understanding the anatomy and physiology of the nervous system in general and of the CNS that they are to master in the following semesters.

Module 1 Cellular organization

Cell structure, plasma membrane (fluid mosaic model), and cell organelles; Cell inclusions-brief description on the structure of carbohydrates, lipids and proteins; Cell theory, cell principle; Unicellularity to multicellularity, differentiation. Brief mention of spatial and temporal control of gene activity; Tissues- brief description of major types.

Module 2 Genes and chromosomes

Structure of D.N.A, D.N.A replication; Concept of a gene - genetic code, introns, exons; Morphology of chromosomes-size, shape, karyotype, idiogram, kinds of chromosomes; Linkage and crossing over, sex linked chromosomes.

Module 3 Cell division

Cell cycle; Mitosis; Meiosis.

Module 4 Elements of heredity and variation

Mendel's work and laws of inheritance (monohybrid cross, dihybrid cross, test cross); Brief explanation of terms-alleles, homozygosity, heterozygosity, genotype, phenotype; Brief description of other patterns of inheritance and genotype expression-incomplete dominance, co-dominance, multiple alleles, epistasis, pleiotropy.

Module 5 Mutations and Genetic disorders

Gene mutation - Kinds of mutation, classification (Somatic, gametic, point, spontaneous, induced, dominant, recessive and silent mutations); Gene mutation disorders - albinism, phenylketonuria, alkaptonuria, galactosemia, brachydactyli; Autosomal anomalies - Down's syndrome, Edward's syndrome, Cri du chat syndrome; Sex chromosomal anomalies - Klinefelter's syndrome and Turner's syndrome.

REFERENCES

Vijayakumaran Nair & Jayaprakash, Cell Biology, Genetics, Molecular Biology, Academia, Thiruvananthapuram.

Guptha, P.K., Cell and Molecular Biology, Rastogi Publications, Meerat.

Dewitt-Saunders, Biology of the cell.

Strickberger W.M-Mac Millon, Genetics.

Gerald Karp, Cell and Molecular Biology: Concept and Experiments.

Roothwell, Human Genetics, Prentice Hall.

Lodish;Verk; et.al; Molecular Cell Biology, W.H. Freemann publishers.

Verma, P. S. and Agarwal, V. K., Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S.Chand and Co. New Delhi.

De Robertis, E. D. P. and De Robertis, E. M. F., Cell and molecular Biology, 7th Edn, Hol-Saunders International Editions.

LESSON PLAN

Module	**Topics to be taught**	**Method of teaching**	**Activity**	**Learning outcome**	**Method of evaluation**
Module 1	Cell structure, plasma membrane (fluid mosaic model), and cell organelles; Cell inclusions-brief description on the structure of carbohydrates, lipids and proteins; Cell theory, cell principle; Unicellularity to multicellularity, differentiation. Brief mention of spatial and temporal control of gene activity; Tissues-brief description of major types.	a. Lecture b. Video presentation	Students are made to prepare notes on each cell organelle.	● Detailed idea on cell organelle.	MCQ, Class test
Module 2	Structure of D.N.A, D.N.A replication; Concept of a gene - genetic code, introns, exons; Morphology of chromosomes-size, shape, karyotype, idiogram, kinds of chromosomes; Linkage and crossing over, sex linked chromosomes.	a. Lecture b. Seminar Presentation c. Assignment	Students are asked to present their topic and discussion is to be done after each presentation.	● Basic idea regarding genetic material and chromosomes	Descriptive class test

Module 3	Cell cycle; Mitosis; Meiosis.	a. Lecture **b.** Video Presentation	Discussion is carried out after video presentation.	• Foundation on mitosis and meiosis.	MCQ
Module 4	Mendel's work and laws of inheritance (monohybrid cross, dihybrid cross, test cross); Brief explanation of terms-alleles, homozygosity, heterozygosity, genotype, phenotype; Brief description of other patterns of inheritance and genotype expression-incomplete dominance, co-dominance, multiple alleles, epistasis, pleiotropy.	a. Lecture b. Seminar Presentation c. Discussion	Students are made to present their topics. Discussions are carried out.		
Module 5	Gene mutation - Kinds of mutation, classification (Somatic, gametic, point, spontaneous, induced, dominant, recessive and silent mutations); Gene mutation disorders - albinism, phenylketonuria, alkaptonuria, galactosemia, brachydactyli; Autosomal anomalies - Down's syndrome, Edward's syndrome, Cri du chat syndrome; Sex chromosomal anomalies - Klinefelter's syndrome and Turner's syndrome.	a. Lecture b. Seminar Presentation **c.** Discussion	Seminars are presented and discussions are carried out	• Get introduced to different kinds of mutations and associated disorders	MCQ

PSY2IC01: Human Physiology

Credits: 3
Hours: 4 /week
Total: 72 hours

OBJECTIVES

This course imparts extensive information to the Psychology student on the nervous system with special emphasis on the CNS. It also introduces the student to states of brain activities and techniques in neurophysiology.

Module 1 The Nervous System

Divisions (CNS, PNS – somatic and autonomic), Nervous tissue (neurons, nerve fibres, nerves, synapse); Non nervous tissue and other materials (neuroglia, meninges, cerebro-spinal fluid, Blood - CSF and blood - brain barriers); Nerve impulse - generation, conduction, synaptic transmission, role of calcium ions, action of transmitter substances on postsynaptic neuron, types of transmitter substances.

Module 2 The Central Nervous System

Brain – an overview (Forebrain, midbrain, hindbrain); Spinal cord – an overview of its structure and organization; Reflex Action – monosynaptic reflex, multisynaptic reflex, crossed extension reflex, mass reflex.

Module 3 The Cerebellum and the Basal Ganglia

The Cerebellum and its motor functions; Anatomical functions, areas of the cerebellum; Function of the cerebellum in overall motor control; The basal ganglia-their motor functions, role of the basal ganglia for cognitive control, functions of neurotransmitters with basal ganglia.

Module 4 The Cerebral Cortex

Functions of the specific cortical areas –association areas (parieto occipito temporal, prefrontal and limbic association areas with special emphasis on Wernike's area and Broca's area), area for recognition of faces, concept of the dominant hemisphere; Function of the brain in communication - Sensory and Motor aspects of communication.

Module 5 States of brain activity and Techniques in neurophysiology

Sleep –Basic theories of sleep, Brain waves, Slow wave sleep and REM sleep; Brain imaging – CT, MRI, PET, CBF, EEG, Lesioning and Electrical Stimulation of Brain (ESB)

REFERENCES

Schneider A.M & Tarshis B., An introduction to Physiological Psychology, Random House, New York.

Guyton & Hall – Textbook of Medical Physiology, 12th Edn., Saunders.

Sherwood L, Thomson, Human Physiology.

Kalat J.W, Wadsworth C.A, Biological Psychology.

Levinthal C.F, Introduction to Physiological Psychology, Prentice Hall, New Delhi.

K.Sembulingam and Prema Sembulingam, Essentials of Medical Physiology, Jaypee brothers Medical Publishers Pvt. Ltd.

Chatterjee, C.C, Human Physiology, Medical Allied Agency.

LESSON PLAN

Module	Topics to be taught	Method of teaching	Activity	Learning Outcome	Method of evaluation
Module 1	Divisions (CNS, PNS – somatic and autonomic), Nervous tissue (neurons, nerve fibres, nerves, synapse); Non nervous tissue and other materials	a. Lecture b. Powerpoint Presentations c. Discussion	Students are made to attend the lecture and carry out discussions	● Getting familiar with the basic characteristics of human nervous system ad conduction	Descriptive Class test

	(neuroglia, meninges, cerebro-spinal fluid, Blood - CSF and blood - brain barriers); Nerve impulse - generation, conduction, synaptic transmission, role of calcium ions, action of transmitter substances on postsynaptic neuron, types of transmitter substances.				
Module 2	Brain – an overview (Forebrain, midbrain, hindbrain); Spinal cord – an overview of its structure and organization; Reflex Action – monosynaptic reflex, multisynaptic reflex, crossed extension reflex, mass reflex.	a. Powerpoint presentations b. Video Presentation c. Discussion	Students are made to attend powerpoint presentations and videos. Discussion is carried out afterwards	● Overview of brain and spinal cord. Clarity regarding reflexes.	MCQ Daily Classroom Question answer session Descriptive class test
Module 3	The Cerebellum and its motor functions; Anatomical functions, areas of the cerebellum; Function of the cerebellum in overall motor control; The basal ganglia-their motor functions, role of the basal ganglia for cognitive control, functions of neurotransmitters with basal ganglia.	a. Lecture b. Powerpoint presentation c. Video presentation	Students are made to attend presentations and and lectures and discussions are carried out.	● Clear idea about the functions of cerebellum, basal ganglia and neurotransmitters	Descriptive Class test
Module 4	Functions of the specific cortical areas –association areas (parieto occipito temporal,	a. Seminar Presentations b. Discussion c. Note making	Students are alloted with topics for seminar presentation	● Detailed idea regarding the functions of each cortical areas and	Note submission MCQ

	prefrontal and limbic association areas with special emphasis on Wernike's area and Broca's area), area for recognition of faces, concept of the dominant hemisphere; Function of the brain in communication - Sensory and Motor aspects of communication.		and discussions are carried out after the presentation. Students are asked to submit notes.	their role in communicati on.	
Module 5	Sleep –Basic theories of sleep, Brain waves, Slow wave sleep and REM sleep; Brain imaging – CT, MRI, PET, CBF, EEG, Lesioning and Electrical Stimulation of Brain (ESB)	a. Seminar Presentation b. Discussion c. Note making	Students are alloted with topics for seminar presentation and discussions are carried out after the presentation. Students are asked to submit notes.	• Clarity on different brain imaging techniques along with the theories of sleep	Note submission Descriptive class test MCQ

