Syllabus for Chemistry

Inorganic Chemistry

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding
5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
8. Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods.
9. Characterisation of inorganic compounds by spectroscopy and microscopic techniques.

Physical Chemistry:

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly- solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals.
2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.
4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems.
5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules
6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.

7. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; thermodynamics of ideal and non-ideal Solutions.
8. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.
9. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.

Organic Chemistry

1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.
2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
3. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.
4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.
5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
6. Common named reactions and rearrangements – applications in organic synthesis.
7. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
8. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
9. Chemistry of natural products: Carbohydrates, proteins, peptides, fatty acids, nucleic acids & alkaloids.
10. Structure determination of organic compounds by IR, UV-Vis, ^{1}H & ^{13}C NMR

BIOLOGY/SEROLOGY/DNA DIVISION

(Syllabus for Zoology)

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INVERTEBRATES

Protista, Parazoa and Metazoa, Porifera, Cnidaria, Ctenophora, Platyhelminthes, Nemathelminthes, Introduction to Coelomates, Annelida, Arthropoda, Onychophora, Mollusca, Echinodermata and their general characteristics.

CHORDATA:

Introduction to Chordates, Protochordata, Origin of Chordata, Agnatha, Pisces, Amphibia, Reptilia, Aves, Mammals, Zoogeography and general characteristics.

CELL BIOLOGY

Membrane structure and function: (Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes). **Structural organization and function of intracellular organelles:** (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility). **Organization of genes and chromosomes:** (Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons). **Cell division and cell cycle:** (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle).

BIOCHEMISTRY

Structure of atoms, molecules and chemical bonds. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties). Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds). Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA). Stability of proteins and nucleic acids. J. Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins

MOLECULAR BIOLOGY

DNA replication, repair and recombination RNA synthesis and processing, Protein synthesis and processing

CELL COMMUNICATION AND CELL SIGNALING

Host parasite interaction, Cell signalling, Cellular communication, extracellular matrix, integrins, neurotransmission and its regulation, Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

INHERITANCE BIOLOGY

Mendelian principles, Concept of gene, Extensions of Mendelian principles, Gene mapping methods, Extra chromosomal inheritance, Microbial genetics, Human genetics, Quantitative genetics, Mutation

SYSTEM PHYSIOLOGY - ANIMAL

Blood and circulation, Cardiovascular System, Respiratory system, Nervous system, Sense organs, Excretory, Endocrinology and reproduction.

ECOLOGICAL PRINCIPLES

The Environment,Habitat and Niche, Population Ecology, Species Interactions, Community Ecology, Ecological Succession, Ecosystem Ecology.

DEVELOPMENTAL BIOLOGY

Basic concepts of development, Gametogenesis, fertilization and early development, Morphogenesis and organogenesis in animals, Programmed cell death, aging and senescence.

IMMUNOLOGY

Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

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DIVERSITY OF LIFE FORMS:
Principles & methods of taxonomy, Levels of structural organization, Outline classification of plants, animals & mi roorganisms, Natural history of Indian subcontinent, Organisms of health & agricultural importance, Organisms of conservation concern.

EVOLUTION AND BEHAVIOUR
Emergence of evolutionary thoughts, Origin of cells and unicellular evolution, Paleontology and Evolutionary History, D. Molecular Evolution, E. The Mechanisms, F. Brain, Behavior and Evolution.

TOOLS AND TECHNIQUES
Molecular Biology and Recombinant DNA methods, Histochemical and Statisitcal Methods, Microscopic techniques

APPLIED BIOLOGY:
Microbial fermentation and production of small and macro molecules, Application of immunological principles, vaccines, diagnostics. Tissue and cell culture methods for animals, Transgenic animals, molecular approaches to diagnosis and strain identification, Genomics and its application to health and agriculture, including gene therapy, Bioresource and uses of biodiversity, Breeding in animals, including marker – assisted selection, Bioremediation, Biosensors

Syllabus:Microbiology

1. DIVERSITY OF PROKARYOTIC AND EUKARYOTIC MICROBES

Archaea, Bacteria, Fungal Systematics and diversity, Fungal endophytes of tropical plants and their applications, Mycorrhizal fungi, Agriculturally important toxigenic fungi, Secondary metabolites from fungi, Genomics and Biodiversity of yeast, Antagonistic interactions in yeasts, Biotechnological applications of yeasts, Algal diversity from morphology to molecules.

2. MICROBIAL PHYSIOLOGY AND METABOLISM

Growth and cell division, Solute Transport, Central Metabolic Pathways and Regulation, Nitrogen metabolism, Metabolism of lipids and hydrocarbons, Metabolism of nucleotides, Physiological Adaptations and Intercellular signaling.

3. VIROLOGY

Animal Viruses Classification, Morphology and Chemistry of Viruses, Working with viruses, Virus replication Strategies, Replication patterns of specific viruses, Pathogenesis of viral infection, Anti-viral strategies-prevention and control of viral diseases.

plant and microbial viruses

plant and microbial Viruses Classification, Morphology and Chemistry of Viruses, Working with viruses, Virus replication Strategies, Replication patterns of specific viruses, Pathogenesis of viral infection, Anti-viral strategies-prevention and control of viral diseases.

4. MICROBIAL PATHOGENICITY

Classical view of microbial pathogenicity, Molecular microbial pathogenicity, Emerging and re-emerging pathogens, Molecular microbial epidemiology, Environmental change and infectious diseases, Antimicrobial resistance, Newer vaccines, Rapid diagnostic principles:

5. MICROBIAL GENETICS

Genetic analysis of bacteria, Gene transfer and mapping by conjugation, Lytic bacteriophages, Gene transfer by transformation and transduction:

Lysogenic phages,Transposons, Gene regulation:

6. MOLECULAR BIOLOGY

The nature of Genetic material, DNA replication, Recombination and Repair of DNA, Transcription, Post-transcriptional processes, Translation, Post-translational processes, Molecular basis of cell physiology.

ntroduction to industrial microbiology, Downstream processing of microbial products, Fermentation economics, Production aspects, Section BMicrobiology of foods, Microbial spoilage of foodsFood preservation, Fermentation processes, Food-borne diseases

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8. ENVIRONMENTAL MICROBIOLOGY

Brief history and development of environmental microbiology, Culture-dependent and culture-independent approaches for understanding microbial diversity in theenvironment, Microbial diversity in normal environments, Microbial diversity in extreme environments, Lignin degradation, Liquid waste management, Solid waste management, Bioremediation of environmental pollutants, Microbes and mineral recovery.

Syllabus: Molecular Biology

BIOCHEMISTRY

Introduction to basic concepts, Ionic Equilibria ,Chemistry of biomolecules, Nucleic acids, Protein structure, Enzymes, Enyme kinetics.

Bioenergetics, Biological oxidation and electron transport, Carbohydrate metabolism, Photosynthesis, Lipid metabolism, Nitrogen metabolism, Nucleic acid metabolism, Prokaryotic Gene Expression, Regulation of prokaryotic genes expression and operons, Eukaryotic gene expression: DNA binding proteins, Transcription factors (TFs), Eukaryotic RNA polymerase, Characterization of TATA box, Gene expression and Chromosome remodeling, Regulation of gene expression at transcriptional level.

MOLECULAR CELL PHYSIOLOGY

Water and Osmoregulation, Cytoplasmic fluidity, Membrane Structure and Function,

Concept of membrane electrical potential, Cell Receptors, Signal Transduction, Intracellular Membrane and Protein flow, Fluid flow circulation in Plants and Human

MOLECULAR CELL BIOLOGY

Extracellular matrix and cell-cell interaction, Plant systems, Nucleus, Chromosomes, Cell cycle, Apoptosis, Cancer, Viruses, Bacteria,Bacterial plasmids, Cyanobacteria, Fungi, Microbial metabolism, Microbial pathogenesis

Medically important bacteria: Mode of infection and pathogenesis of Staphylococcus, Clostridium, Streptococcus, Enteropathogenic bacteria, Salmonella and Mycobacterium.

TOOLS AND TECHNIQUES OF MOLECULARBIOLOGY

Microscopy and Microscopic techniques:,Micrometry and flow cytometry, Rotary and ultra microtomes. pH measuring divices, biochemical buffers, principles of electrochemical techniques,

potentiometry and voltametry, conductivity bridge, oxygen electrode and biosensors. Cell disruption techniques sonication, freeze-thaw techniques, enzymatic methods. Centrifugation – basic principles of sedimentation, types of centrifuges and rotors, ultracentrifugation, differential

centrifugation, density gradient and analytical ultracentrifugation and its application, Turbidometry.