PSY1ICO2: Psychological Statistics

Credits: 3
Hours: 4 /week
Total: 72 hours

OBJECTIVES:

To generate interest in Statistics

To equip the students with the concepts of basic Statistics

To provide basic knowledge about Statistical methods

Module 1: A basic idea about data

Collection of data, primary and secondary data, organization, planning of survey and diagrammatic representation of data

Module 2: Classification and tabulation

Classification of data, frequency distribution, formation of a frequency distribution, Graphic representation viz. Histogram, Frequency Curve, Polygon, Ogives, Bar diagram and Pie diagram

Module 3: Measure of central tendency

Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean, Combined Mean, Advantages and disadvantages of each average

Module 4: Measures of dispersion

Range, Quartile Deviation, Mean Deviation, Standard Deviation, Combined Standard Deviation, Percentiles, Deciles, Relative Measures of Dispersion, Coefficient of variation

Module 5: Skewness and Kurtosis

Pearson's and Bowley's coefficient of skewness, Percentile Measure of Kurtosis

REFERENCES

Gupta, S.P. Statistical Methods. Sultan Chand and Sons: New Delhi.

Gupta, S.C., & Kapoor, V.K. Fundamentals of Applied Statistics. New Delhi: Sultan Chand and Sons.

Garret, H.E., &Woodworth, R.S. Statistics in Psychology and Education. Bombay: Vakila, Feffex and Simens Ltd.

Mood, A.M., Graybill, F.A and Boes, D.C. Introduction to Theory of Statistics. 3rd Edn. Paperback – International Edition.

Mukhopadhyay,P. Mathematical Statistics. New central Book Agency (P) Ltd: Calcutta.

LESSON PLAN

Module	Topics to be taught	Method of teaching	Activity	Learning Outcome	Method of evaluation
Module 1	Collection of data, primary and secondary data, organization, planning of survey and diagrammatic representation of data	a. Lecture b. Note making	Students are asked to submit assignments.	● Basic idea about data, collection of data, organization of data and diagrammatic representations	Descriptive Class test Assignment
Module 2	Classification of data, frequency distribution, formation of a frequency distribution, Graphic representation viz. Histogram, Frequency Curve, Polygon, Ogives, Bar diagram and Pie diagram	a. Lecture b. Classroom exercises c. Mathematical problems	Classroom exercises on each topic is given and conceptual clarity is given	● Practice of making frequency table, graphs and diagrams	Descriptive Class test
Module 3	Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean, Combined Mean, Advantages and disadvantages of each average	a. Lecture b. Classroom exercises c. Example problems	Classroom exercises on each topic is given and conceptual clarity is given	● Practice of finding out different central tendencies with understanding about advantages and disadvantages of each	Descriptive Class test
Module 4	Range, Quartile Deviation, Mean Deviation, Standard Deviation, Combined Standard Deviation, Percentiles, Deciles, Relative Measures of Dispersion, Coefficient of variation.	a. Lecture b. Classroom exercises c. Mathematical Problems	Classroom exercises on each topic is given and conceptual clarity is given	● Practice and conceptual clarity about measures of dispersion	MCQ Class test
Module 5	Pearson's and Bowley's coefficient of skewness, Percentile Measure of Kurtosis	a. Seminar Presentation b. Assignment Submission	Topics were allotted into groups for presentation	● Clear understanding regarding	Assignment

			and assignment submission.	the basic concepts related to skewness and kurtosis	

PSY2ICO2: Psychological Statistics

Credits: 3
Hours: 4 /week
Total: 72 hours

OBJECTIVES:

To make the students aware of various Statistical tools

To create awareness about probability

Module 1: Bivariate data

Relationship of variables, correlation analysis, methods of studying correlation, Scatter Diagram, Karl Pearson's Coefficient of Correlation, Calculation of Correlation from a 2-way table, Interpretation of Correlation Coefficient, Rank Correlation

Module 2: Regression analysis

Linear regression, Regression Equation, Identifying the Regression Lines properties of regression coefficients, numerical problems

Module 3: Partial and Multiple Correlation Coefficients

Multiple Regression Equation, Interpretation of Multiple Regression Coefficients (three variable cases only)

Module 4: Basic probability

Sets, Union, Intersection, Complement of Sets, Sample Space, Events, Classical, Frequency and Axiomatic Approaches to Probability, Addition and Multiplication Theorems, Independence of Events (Up-to three events)

Module 5: Random Variables and their probability distributions

Discrete and Continuous Random Variables, Probability Mass Function, Distribution Function of a Discrete Random Variable

REFERENCES

Gupta, S.P. Statistical Methods. Sultan Chand and Sons: New Delhi.

Gupta, S.C., &Kapoor, V.K. Fundamentals of Applied Statistics. New Delhi: Sultan Chand and Sons.

Garret, H.E., &Woodworth, R.S. Statistics in Psychology and Education. Bombay: Vakila, Feffex and Simens Ltd.

Mood, A.M., Graybill, F.A and Boes, D.C. Introduction to Theory of Statistics. 3rd Edition Paperback – International Edition.

Mukhopadhyay, P. Mathematical Statistics. New central Book Agency (P) Ltd: Calcutta.

LESSON PLAN

Module	Topics to be taught	Method of teaching	Activity	Learning Outcome	Method of evaluation
Module 1	Relationship of variables, correlation analysis, methods of studying correlation, Scatter Diagram, Karl Pearson's Coefficient of Correlation, Calculation of Correlation from a 2-way table, Interpretation of Correlation Coefficient, Rank Correlation	a. Lecture b. Demonstration of examples	Students are asked to find out examples and demonstrate as groups	● Clarity regarding bivariate analysis	Class test
Module 2	Linear regression, Regression Equation, Identifying the Regression Lines properties of	a. Lecture b. Demonstration of examples c. Problem exercises	Students are asked to find out examples and demonstrate as groups	● Getting introduced to regression	Class test

	regression coefficients, numerical problems		Numerical problems are exercised		
Module 3	Multiple Regression Equation, Interpretation of Multiple Regression Coefficients (three variable cases only)	a. Lecture b. Demonstration of examples c. Problem exercises d. Assignment	Students are asked to submit assignments on different subtopics with demonstration of examples	● Basic understanding regarding the concept of multiple regression.	Assignment, Class test
Module 4	Sets, Union, Intersection, Complement of Sets, Sample Space, Events, Classical, Frequency and Axiomatic Approaches to Probability, Addition and Multiplication Theorems, Independence of Events (Up-to three events)	a. Lecture b. Seminar Presentations c. Discussion	Topics are to allotted to each of the students and presentations are followed by discussions.	● Clear cut idea regarding the basic concepts related to sets and probability.	Presentation Class test
Module 5	Discrete and Continuous Random Variables, Probability Mass Function, Distribution Function of a Discrete Random Variable	a. Lecture b. Seminar Presentation c. Discussion	Seminar presentations are to be conducted followed by discussions.	● Students are getting idea regarding variables and probability distribution	Presentation Class test

LESSON PLAN-2016(MALAYALAM)

Semester 1

Course category: Common Course Malayalam

Paper name: Malayala Sahithyam-1

Code: MAL1A01

Course Outcome:

- To understand the change of Malayalam literature in different periods.
- To understand the writings of Malayalam writers.
- To develop interest in mother tongue and literature.
- The cultural upliftment of the students Identify.
- Malayalam literature and language usage of different eras.
- Introduce various literary and discourse forms in Malayalam.