Cell culture and Molecular biology tools, Separation methods

MOLECULAR BIOLOGY

DNA: Chemical composition of DNA, Cvalue paradox, DNA replication: Prokaryotic DNA replication, Eukaryotic-replication , DNA damage, RNAs: types, GENETIC ENGINEERING, Restriction enzymes, DNA Modifying enzymes, Cloning vectors, Cloning hosts.

Post transcriptional Processing of RNA: Processing of rRNA, Processing of pre-tRNAs, Pre-mRNA processing, Capping and polyadenylation, Splicing, Pre-mRNA Editing, Self-splicing introns, Informosomes, mRNA stability and turn over, Genetic code, Prokaryotic Translation, Eukaryotic translation Translational apparatus, Regulation of protein synthesis, Post translational processing, Processing of Pre-pro-proteins, Protein stability and turnover.

Protocols:

(a) Agarose gel electrophoresis, (b) Methods of Cloning, sub cloning and characterization of cloned material, (c) DNA transfer techniques:- Transformation, Transfection, Electroporation and Gene gun methods.

Gene Isolation methods,

PCR Techniques, DNA sequencing & In Vitro Translation.

PRINCIPLES OF GENETICS

Mendelism, Extensions of Mendelian principles, Evolution of genes concept, Linkage and chromosomal mapping, Inbreeding depression and Heterosis., ex linkage and sex determination, Chromosomal and Molecular basis of sex determination, Extrachromosomal Inheritance ,Mutation, Molecular mechanisms of gene Mutations, Population genetics, Quantitative genetics, Evolutionary genetics.

PLANT TISSUE CULTURE

History and applications of Plant Tissue Culture, Requirments, Totipotency

Clonal Propagation:Techniques, Organ, tissue and cell culture, Somatic Embryogenesis, Protoplast Culture, Somaclonal and Gametoclonal Variation, Role of Tissue Culture in Germplasm Conservation, Genetic Transformation:

MICROBIAL BIOTECHNOLOGY

Use of microbes in industry, Biotransformation methods:

Production of Restriction enzymes, Production of DNA modifying enzymes, Extreme enzymes (Taq DNA polymerase and keratinase), bifunctional enzymes. Enzyme immobilization and its application: Enzymes used in food (proteases and amylases) and beverage (amylases and invertases) industries, detergent industry, leather industry, wool industry, paper industries. Production of glucose from Cellulose; application in food, dairy (proteases), beverage and pharma industry. Yeast expression systems for production of therapeutical agents: Hepatitis- B surface antigen, Human platelet derived growth factor B. Production of single cell proteins: Large scale production and application. *Spirulina maxima* (Cyanobacteria), *Kluyveromyces fragilis* (yeast), *Candida lipolytica* (yeast), *Chaetomium cellulolyticum* (fungus), *Methylophilus methylotrophus* (bacterium).

Microbes and environment-I: Brief account of pollution control-use of cleaner technology, treatment of industrial effluents, toxic sites, Genetically engineered microbial systems (GEMS) for environmental remediation. Production of biofuels from municipal and agricultural waste, Methanogenic and hydrogen producing bacteria for biofuel production.

Microbes and environment-II: Bioremediation and Bioleaching: Land restoration or reclamation by microbes. Mycorrhizae, biofertilizers, biopesticides. Collection, conservation and cataloguing of microbial biodiversity – their role in environmental conservation and reclamation.

MOLECULAR BIOLOGY OF DEVELOPMENT

Plant Systems: Biochemical and molecular basis of Growth and differentiation: Concept of growth and differentiation vs. morphogenesis; Site and cell types involved in growth and differentiation. Kinematics of growth, Spatial and material basis of growth, mechanism of differentiation. Polarity fixation: A brief account of polarity fixation in a fertilized egg cell; calcium channel redistribution and transcellular currents, role of mRNAs, Actin and Microtubule cytoskeletons and Golgi derived vesicles in polarity determination (Use example from red algae). Genetic basis: Identity of a gene that control development in Arabidopsis; three stages of development from embryo, axial pattern, apical basal pattern, radial pattern and requirement of gene expression for the development of the above structure in Arabidopsis. The role of homeobox genes.

Phytohormone: Biosynthesis of phytohormones, Effects of phytohormones on plant growth and development Flowering, Molecular genetics of flowering:

Mammalian systems: Stem cells-Different kinds of stem cells and their characters, transformation into different types cell types-molecular approach; Bone marrow multipotent stem cells; hematopoietic stem cells and their mode of differentiation and development into a variety of circulatory cells-molecular approach. Embryonic cells-pleuripotent cells, induction of differentiation and the factors and the mechanism. Stem cell engineering, applications and prospects.