Modules	Contents	Hours	Procedure/ Activity Plan	Assessment
Module-1	Kuchelagathi-(Cherussery Krishnagadha)	4	Lecture	Evaluation through question – answer session
	Sthreeparvam-Ezhuthachan (Mahabharatham Kilippattu)	4	Lecture	Evaluation through question – answer session
	Nchanappana-(Poonthanam)	4	Lecture	Evaluation through question – answer session
	Symanthakam Thullal-Kunchan Nambyar	4	Discussion	Discussion on the topic about Kavithrayas
Module-2	Folks Song	4	Lecture	Evaluation through question – answer session
	Vadakkan Pattu	4	Discussion students seminar	Seminar Evaluation
	Mappilappattu	4	Lecture	Evaluation through question – answer session

Module-3	Vellapokkathil-Thakazhi	4	Lecture	Evaluation through question – answer session
	Bus Kattu-Kesavadev	4	Lecture	Evaluation through question – answer session
	Marappavakal-Karoor	4	Students seminar lecture	Evaluation through question – answer session
Module-4	Kalppantham-M.T.Vasudevan Nair	4	Lecture	Evaluation through question – answer session
	Kaatu Paranja Kadha-O.V.Vijayan	4	Lecture	Evaluation through question – answer session
	Aval Oru Kuttiyayirunnappol-V.R.Sudheesh	4	Lecture	Evaluation through question – answer session
	Rand Eleppanmar-Shihabudeen Poythumkadavu.	4	Lecture Reference	Students reference notes are evaluated
Internal Exam	Two internals of 80 marks and 2.5 hours durations	5	Written exam	Paper are evaluated and mark are taken for CIE feedback are given individually
Assignment	Topic		All students are required to prepare and assignment from any of the topic they are interested, but should avoid repetition	Assignments are corrected and feedbacks are given CIE internal mark is awarded on the basis of assignment too.
Seminar	Topic	10	All students are required to present a topic with the help of presentation preferably.	Feedback are provided and marks are considered for CIE

Reference Materials:

1. Dr. M.Leelavathy, Kavitha Sahithya Charithram, Kerala Sahithya Academy. Thrissur-1998.
2. Dr.Kalppatta Bhalakrishnan , Malayala Sahithya Charithram, Kerala Bhasha Institute, Trivandrum -2000.
3. N.Krishnappilla, Kairaliyde Kadha.
4. Poonthanam Nchanappana.
5. Dr.Ampalappuzha Gopakumar, Kunchan Nambyar (Padanam) SPCS.Kttayam -2015.
6. Elam Kulam Kunjanpilla , Bhashayum Sahithyavum Noottandukalil.
7. M.Achuthan, Cherukadha- Innale ,Innu. DC Books, Kottayam-2007.
8. Dr.M.M.Basheer Malayala Cherukadha Sahithya Charithram.

Semester -2

Course category: Common Course Malayalam

Paper name: Malayala Sahithyam-2

Code: MAL2A02

Course Outcome:

- ❖ To understand the stages of growth in Malayalam poetry.
- ❖ Formulate common ground on the progression of prose and critical literature.

Modules	Contents	Hours	Procedure/ Activity Plan	Assessment
Module-1	Chindavishttayaya Seetha-Kumaranasan	4	Lecture	Evaluation through question – answer session
	Perumthachan-G.Sankarakkuruppu	4	Lecture	Evaluation through question – answer session
	Sahyante makan-Vailoppilli.	4	Lecture	Evaluation through question – answer session
Module-2	Pattupavada-Sugathakumari	4	Lecture	Evaluation through question – answer session
	Rathrikal Pakalukal-Ayyappapanikkar	4	Lecture students seminar	Question answers sessions seminar evaluation
	Ivanekoodi-Sachithanandan	4	Lecture	Evaluation through question – answer session
	Mazhakodumatram-Rafeek Ahammed	4	Lecture	Evaluation through question – answer session
Module-3&4	Ithihasakadhapathrangal-Kuttikrishnamarar	4	Lecture	Evaluation through question – answer session
	Hasyathinte ulppathi-M.P.Paul	4	Lecture	Evaluation through question – answer session
	Srishttavinte Swathanthriavum Srishtiyude	4	Lecture	Evaluation through question – answer session

	Sadhacharavum-M.Thomas Mathew			
	Spandhikkunna Asthimadam-M.K.Sanu	4	Lecture	Evaluation through question – answer session
	Thapante Amma-M.M.Bhasheer	4	Lecture	Evaluation through question – answer session
Internal Exam	Two internals of 80 marks and 2.5 hours durations	4	Written exam	Paper are evaluated and mark are taken for CIE feedback are given individually
Assignment	Topic		All students are required to prepare and assignment from any of the topic they are interested, but should avoid repetition	Assignments are corrected and feedbacks are given CIE internal mark is awarded on the basis of assignment too.
Seminar	Topic	10	All students are required to present a topic with the help of presentation preferably .	Feedback are provided and marks are considered for CIE

Reference Materials:

1. K.P.Appan, Kshobikkunnavurude Suvisesham.
2. Akkitham Achuthan Namboothiri, Akkitham Kavithakal Samboornam.
3. Ayyappa Panikkar, Ayyappa Panikkarude Thiranjedutha Kavithakal.
4. P.K.Rajasekharan, Andhanaya Daivam-Malayalanovalinte100varshangal.
5. Sachidhanandan, Malayala Kavitha Padanangal.

Semester -3

Course category: Common Course Malayalam

Paper name: Malayala Sahithyam-3

Code: MAL3A03

Course Outcome:

- ❖ Get acquainted with the tide of drama, Screen play, and Auto biography.
- ❖ To understand the general knowledge about film art.

Modules	Contents	Hours	Procedure/ Activity Plan	Assessment
Module-1	Nadakasadassu– G.Sankarappilla.	5	Lecture	Evaluation through question – answer session
	Malayala Nadaka Charithrathinoramukham- Dr.L.Thomas Kutty.	5	Lecture	Evaluation through question – answer session
Module-2	Thirakkadha- M.T.Vasudhevan Nair	5	Lecture	Evaluation through question – answer session
	Oridathoru Fayalvan- Padmarajan	5	Lecture	Evaluation through question – answer session
Module-3	Valarnnu Varunnorathmavu- V.T.Bhattathirippadu	5	Lecture	Evaluation through question – answer session
	Sahib Ennamanushyan- M.Rasheed	5	Lecture	Evaluation through question – answer session
	Kandal Jeevitham- Pokkudan	5	Lecture	Evaluation through question – answer session
	Mattu- V.K.Sreeraman	5	Lecture	Evaluation through question – answer session
Module-4	Marubhoomiyude Athmakadha-V.Musafar Ahammed	5	Lecture	Evaluation through question – answer session
Internal Exam	Two internals of 80 marks and 2.5 hours durations	5	Written exam	Paper are evaluated and mark are taken for CIE feedback are given individually

Assignment	Topic		All students are required to prepare and assignment from any of the topic they are interested, but should avoid repetition	Assignments are corrected and feedbacks are given CIE internal mark is awarded on the basis of assignment too.
Seminar	Topic	10	All students are required to present a topic with the help of presentation preferably .	Feedback are provided and marks are considered for CIE

Reference Materials:

1. Kairaliyude Kadha, N.Krishnappilla.
2. Malayala Nadaka Sahithya Charithram- G.Sankarappilla.
3. Malayala Nadakangaliloode- Kattumadan Narayanan.
4. Nadakam- Kanninte Kala, T.P.Sukumaran.
5. Malayala Cinemayude Kadha- Vijayakrishnan.
6. Malayala Cinemayum Sahithyavum- Madhu Iravankara.
7. Cinemayum Samskaravum- K.Gopi Nadhan.

Semester -4

Course category: Common Course Malayalam

Paper name: Malayala Sahithyam-4

Code: MAL4A04

Course Outcome:

- ❖ Gain the ability to translate from Malayalam and English.
- ❖ To understand about novel literature.