Renewal of tissues and tissue engineering: Renewal of cells that are lost in adult tissues; such as epidermal cells, mammary gland cells, photoreceptor cells in Retina, Liver cells. Differentiation and development of muscle cells-embryonic somites to myoblasts, myogenic genes and expression, muscle developmental factors-such as MEFs and MRFs, terminal Differentiation of myoblasts, cell to cell signaling pathway in determining muscle cell fate and development.

Developmental Biology in Drosophila

BIOETHICS AND BIOSAFETY

Bioethics and Biosafety, Ethical issues in Genetically Modified Organisms. Definition, Properties of stem cells, stem cells in gene therapy, stem cell biosafety, Ethical issues of stem cell research and use.

IMMUNOLOGY

Unit I: Types of immunity, Organs of immune system, Cells of immune system, Antigens and Antibodies, Antigen recognition, Vaccines, Disorders of immune system.

GENOMICS AND PROTEOMICS

Structural Genomics, Physical mapping, Whole genome sequencing, Functional genomics, Protein-protein interactions, Metabolomics and metabolic engineering, Comparative Genomics. Bioinformatic tools for genome and proteome analysis, Applications of genomics and proteomics.

PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY

Biotechnology:
Introduction: History, aim and scope of Plant Biotechnology, Liquid culture, Transgenic Plants, Disease Resistance , Improvement of food crops.
Animal Biotechnology: Methods and protocols used for tissue and cell cultures, Animal cell Transformation and immortalization, transgenic animals.

Botany

Phycology
General character and classification of algae; Role of Pigments, reserve food and flagella in the classification of algae; Thallus organization in algae; Structure, life cycle and Phylogeny Life cycle pattern of algae; Evolution of sex in algae; Economics importance of algae.

Mycology
General character and classification of Fungi (Anisworth 1973; Alexopoulos & Mims 1979); Heterothallism, Parasexuality, and sex hormone in fungi; Structure, life cycle and Phylogeny Economic importance of fungi with special reference to industry, food industry and as biocontrol agent; Mycotoxins General account, classification, structure, reproduction and economic importance of Lichen.

Bryophyta
General character and classification of Bryophytes (Cavers 1911; Smith 1955; Parihar 1965); Structure, reproduction, affinities and evolutionary trends, Evolution of sporophytes and gametophytes in Bryophytes; Spore dispersal, conductive tissue, archesporium & sterilization of sporogenous tissues; Economic importance of Bryophytes.

Pteridophyta
General Character and classification of Pteridophytes (Smith 1955; Sporne 1975); Structure, reproduction, affinities and evolutionary trends, Origin and evolution of Pteridophytes, Telome theory, heterospory and seed habit; Stele; Fossil: type, process, geological time scale and distribution of fossil Pteridophytes in India.

Gymnosperms
General characters and classification of gymnosperms (Arnold 1984; Sporne 1965); Distribution of living gymnosperms in India; General account and Phylogeny, Evolution of Male Female gametophyte and embryogeny in gymnosperms; Origin, evolution and economic importance of gymnosperms. .

Taxonomy of Angiosperms
Origin and evolution of angiosperms; Modern trends in plant taxonomy with special reference to numerical taxonomy, Chemotaxonomy, Cytotaxonomy and embryology; Taxonomic tools: Herbariums and botanical gardens; Binomial nomenclature and salient features of International code of Botanical nomenclature; System of angiospermic classification, Distinctive taxonomic features and Phylogeny of following families – Ranunculaceae, Lamiaceae, Rubiaceae, Acanthaceae, Scrophulariaceae, Asclepiadaceae, Euphorbiaceae, Poaceae and Cyperaceae, Botany, cultivation and uses of cereals, pulses, vegetables, fruits, oil, timber and fiber , dye yielding plants yielding plants of Jharkhand of Jharkhand, Medicinal plants of Jharkhand and its importance.

Anatomy
Organization of Root Apical Meristem, Shoot Apical Meristem, Leaf development and differentiation; Stomata: morphology, different types and ontogeny; Periderm: Origin, structure, function, cork and lenticels; Nodal anatomy and its significance; Mechanical tissues: types and distribution

Embryology
Microsporogenesis, Megasporogenesis, Sexual imcompatibility: Self and interspecific incompatibility, Pollen – Pistil interaction; Endosperm, Embryogeny: Dicot and monocot embryogeny; Polyembryony,Apomixis. Palynology: Pollen morphology, pollen wall & scope of palynology.