Modules	Contents	Hours	Procedure/ Activity Plan	Assessment
Module-1	Sailiyeppatti Chila Chindhakal- S.Gupthan Nair	5	Lecture	Evaluation through question – answer session
	Nattu Bhasha-A.R.Raja Rajavarma	5	Lecture	Evaluation through question – answer session
	Marunna Malayalam-Prabodha Chandran Nair		Lecture	Evaluation through question – answer session
	Saili Chinda-M.N.Karasseri	5	Lecture	Evaluation through question – answer session
Module-2	Ente Kavitha- Akkitham	5	Lecture	Evaluation through question – answer session
	Cheruvakalum Charuthayum-C.Radhakrishnan	5	Lecture	Evaluation through question – answer session
	Kalayum Kalavum-V.Rajeevan	5	Lecture	Evaluation through question – answer session
Module-3	Adivasikalum Avarude Samskaravum-P.K.Gopalakrishnan	5	Lecture	Evaluation through question – answer session
	Marumakkathayathinte Ulbhavam-Elamkulam Kunjanpilla	5	Lecture	Evaluation through question – answer session
	Ayyankali-Velayudhan Panikkasseri	5	Lecture	Evaluation through question – answer session

Module-4	Oru Dalith Yuvathiyude Kadhanakadha- M.Mukundan	5	Lecture	Evaluation through question – answer session
Internal Exam	Two internals of 80 marks and 2.5 hours durations	5	Written exam	Paper are evaluated and mark are taken for CIE feedback are given individually
Assignment	Topic		All students are required to prepare and assignment from any of the topic they are interested, but should avoid repetition	Assignments are corrected and feedbacks are given CIE internal mark is awarded on the basis of assignment too.
Seminar	Topic	10	All students are required to present a topic with the help of presentation preferably .	Feedback are provided and marks are considered for CIE

Reference Materials:

1. M.N.Karassery, Thaimozhi-Dc Books Kozhikode -2009
2. Dr.K.M.Prabhakaravaryar, Bhashayum Manasasthrasvum, Kerala Bhasha Institute-Tvm -1999.
3. Dr.K.A.Kosi, Bhashayum Bhashantharanavum,Dc Books, Koyyayam, 1994.
4. K.P.Sankaran, Navakam, Poorna Publishers, Kozhikkodu, 1938.
5. Omprakash Valmeeki, Echil, (Vivarthanam- Nisha.K.Nair).
6. K.Jayakumar, Roomiyude 100 Kavithakal, Current Books, Thrissur.

Lesson plan-2019(Common Course-Malayalam)

Semester 1

Course category: Common Course Malayalam

Paper name: Malayala Sahithyam-1

Code: MAL1A07 (1)

Course Outcome:

- To Develop interest in mother tongue and literature
- The cultural upliftment of the students Identify
- Malayalam literature and language usage of different eras
- Introduce various literary and discourse forms in Malayalam

Modules	Contents	Hours	Procedure/ ActivityPlan	Assessment
Module-1	Kaliyamardhanam- (Cherussery Krishnagadha)	4	Lecture	Evaluation through question – answer session
	Lakshmana santhwanam (Adhyathmaramayanam)	4	Lecture	Evaluation through question – answer session
	Nchanappana- (Poonthanam)	4	Lecture	Evaluation through question – answer session
	Rugmani Swayamvaram(Ottan Thullal)	4	Discussion	Discussion on the topic about Kavithrayas
Module-2	Folks song	4	Lecture	Evaluation through question – answer session
	Vadakkan pattu	4	Discussion students seminar	Seminar Evaluation
	Mappilappattu	4	Lecture	Evaluation through question – answer session
Module-3	Mothiram- Karoor	4	Lecture	Evaluation through question – answer session

	Double act- K.Saraswathi amma	4	Lecture	Evaluation through question – answer session
	Rachiyamma- P.C. KutiKrishnan	4	Students seminar lecture	Evaluation through question – answer session
Module-4	Ullurukkam- N.P.Mohammad	4	Lecture	Evaluation through question – answer session
	Ottuchedi-C.V.Raman	4	Lecture	Evaluation through question – answer session
	Ghare Bhayire-Geetha	4	Lecture	Evaluation through question – answer session
	Thanthathazhu- Pramod Raman	4	Lecture Reference	Students reference notes are evaluated
Internal Exam	Two internals of 80 marks and 2.5 hours durations	5	Written exam	Paper are evaluated and mark are taken for CIE feedback are given individually
Assignment	Topic		All students are required to prepare and assignment from any of the topic they are interested, but should avoid repetition	Assignments are corrected and feedbacks are given CIE internal mark is awarded on the basis of assignment too.
Seminar	Topic	10	All students are required to present a topic with the help of presentation preferably .	Feedback are provided and marks are considered for CIE

Referance Meterials:

9. Dr. M.Leelavathy, kavitha sahithya charithram, kerala sahithya academy . Thrissur-1998
10. Dr.Kalppatta Bhalakrishnan , Malayala sahithya charithram, Kerala bhasha Institute, Trivendrum -2000
11. N.Krishnappilla, Kairaliyde kadha
12. Poonthanam Nchanappana

13. Dr.Ampalappuzha Gopakumar, Kunchan Nambyar(Padanam)SPCS.Kttayam -2015
14. Ilam kulam Kunjanpilla , Bhashayum sahithyavum noottandukalil.
15. M.Achuthan , Cherukadha- innale ,innu. DC Books, Kottayam-2007
16. Dr.M.M.Basheer Malayala cherukadha sahithya charithram.

Semester -2

Course category: Common Course Malayalam

Paper name: Malayala Sahithyam-2

Code: MAL2A08 (1)

Course Outcome:

- ❖ To understand the stages of growth in Malayalam poetry.
- ❖ Formulate common ground on the progression of prose and critical literature.

Modules	Contents	Hours	Procedure/ ActivityPlan	Assessment
Module-1	Nalini-Kumaranasan	4	Lecture	Evaluation through question – answer session
	Sooryakanthi-G.Sankarakkuruppu	4	Lecture	Evaluation through question – answer session
	Maninadham- Idappalli Raghavan pilla	4	Lecture	Evaluation through question – answer session
Module-2	Kalopasakan- Akkitham	4	Lecture	Evaluation through question – answer session
	Kuthirakkombu-Ayyappapanikkar	4	Lecture students seminar	Question answers sessions seminar evaluation
	Puthganchollu- Attoor	4	Lecture	Evaluation through question – answer session
	Ammayekulippikkumpol-Savithrirajeevan	4	Lecture	Evaluation through question – answer session
Module-3&4	Amba-Kuttikrishnamarar	4	Lecture	Evaluation through question – answer session
	Kalidhasanum Kalathinte dhasan- Mudassery	4	Lecture	Evaluation through question – answer session
	Maranathinte soundharyam-K.P.Appan	4	Lecture	Evaluation through question – answer session

	Sthreeyillatha mathrubhoomi- Kalppatta Narayanan	4	Lecture	Evaluation through question – answer session
	Ezhuthum Adhikaravum- P.K.Rajasekharan	4	Lecture	Evaluation through question – answer session
Internal Exam	Two internals of 80 marks and 2.5 hours durations	5	Written exam	Paper are evaluated and mark are taken for CIE feedback are given individually
Assignment	Topic		All students are required to prepare and assignment from any of the topic they are interested, but should avoid repetition	Assignments are corrected and feedbacks are given CIE internal mark is awarded on the basis of assignment too.
Seminar	Topic	10	All students are required to present a topic with the help of presentation preferably.	Feedback are provided and marks are considered for CIE

Referance Meterials:

6. K.P.Appan,Kshobikkunnavurude Suvisesham.
7. Akkitham Achuthan Namboothiri,Akkitham Kavithakal samboornam.
8. Ayyappa panikkar,Ayyappa panikkarude thiranjedutha kavithakal.
9. P.K.Rajasekharan, Andhanaya Daivam-Malayala novalinte 100 varshangal.
10. Sachidhanandan,Malayala kavitha padanangal.

Semester -3

Course category: Common Course Malayalam

Paper name: Malayala Sahithyam-3

Code: MAL3A09

Course Outcome:

- ❖ Get acquainted with the tide of drama, screen play, auto biography.
- ❖ To understand the general knowledge about film art.

Modules	Contents	Hours	Procedure/ ActivityPlan	Assessment
Module-1	Bharathavakyam – G.Sankarappilla.	5	Lecture	Evaluation through question – answer session
	Thanathu Nadaka dharsanam- Vayala Vasudhevan pilla.	5	Lecture	Evaluation through question – answer session
Module-2	Perumthachan- M.T.Vasudhevan nair	5	Lecture	Evaluation through question – answer session
	Samvidhayakante kala- Adoor Gopalakrishnan	5	Lecture	Evaluation through question – answer session
Module-3	Kedatha theenalangal- V.T.Bhattathirippadu	5	Lecture	Evaluation through question – answer session
	Pushpagopuram – P.Kunjiraman nair	5	Lecture	Evaluation through question – answer session
	Neelakkadalasil pothinja Pchakkuthira- Rosy Thomas	5	Lecture	Evaluation through question – answer session
	Karuthivecha oru ilachoru- EEcharavarriyar	5	Lecture	Evaluation through question – answer session
Module-4	Himavante mukalthattu- Rajan Kakkanadan	5	Lecture	Evaluation through question – answer session
Internal Exam	Two internals of 80 marks and 2.5 hours durations	5	Written exam	Paper are evaluated and mark are taken for CIE feedback are given individually
Assignment	Topic		All students are required to prepare and assignment from any of the topic they are interested, but	Assignments are corrected and feedbacks are given CIE internal mark is awarded on the basis of assignment too.

			should avoid repetition	
Seminar	Topic	10	All students are required to present a topic with the help of presentation preferably .	Feedback are provided and marks are considered for CIE

Referance Meterials:

1. Naduvettam Gopalakrishnan, Athmakadha sahithyam malayalathil, Bhasha Institute,TVM,1998.
2. V.T.Bhattathirippadu,Kannerum kinavum,DC Books,Kottayam.
3. P.KunjiramanNair,Kaviyudekalppadukal,DC.Books , Kottayam,2006.
4. Rossy Thomas,Ivanente priya CJ, DC.Books ,Kottayam,1970.
5. Echaravariyar,Orachante ormmakkurippukal,Current Books , Thrissur,2005.

Semester -4

Course category: Common Course Malayalam

Paper name: Malayala Sahithyam-4

Code: MAL4A10

Course Outcome:

- ❖ Gain the ability to translate from Malayalam and English.

- To understand about novel literature.

Modules	Contents	Hours	Procedure/ ActivityPlan	Assessment
Module-1	Bhashayum asayavinimayavum-K.M.Prabhakara variyar	5	Lecture	Evaluation through question – answer session
	Vrudhasthoolatha-C.V.Vasudhevan Bhattathiri	5	Lecture	Evaluation through question – answer session
	Theettayum Janadhipathyavum,Bhangi vakku-M.N.Karassery	5	Lecture	Evaluation through question – answer session
	Doctormarude Rogam,vendath soundharyathmaka vidhyabyasam- P.Pavithran	5	Lecture	Evaluation through question – answer session
Module-2	Apapyamaya oru vidhanam-K.P.Sankaran	5	Lecture	Evaluation through question – answer session
	Vyajasoochanakal-Roomi	5	Lecture	Evaluation through question – answer session
	Echil-Omprakas Vathmeeki	5	Lecture	Evaluation through question – answer session
Module-3	Arivinte phaalangal—M.Govindan	5	Lecture	Evaluation through question – answer session
	Vyakthinamapadanangal-M.V.Vishnunampoothiri	5	Lecture	Evaluation through question – answer session
	Manushyrellam sodharar-M.K.Sanu	5	Lecture	Evaluation through question – answer session
Module-4	Anubhavangal-Nandhanar	5	Lecture	Evaluation through question – answer session
Internal Exam	Two internals of 80 marks and 2.5 hours durations	5	Written exam	Paper are evaluated and mark are taken for CIE feedback are given individually

Assignment	Topic		All students are required to prepare and assignment from any of the topic they are interested, but should avoid repetition	Assignments are corrected and feedbacks are given CIE internal mark is awarded on the basis of assignment too.
Seminar	Topic	10	All students are required to present a topic with the help of presentation preferably .	Feedback are provided and marks are considered for CIE

Referance Meterials:

7. M.N.Karassery, Thaimozhi-DC Books Kozhikkodu -2009
8. Dr.K.M.Prabhakaravaryar, Bhashayum Manasasthrasvum, Kerala Bhasha Institute-TVM -1999.
9. Dr.K.A.Kosi, Bhashayum Bhashantharanavum,DC Books, Koyyayam, 1994.
10. K.P.Sankaran, Navakam, Poorna Publishers, Kozhikkodu,1938.
11. Omprakash Valmeeki,Echil, (Vivarthanam- Nisha.K.Nair).
12. K.Jayakumar,Roomiyude 100 Kavithakal,Current Books, Thrissur.

LESSON PLAN-2016(MALAYALAM)

Semester I

Course category: Common Course Malayalam

Paper name: Malayala Sahithya Padanam -1

Code: MAL1A01 (1)

Course Outcome:

- Be interested in Literature.
- To understand different literary movements.
- To understand the writings of Malayalam writers.
- To develop interest in mother tongue and literature.
- Understand the importance of the translation and increase your translation skills.

Modules	Contents	Hours	Procedure/ Activity Plan	Assessment
Module-1	Enthinezhuthunnu-M.T.Vasudevan Nair	5	Lecture	Evaluation through question – answer session
	Parithyktharude Rashtreeyam-Sachidhanandan	5	Lecture	Evaluation through question – answer session
	Malayala cinemayude sahithya bandham-Madhu Iravankara.	5	Lecture	Evaluation through question – answer session
	Facisathinte Manasasthram-M.P.veerendrakumar	5	Lecture	Evaluation through question – answer session
Module-2	Tharjamayil Varavunna Apakathakal-Vishnunarayanan Namboothiri	5	Lecture Students Seminar	Question-Answer sessions, Seminar evaluation
	Vanijyasasthram-M.M.Vasudevan namboothirippadu	5	Lecture	Evaluation through question – answer session
Module-3	Kanunnathalla kazhchakal-U.K.Kumaran	5	Lecture Students Seminar	Evaluation through question – answer session
Module-4	Cairo Kathukal-S.K.Pottakkadu	5	Lecture	Evaluation through question – answer session

Internal Exam	Two internals of 80 marks and 2.5 hours durations	5	Written exam	Paper are evaluated and mark are taken for CIE feedback are given individually
Assignment	Topic		All students are required to prepare and assignment from any of the topic they are interested, but should avoid repetition	Assignments are corrected and feedbacks are given CIE internal mark is awarded on the basis of assignment too.
Seminar	Topic	10	All students are required to present a topic with the help of presentation preferably .	Feedback are provided and marks are considered for CIE

Reference Materials:

1. M.T.Vasudevan Nair, Kadikante Panippura, Current Books, Kottayam.
2. M.P.Veerendrakumar, Budhante Chiri, Mathrubhoomi Books, Kozhikkodu.
3. Sugathakumari, Irul Chirakukalude Amukham.
4. Vishnu Narayanan Namboothiri, Vivarthanam, Kerala Bhasha Institute.

Semester -2

Course category: Common Course Malayalam

Paper name: Malayala Sahithya Padanam -2

Code: MAL2A02 (1)

Course Outcome:

- To understand the stages of growth in Malayalam poetry.
- Formulate common ground on the progression of prose and critical literature.

Modules	Contents	Hours	Procedure/ Activity Plan	Assessment
Module-1	Achanum Makalum-Vallathole	5	Lecture	Evaluation through question – answer session
	Safalameeyathra-N.N.Kakkad	5	Lecture	Evaluation through question – answer session
	Jose Josephinte Maranam-G.Kumarappilla	5	Lecture	Evaluation through question – answer session
Module-2	Ottuchedi-C.V.Sreeraman	5	Lecture	Evaluation through question – answer session
	Dhooth-Sethu	5	Lecture	Evaluation through question – answer session
	Jeevachavangal-Punathil Kunjabdhulla	5	Lecture	Evaluation through question – answer session
Module-3	Lanka Lakshmi-C.N.Sreekandannair	5	Lecture	Evaluation through question – answer session
Module-4	Ivanente Priya CJ-Rossy Thomas	5	Lecture	Evaluation through question – answer session
	Prakruthikku Kodukkuka-Dhayabhai	5	Lecture	Evaluation through question – answer session
	Ezhuthinte Eettillam-Lalithampika Antharjanam	5	Lecture	Evaluation through question – answer session

Internal Exam	Two internals of 80 marks and 2.5 hours durations	5	Written exam	Paper are evaluated and mark are taken for CIE feedback are given individually
Assignment	Topic		All students are required to prepare and assignment from any of the topic they are interested, but should avoid repetition	Assignments are corrected and feedbacks are given CIE internal mark is awarded on the basis of assignment too.
Seminar	Topic	10	All students are required to present a topic with the help of presentation preferably.	Feedback are provided and marks are considered for CIE

Reference Materials:

1. M.Leelavathi, Malayala Kavitha Sahithya Charithram.
2. N.Krishnappilla, Kairaliyudekadha.
3. G.Sankarappilla, Malayala Nataka Sahithyacharithram.

LESSON PLAN-2019

Semester 1

Course category: Common Course Malayalam

Paper name: Malayala Sahithya Padanam -1

Code: MAL1A07 (2)

Course Outcome:

- Be interested in Literature.
- To understand different literary movements.
- To develop interest in mother tongue and literature.
- The cultural upliftment of the students Identify.
- Malayalam literature and language usage of different eras.
- Introduce various literary and discourse forms in Malayalam.