Cell Biology
Plasma membrane:- Models, Site of ATPase, Channel and Pumps and Function; Structure and Function of microbodies, Golgi appacatus peroxisome and Endoplasmic reticulum; Cytosekleton:- Nature of cytoskeleton, intermediate filament, microtubules, cilia & centrioles; Nucleus:- Nuclear membrane, nuclear pores, nucleolus and functions; Cell cycle:- Mitosis, Meiosis and cell cycle control; Structure of Chromatin and Chromosomes:- Packing of DNA, euchromatin, heterochromatin, morphology & structure of chromosome, banding patterns; Linkage, crossing over and chromosome mapping.

Genetics, Plant Breeding, Molecular Biology, Biochemistry Biotechnology and genetic engineering of plants
Classical and modern genetics, Cytoplasm inheritance, Structural changes in chromosomes, Numerical changes in chromosome, Mutation, Molecular basis of gene mutation and mutagens, Principles of Plant breeding, Hybrid vigor and its role in plant improvement, Recombination DNA Technology & PCR, Gene transfer method and synthesis of transgenic plants, Genetically manipulated crops, DNA; Structure, replication, damage and repair; RNA; Structure, types and functions and RNA splicing; Transcription and translation- mechanism of initiation, elongation and termination in prokaryotes; Genetic Code; Modern concept of gene and regulation of gene expression in prokaryotes. Enzyme Nature, properties, classification, mode of action, enzyme kinetics isoenzyme and allosteric enzymes, Carbohydrates- Classification & structure of monosaccharides & disaccharides; Proteins: - Primary, Secondary Tertiary & Quaternary structure; Vitamins: - Types, distribution and deficiency. Basic concept, Principles and scope; Embryo culture, Somatic embryogenesis,Artificial seeds, anther culture, factors, significance. Uses of haploids in crop improvement; Plant protoplast culture techniques,

selection of fused protoplast and significance; Cybrids:- Techniques, advantages and uses; Soma clonal Variations Recombinant DNA Technology, Electrophorasis, Nucleic Acid hybridization, Polymerase Chain Reaction .

Plant Physiology

Water relation, Water potential, Osmosis, mechanism of water absorption & mechanism of Ascent of sap, mechanism of mineral salt absorption, mechanism of translocation of solutes & mechanism of stomatal movement; Mineral nutrition of plants: Deficiency, symptoms and disease. Macro and Micro nutrients; Photosynthesis: - Light harvesting complex, mechanism of electron transport, Calvin cycle, Hatch & Slack Pathway & Photorespiration; Respiration: - Glycolysis, Kreb's cycle, oxidative phosphorylation and ATP Synthesis & Fermentation; Lipid metabolism: - Biosynthesis of Fatty acid & oxidation of Fat (β-oxidation); Biological Nitrogen Fixation; Phytohormones: - Chemical nature, mode of action and role of Auxins, Gibberellins and Cytokinins; Photoperiodism: - Mechanism and role of florigen and phytocrome; Vernalization; Movement: - Tropic and Nastic movement; Dormancy: - Types, reason and methods to overcome.

Microbiology

Historical aspects of microbiology, Sterilization: - Types, methods and precautions, Culture medium: - Types, composition, methods of preparation and merits & demerits, Isolation culture and purification of viral, bacterial and fungal pathogen: - Types, methods & precautions and preparation of their pure culture; General Character and classifications of Fungi, bacteria, viruses and mycoplasma; Viruses- morphology, ultrastructure, capsid & their arrangement, Viroids and Prions; Mycoplasma: - General account, Classification, Structure and life cycle and diseases caused by mycoplasma; Bacteria: - General character, Ultrastructure, Bacterial Cell Wall, Genome, genetic recombination, bacterial toxin and interferons, economic importance with reference to Agriculture, Industry and Medicine; Cyanobacteria: - General characters, Classification, Ultrastructure, Reproduction & Economic importance

Plant Pathology

Important terms and classification of plant diseases and symptoms, Study of symptoms, etiology, disease cycle and control measure of following diseases –Fungal diseases: - Late blight of potato, Loose smut of wheat, black rust of wheat, Red rot of sugarcane and Tundu disease of wheat, Green ear of bajra, False smut of rice, Gall of coriander, Rust of linseed & Tikka disease of Groundnut. , Bacterial diseases: - Blight of rice, Citrus canker, Black leg and soft rot of Potato. Viral diseases: - Leaf curl of Tomato, leaf curl of Papaya, yellow vein mosaic of Bhindi, TMV. Mycoplasmal diseases: - Little leaf of Brinjal & Grassy shoot of Sugarcane. Nematodal diseases: - Root knot of vegetable & Ear cockle of wheat.