Modules	Contents	Hours	Procedure/ Activity Plan	Assessment
Module-1	Soundharya nireekshanam-M.P.Paul	5	Lecture	Evaluation through question – answer session
	Swathiyude Sannidhiyil-S.Gupthan Nair	5	Lecture	Evaluation through question – answer session
	Swarnnamalsyangal-M.N.Vijayan	5	Lecture	Evaluation through question – answer session
	Mathavum Mathangalum-Sukumar Azhikkodu	5	Lecture Students Seminar	Question-Answer sessions, Seminar evaluation
Module-2	Soochi mukhi-Malayattoor	5	Lecture	Evaluation through question – answer session
	Ayal Rajavu-M.Sukumaran	5	Lecture Students Seminar	Evaluation through question – answer session
	Orithal-Manasi	5	Lecture	Evaluation through question – answer session

Module-3	Nooru Simhasanangal-Jayamohan	5	Lecture	Evaluation through question – answer session
Module-4	Kudaku Yathrakal-N.Prabhakaran	5	Lecture discussion	Class test
Internal Exam	Two internals of 80 marks and 2.5 hours durations	5	Written exam	Paper are evaluated and mark are taken for CIE feedback are given individually
Assignment	Topic		All students are required to prepare and assignment from any of the topic they are interested, but should avoid repetition	Assignments are corrected and feedbacks are given CIE internal mark is awarded on the basis of assignment too.
Seminar	Topic	10	All students are required to present a topic with the help of presentation preferably .	Feedback are provided and marks are considered for CIE

Reference Materials:

1. Dr.Kalppatta Bhalakrishnan , Malayala Sahithya Charithram, Kerala Bhasha Institute, Trivandrum -2000.
2. N.Krishnappilla, Kairaliyde Kadha.
3. M.Achuthan, Cherukadha - Innale, Innu. DC Books, Kottayam-2007.
4. Dr.M.M.Basheer Malayala cherukadha Sahithya Charithram.
5. M.P.Paul, Soundharya Nireekshanam.

Semester -2

Course category: Common Course Malayalam

Paper name: Malayala Sahithya padanam -2

Code: MAL2A08 (2)

Course Outcome:

- To understand the stages of growth in Malayalam poetry.
- Formulate common ground on the progression of prose and critical literature.

Modules	Contents	Hours	Procedure/ Activity Plan	Assessment
Module-1	Ente Bhasha-Vallathole	5	Lecture	Evaluation through question – answer session
	Mazhuvinte Kadha-Balamaniyamma	5	Lecture	Evaluation through question – answer session
	Safalameeyathra-N.N.Kakkadu	5	Lecture	Evaluation through question – answer session
Module-2	Bamglavu-T.V.Kochubava	5	Lecture	Evaluation through question – answer session
	Dhushyndhan Mashu-V.K.N	5	Lecture	Evaluation through question – answer session
	Thaykulam- Sara Joseph	5	Lecture Students Seminar	Question-Answer sessions, Seminar evaluation
	Modhasthithanayangu Vasippu Malapole-S.Hareesh	5	Lecture	Evaluation through question – answer session
Module-3	Saketham-C.N.Sreekandan Nair	5	Discussion	Discussion on the topic about Nadaka
Module-3	Sindhoorappottinte Ormmaykk- O.V.Vijayan	5	Lecture	Evaluation through question – answer session
	Sharonile Rosapookal-Vaikkam Chandrasekharan	5	Lecture	Evaluation through question – answer session

	Pavakkutty-Madhavikkutty	5	Lecture Students Seminar	Question-Answer sessions, Seminar evaluation
Internal Exam	Two internals of 80 marks and 2.5 hours durations	5	Lecture	Evaluation through question – answer session
Assignment	Topic		All students are required to prepare and assignment from any of the topic they are interested, but should avoid repetition	Assignments are corrected and feedbacks are given CIE internal mark is awarded on the basis of assignment too.
Seminar	Topic	10	All students are required to present a topic with the help of presentation preferably.	Feedback are provided and marks are considered for CIE

Reference Materials:

4. M.Leelavathi, Malayala Kavitha Sahithya Charithram.
5. N.Krishnappilla, Kairaliyudekadha.
6. G.Sankarappilla,Malayala Nataka Sahithyacharithram.
7. Madhavikkutty, Varshangalkkumunp.
8. O.V.Vijayante Lekhanangal.

Lesson Plan BA/BSC

Semester 1

Course Category : Common course in Hindi

Paper name : Prose & Drama

Code : HINIA07(01)

Course Outcome :

- To acquaint the students with different forms of thoughts and styles used in Hindi prose writing .
- To make them able to express their thoughts in these different forms.
- To intoduce Hindi Drama to the students for appreciation and critical analysis.
- To help them develop their creative thinking and writing.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assessment
Module - 1	HARI BINDI by MARIDULA GARG SHAVYATRA by OMPRAKASH VATMIKI NAKHUN KYON BADHTE HAI by HAZARI PRASAD DWIVEDI	4	Lecture	Evaluation through question – answer session
Module - 2	SONA by MAHADEI VARMA SADACHAR KAA THAWEEZ by HARISANKAR PARSAI	4	Lecture	Evaluation through question – answer session
Module - 3	SAKKUBAI	4	Lecture	Evaluation through question – answer session
Internal	Two Internal 80 marks and	4	Written Exam	Papers are evaluated,

Examinations	2.5 hours duration			Feedbacks are given individually
Assignments	Any Topic	4	All students are required to prepare an assignment from any of the topics they are interested but should avoid repetition	Assignments are corrected and feedbacks are given. Internal marks is awareded on the basis of assignments too.
Seminars	Any Topic	4	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for

Reference Materials:

1. Sahitya Saptak – Prof. Pratibha Mudaliyar, Aman Prakashan 104A/80C, Rambay, Kanpur
2. Hindi Snatak Adhyan Mandel – Gadhya Aman Prakasan, 104A/8C Rambay, Kanpur
3. Nadira Zahir Babbaar – Sakku Bai – Vani Prakashan, 21-A Dariya Ganj, New Delhi.

Semester II

Course Category : Common Course in Hindi

Paper Name : Grammar & Translation

Code : A08 (1)

Course Outcome :

- To make students able to use Hindi language correctly and efficiently.
- To make them understand various types of letters both personal and business. To facilitate the use of translation as a tool for communication between different languages.
- Grammar is essential to the study of language. Developing a correct grammar sense is very important for written communication.
- A student who successfully complete the course should be able to write in Hindi independently in their personal and professional life.
- Familiarizing the technology of translation with its possibilities.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assignment
Module - 1	Correct usages of Hindi – Shabdavichar, definition and classification of words – noun, gender, number, karak	4	Lecture	Evalauation through question-answer session
Module - 2	Pronoun, adjective, tense,Voice	4	Lecture	Evalauation through question-answer session
Module - 3	Adverb, Preposition, Conjunction, Interjection	4	Lecture	Evalauation through question-answer session
Module - 4	Translation from English to Hindi	4	Lecture	Evalauation through question-answer session
Internal Examinations	Two Internal 80 marks and 2.5 hours duration	4	Written exam	Papers are evaluated feedbacks are given individually

Assignments	Any Topic	4	All students are required to prepare an assignment from any of the topics they are interested but should avoid repetition	Assignments are corrected and feedbacks are given . Internal marks is awarded on the basis of assignments too.
Seminars	Any Topic	4	All students are required to present a topic with the help of presentation preferably	Feedbacks are provided and marks are considered for DE

Reference Materials

SAMANYA HINDI VYAKARAN TATHA RACHANA : SREEKRISHNA PANDEV, LOKMANGAL PRAKASHAN, B-32, KAILASH COLONY, SHAHDARA, DELHI

Semester III

Course Category : Common Course in Hindi

Paper name : Poetry in Hindi

Code : HIN09(1)

Course Outcome :

- To sensitize the students to the aesthetic cultural and social aspects of literacy appreciation and analysis.
- Appreciation of poetry using the best specimens provided in an anthology.
- Understanding the origin and development of Hindi poetry through selected poems.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assessment
Module - 1	Ancient Hindi Poetry – A collection of poems of ancient poets	5	Lecture	Evaluation through question – answer session
Module - 2	Modern Hindi Poetry – A collection of poems of different periods representing different styles and themes	5	Lecture	Evaluation through question – answer session
Module - 3	A collection of poems of different periods	5	Lecture	Evaluation through question – answer session
Module - 4	Khandakavya	5	Lecture	Evaluation through question – answer session
Internal Examinations	Two Internal 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated, Feedbacks are given

				individually
Assignments	Any Topic	5	All students are required to prepare an assignment from any of the topics they are interested but should avoid repetition	Assignments are corrected and feedbacks are given. Internal marks is awareded on the basis of assignments too.
Seminars	Any Topic	5	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for

Reference Materials

- PADYA.VIHAR – RAJKAMAL PUBLICATIONS, 1B NETAJI SUBASH MARG, DARIYAGANJ, NEW DELHI.
- KANUPRIYA – BHARATEEYA GYAANPEETH, 18, INDUSTRIAL AREA LODHI ROAD, NEW DELHI.

Semester IV

Course Category : Common Course in Hindi

Paper name : Novel & Short stories

Code : A10

Course Outcome :

- To sensitize the students to aesthetic, cultural and social aspects of literacy appreciation and analysis. To provide them the best specimens of Hindi Fiction of eminent authors of different periods.
- To acquaint the students with different forms of thoughts and styles of Hindi fiction.
- To help them develop their thinking and writing.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assessment
Module - 1	Short stories from the collection	5	Lecture	Evaluation through question – answer session
Module - 2	Short stories from the collection	5	Lecture	Evaluation through question – answer session
Module - 3	Novel	5	Lecture	Evaluation through question – answer session
Internal Examinations	Two Internal 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated, Feedbacks are given individually
Assignments	Any Topic	5	All students are required to prepare an assignment from any of the topics they are interested but should avoid repetition	Assignments are corrected and feedbacks are given. Internal marks is awareded on the basis of assignments too.

Seminars	Any Topic	5	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for

Reference Materials

1. SADABAHAR KAHANIYAN – RASPAL AND SONS, MADRASA ROAD KASHMIRI GATE, NEW DELHI.
2. SAPNON KEE HOM DELIVERY – MAMATA KAALIAYA, LOK BHARATI PRAKASHAN, DARBARI BUILDING, M.G.ROAD, CIVIL LINES, ALLAHABAAD.

Lesson Plan BCOM

Semester I

Course Category : Common Course in Hindi

Paper Name : PROSE FORMS in HINDI LITERATURE

Code : 07(2)

Course Outcome :

- To sensitize the students to aesthetic, cultural and social aspects of literacy appreciation and analysis.
- To acquaint the students with different forms of thoughts and styles of Hindi prose writing.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assessment
Module - 1	Selected prose forms,essay, Memoir, Story	5	Lecture	Evaluation through question – answer session
Module - 2	Selected prose forms satire, Sketch, Mini story	5	Lecture	Evaluation through question – answer session
Module - 3	Selected prose forms Travelogue, one act play	5	Lecture	Evaluation through question – answer session
Internal Examinations	Two Internal 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated, Feedbacks are given individually
Assignments	Any Topic	5	All students are required to prepare an assignment from KABIR DAS they are interested but should avoid	Assignments are corrected and feedbacks are given. Internal marks is awareded on the basis of assignments too.

			repetition	
Seminars	Any Topic	5	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for

Reference Materials

GADYA GAGN – VANI PRAKASHAN, 21 – A, DARYA GANJ, NEW DELHI

Semester II

Course Category : Common Course in Hindi

Paper Name : Poetry, Correspondence and Translation

Code : Course No: 09 (2)

Course Outcome:

- To sensitize the students to aesthetic, cultural and social aspects of literacy appreciation and analysis.
- To make them aware of the importance of correspondence and translation. To make them proficient to prepare certain basic kind of letters independently in their personal and professional life.
- Familiarizing the technology of translation with its possibilities.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assessment
Module - 1	Kabirdas – Five Dohas Soordas – Three Padas Sumitranantan panth – Nauka – Vihar Sooryakaanth Thripathinirala – Juhikeekali Agyey – Naach	5	Lecture	Evaluation through question – answer session
Module - 2	Anamika – Mausiyan Saritha Sharma – Beti Arunkamal – Mukti Gyanendrapathi – pyasaakuan Gagan Gill – is tharah.	5	Lecture	Evaluation through question – answer session
Module - 3	Letters : Personal letter, application letter, letter of order, complaint letter, business letter (bank and bima) technical	5	Lecture	Evaluation through question – answer session

	terminology 1-50			
Module - 4	Translation from English to Hindi	5	Lecture	Evaluation through question – answer session
Internal Examinations	Two Internal 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated, Feedbacks are given individually
Assignments	Any Topic	5	All students are required to prepare an assignment from any of the topics they are interested but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	5	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for

Reference Materials

- KAYASARGAM – VANI PRAKASHAN, 21-A, DARYA GANJ, NEW DELHI
- ANUVAD EVAM PATRVYAVAHAAN – GOVIND PRAKASHAN

Course Outcome – Hindi

BA/BSC Programme

First Semester

Common Additional Language course in Hindi

HIN1A07(1) Prose and Drama

Course Outcome:

- Approach literary texts in terms of genre, gender and the canon
- Understand and use academic conventions : referencing and bibliography.
- Exposed to the origin and development of Hindi drama and its various themes and forms of different ages and stages.

Second Semester

HIN2A08(1) Grammar and Transilation

- Understand the differences between spoken and written Hindi
- Understand the factors that influence use of grammar and vocabulary in speech and writing.
- Understand the different ways in which grammar has been described.
- Define the link between translation theory and translation practice.
- Defne the effects of translation theories on translation practice.
- Define the contribution of translation practice to translation theory.

Third Semester

HIN3A09 – Poetry in Hindi

- Understand the common techniques underlying free verse and traditional forms of poetry.
- Identify personal experiences that can be used when writing poems.
- Understand the basic terminology and practical elements of poetry.

Fourth Semester

HIN4A10 – Novel and Short Stories

- Enables the students to analyse literature and fiction using appropriate theoretical, historical and cultural apparatus.
- Students get to know various cultures and construction of gender, nation and race throghout the history.
- The prescribed fiction helps the students to learn human values and the behavioural patterns from great works of art, and develops the ability to understand human race.

BCOM/BBA Programme Course Outcome

First Semester

Common Additional Language Course in Hindi

HIN1A07(2) Prose forms in Hindi Literature

- Approach literary texts in trems of genre, gender and the canon.
- Understand and use academic conventions referencing and bibliography
- The learner will be aware of Socio – political and economic conditions of the societry from different periods.

Second Semester

Common Additional Language Course in Hindi

HIN2A08(2) – Poetry; Correspondance and Translation

- Understand the common techniques underlying free verse and traditional forms of poetry.
- Identify personal experiences that can be used when writing poems
- Understand the basic terminology and practical elements of poetry
- Define the link between translation theory and translation practice
- Define the effects of translation theories on translation practice
- Define the contribution of translation practice to translation theory.
- Understand the importance of correspondence

Lesson Plan – BCOM

Semester I

Course Category : Common Course in Hindi

Paper Name : Prose Forms in Hindi Literature

Code : Course No.07 (2)

Course Outcome :

- To Sensitize the students to aesthetic, cultural and social aspects of literacy appreciation and analysis.
- To acquaint the students with different forms thoughts and styles in Hindi prose writing.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assessment
Module - 1	1. Gasap – Namvar Singh 2. Gurudev – Haribhavu – Upadhay 3. Atmakatha amsh – Bhishma Sahini	5	Lecture	Evaluation through question – answer session
Module - 2	4. Mein narak se bol raha hum – Hari – Sankar Parsai 5. Bhakthin – Mahadevi varma 6. Sava ser gehum – prem chand.	5	Lecture	Evaluation through question – answer session
Module - 3	7. Devathavom ke anchal mein ageya 8. Toothe parivesh – Vishu prabakar 9. Sathi – G.J. Hariseeth.	5	Lecture	Evaluation through question – answer session
	Two Internal			Papers are

Internal Examinations	80 marks and 2.5 hours duration	5	Lecture	evaluated, Feedbacks are given individually
Assignments	Any topic	5	All students are required to prepare an assignment from any of the topics they are interested but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	5	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for

Reference Materials:

Gady ke vividh aayam – Ed: Dr. Raju Bagalkot, Aman Prakasan, Kanpur.

Semester II

Course Category : Common Course in Hindi

Paper Name : Poetry, Correspondence And Translation

Code : Course No.09 (2)

Course Outcome :

- To Sensitize the students to aesthetic, cultural and social aspects of literacy appreciation and analysis.
- To make them aware of the importance of correspondence and translation. To make them proficient to prepare certain basic kinds of letters independence and translation. To make them proficient to prepare certain basic kinds of letters independently in their personal and professional life.
- Familiarising the technology of translation with its possibilities.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assessment
Module - 1	1. Kabirdas – First – Five dohas 2. Surdas – First – three padas 3. Prathibimb – panth 4. Kavikah gaye hein - nirala	5	Lecture	Evaluation through question – answer session
Module - 2	5. Kavitha ki bath - agyey 6. Dhabba – Kedar Nath Singh 7. Chidiya, Chittiyam – Ramdarash Mishra 8. Dhoomil ki anthim kavitha – Dhoomil 9. Vakth – Arun Kamal 10. Yah mahaj kora kagz nahi – Bhagavath Ravath 11. Machis – sunitha Jain	5	Lecture	Evaluation through question – answer session

Module - 3	Letters : Personal letter, application letter, letter of order, complaint letter, business letter (bank and bima) technical terminology 1-50	5	Lecture	Evaluation through question – answer session
Module – 4	Translation passage from English to Hindi	5	Lecture	Evaluation through question – answer session
Internal Examinations	Two Internal 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated, Feedbacks are given individually
Assignments	Any topic	5	All students are required to prepare an assignment from any of the topics they are interested but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	5	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for

Reference Materials:

i. Kavya Sudha – Ed:V. Bhaskar, Jawahar Pusthakalay, Mathura.
ii. Anuvad Evam pathra Vyavahar – Ed: Vanaja Govinda Prakasan

Lesson Plan BA/BSC

Semester I

Course Category : Common Course in Hindi

Paper Name : Prose and Drama

Code : Course No.07 (1)

Course Outcome :

- To Sensitize the students to aesthetic, cultural and social aspects of literacy appreciation and analysis.
- To acquaint the students with different forms thoughts and styles used in Hindi prose writing, to make them able to express their thoughts in these different forms.
- To introduce Hindi Drama to the students for appreciation and critical analysis.
- To help them develop their creative thinking and writing.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assessment
Module - 1	Introduction : different forms of prose from prescribed text book.	4	Lecture	Evaluation through question – answer session
Module - 2	1. Vapasi – Usha priyamvada 2. Mithratha – Ramachandra sukla 3. Irshya tu na gayi mere man se – Ramshari Singh Dinkar.	4	Lecture	Evaluation through question – answer session
Module - 3	1. Gungiya – Mahadevi Varma. 2. Mein narak se bol raha hum – Harisankar Parsay: 3. Swami – Vivekananda Premchand	4	Lecture	Evaluation through question – answer session

Module – 4	Drama – Bina Deevaron ke khar – Mannu - Bhardari	4	Lecture	Evaluation through question – answer session
Internal Examinations	Two Internal 80 marks and 2.5 hours duration	4	Written Exam	Papers are evaluated, Feedbacks are given individually
Assignments	Any topic	4	All students are required to prepare an assignment from any of the topics they are interested but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	4	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for

Reference Materials:

1. Sahitya Sapthak – Ed : Prathibha Mudaliar – Aman Prakasan, 104A/80C Rambag, Kanpur.
2. Bina deevaron ke khar – Mannu Bhandari – Radhakrishna Prakasan, New Delhi – 2

Semester II

Course Category : Common Course in Hindi
Paper Name : Grammar Correspondence And Translation
Code : Course No.08 (1)
Course Outcome :

- To make students able to use Hindi language correctly and eficiently. To make them understand various types of letters both personal and business. To facilitate the use of translation as a tool for communication between different languages.
- Grammar is essential to the study of language. Developing a correct grammar sense is very important for written communication.
- A student who successfully complete the course should be able to prepare certain basic kinds of letters independently in their personal and professional life.
- Familiarising the technology of translation with is possibilities.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assessment
Module - 1	Sabda vichar, Sagya, Ling, vachan, Karak (Chapters – 3,4,5,6,7)	5	Lecture	Evaluation through question – answer session
Module - 2	Sarvanam, viseshan, kriya,Kriya + zeropanthar - Kaal, Vachya (Chapter – 8,9,10,11,12)	5	Lecture	Evaluation through question – answer session
Module - 3	Correspondance, personal letter, order for books, application for job, letter of complaints.	5	Lecture	Evaluation through question – answer session
Module – 4	Translation from English to Hindi	5	Lecture	Evaluation through question – answer session
	Two Internal			Papers are

Internal Examinations	80 marks and 2.5 hours duration	5	Written Exam	evaluated, Feedbacks are given individually
Assignments	Any topic	5	All students are required to prepare an assignment from any of the topics they are interested but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	5	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for

Reference Materials:

Samanya Hindi Vyakaran Thatha Rachana, Sreekrishna Pandey, Lokmangal Prakasan, B-32, Kailash Colony, Shahdara, Delhi

Semester III

Course Category : Common Course in Hindi

Paper Name : Poetry In Hindi

Code : Course No.09 (1)

Course Outcome :

- To sensitize the students to the aesthetic cultural and social aspects of literacy appreciation and analysis
- Appreciation of poetry using the best specimens provided in a anthology.
- Understanding the origin and development of Hindi poetry through selected poems.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assessment
Module - 1	1. Kabeerdas (10 dohas) 2. Soordas (4 padas)	5	Lecture	Evaluation through question – answer session
Module - 2	3. Badal raag – Nirala 4. Moh – Panth 5. Samragyi ka Naivedya daan – Agyey	5	Lecture	Evaluation through question – answer session
Module - 3	8. Dhabba – Kedar Nath singh 9. Aparajitha – Kathyayani 10. Otni – Anamika 11. Nadi aur Saabun – Gyanendrapathi 12. Bus bahuth ho chukka – Om Prakash Valmiki	5	Lecture	Evaluation through question – answer session
Module – 4	Khandakavya – Bhoomiosa – Nagarjun for detailed study.	5	Lecture	Evaluation through question – answer session
Internal Examinations	Two Internal 80 marks and 2.5 hours duration	5	Written Exam	Papers are evaluated, Feedbacks are given individually

Assignments	Any topic	5	All students are required to prepare an assignment from any of the topics they are interested but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	5	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for

Reference Materials:

1. Kaalgartri Kavithayen – Ed:Dr.B. Vijayakumar, Arunoday Prakasan,Dariyaganj, New Delhi – 2
2. Bhoomisa – Nagarjun – Radhakrishna Prakasan, 7/31, Ansari marg, NewDelhi – 2.

Semester III

Course Category : Common Course in Hindi
Paper Name :
Code :
Course Outcome :

- To sensitize the students to aesthetic, cultural and social aspects of literacy appreciation and analysis. To provide them the best specimens of Hindi fiction of eminent authors of different periods.
- To acquaint the students with different forms thoughts and styles of Hindi fiction.
- To help them develop their creative thinking and writing.

Modules	Contents	Hours	Procedure/ Activity/ Plans	Assessment
Module - 1	Introduction of origin and development of Hindi fiction	5	Lecture	Evaluation through question – answer session
Module - 2	1. Poos kiraat Premchand 2. Akash deep – Jayasankar Prasad 3. Dukh – Yashpal	5	Lecture	Evaluation through question – answer session
Module - 3	4. Aparichith – Mohan Rakesh 5. Ikkisvim sadi ka ped mridula garg 6. Dalit Brahman Sathyaprakash	5	Lecture	Evaluation through question – answer session
Module – 4	Novel – Loute huye musafir – Kamaleswar (for non- detailed study – only short questions) and essay type question may be asked for examination	5	Lecture	Evaluation through question – answer session

Internal Examinations	Two Internal 80 marks and 2.5 hours duration		Written Exam	Papers are evaluated, Feedbacks are given individually
Assignments	Any topic	5	All students are required to prepare an assignment from any of the topics they are interested but should avoid repetition	Assignments are corrected and feedbacks are given.
Seminars	Any topic	5	All students are required to present a topic with the help of presentation, preferably.	Feedbacks are provided and marks are considered for

Reference Materials:

1. Samakaleen Kahaniyan – Ed: Dr. K. Vanaja,Rajpal and sons, Delhi
2. Loute huye musafir – Kamaleswar, Lokbharathi Prakasan, Allahabad.

Course Outcome – Hindi

BA/BSC Programme

First Semester

Common Additonal Language Course in Hindi.

HINI A07 (1) Prose and Drama

Course Outcome :

1. To acquaint the students with different forms of thoughts and styles used in Hindi prose writing. To make them able to express their thoughts in these different forms.
2. To introduce Hindi Drama to the students for appreciation and critical analysis.
3. To help them develop their creative thinking and writing.

Second Semester

HIN A08 (1) Grammar and Translation

1. Grammar is essential to the study of language. Developing a correct grammar sense is very important for written communication.
2. A student who successfully complete the course should be able to write in Hindi independently in their personal and professional life.
3. Familiarizing the technology of translation with its possibilities.

Third Semester

HIN 3 A09 – Poetry in Hindi

1. Apprecitaion of poetry using the best specimens provided in an anthology.
2. Understanding the origin and development of Hindi poetry through selected poems.

Fourth Semester

HIN 4 A10 – Novel and Short Stories

1. To acquaint the students with different forms of thoughts and styles of Hindi fiction.
2. To help the develop their thinking and writing.

BCOM/BBA Programme Course Outcome

First Semester

Common Additional Language Course in Hindi

HINI A07 (2) Prose Forms in Hindi Literature

1. To acquaint the students with different forms of thoughts and styles in Hindi prose writing.

Second Semester

Common Additional Language Course in Hindi

HIN2 A08 (2) Poetry Correspondance and Translation

1. To sensitize the students to the aesthetic, cultural and social aspects of literacy appreciation and analysis.
2. To make them aware of the importance of correspondance and translation. To make them proficient to prepare certain basic kinds of letters independently in their personal and professional life.
3. Familiarizing the technology of translation with its possibilities.