Ecology ,Environmental Biology and Plant Resources and Utilization, Biodiversity and Conservation

Ecosystem: - Modern concept, structural component, trophic structure, food chain, food web and ecological pyramid, structure and functions of pond, grassland and forest ecosystem; Ecological energetics: - Concept and energy flow in ecosystem; Productivity: - Types, methods of primary productions and its measurement; Biochemical cycle of N, C, P and S; Community structure: - Analytical and synthetic characters with emphasis on I.V.I. and species diversity Index(H); Ecological niche, edges and ecotones; Ecological succession: - Types and process of succession, hydrosere & Xerosere concept of climax; Biomes of the world; Major vegetation types of India; Major floristic regions of India; Plant diversity: Concept, status in India, Utilization and concerns; Strategies for plant conservation; in Situ conservation: Protected areas, sanctuaries, National Parks, biosphere reserves, wetland, mangroves, sacred groves and coral reefs for conservation of wild biodiversity; Ex Situ conservation: Botanical gardens, gene banks, seed banks and cryobanks; Genetically modified (GM) crops. Solid waste management, Fly ash , Water pollution, Air pollution, Radiation pollution, Soil pollution, Noise pollution: Types, measurement, sources, impact on health and its mode of action, strategy for control/minimizing and Biotechnology for pollution abetment Climatic changes – Climatic change, global warming, present status, future projections of climatic change, impact, adaptation and mitigation of climatic change, Convention on Biological Diversity (CBD), Kyoto protocol and carbon trading, Gene campaign, Rare, threatend and endangered flora of India; Energy resources – Renewable and nonrenewable source of energy; Sustainable development; Concept, methods and IUCN categories of threats; Plant Indicators. IUCN, UNEP, WWF, NBPGR, BSI, ICAR, CSIR & DBT role and fuction.

Biostatistics

Concept of statistical analysis in biology; Basic idea about mean, median, mode, Chi-square test, standard deviation, standard error and probability; Presentation of biological data in Table, graphs, histograms and Pie Chart.

Biotechnology

1) **Biomolecular structure and function**
   a) Covalent structure of Amino acids, proteins, nucleic acids, carbohydrates and lipids.
   b) Forces that stabilize biomolecules: electrostatic and van der Waal"s interaction, hydrogen bonding. Interactions with solvents, Hydrophobic effect.
   c) Basic Thermodynamics: Laws of thermodynamics. Concepts of ΔG, ΔH and ΔS.
   d) Physical properties of water and their role in biology. Concepts of pH, ionic strength and buffers.
   g) Chemical kinetics: Concepts of order and molecularity of a chemical reaction. Derivation of first and second order rate equation, measurement of rate constants. Concept of activation energy.
   h) Enzymology: Introduction to enzymes. Types of enzymatic reaction mechanisms, Michaelis-Menten kinetics. Competitive, Non-competitive and Un-competitive inhibition. Bi-substrate reaction kinetics. Allostery.

2) **Methods in Biotechnology**
   a) Biochemical Methods: Chromatography: Ion exchange, Gel Filtration and Affinity chromatography. Electrophoresis: Native and SDS-PAGE. Iso-electric focusing. 2D-PAGE and its applications.
   b) UV/Vis spectrophotometry. Beer-Lambert"s law and its use in determination of protein/ nucleic acid concentration.
   e) Fluorescence Spectroscopy: Basic concepts of excitation and emission. Quenching, Theory and applications of FRET.
   f) Centrifugation: Basic concepts of centrifugation. Calculation of g value from RPM. Density gradient centrifugation. Sedimentation velocity and Sedimentation equilibrium. Separation of sub-cellular components and macromolecules using high speed and ultracentrifugation.
   g) Microscopy: Bright field, phase contrast, fluorescence, confocal, and electron microscopy.

3) **Organization of structure and functions of prokaryotic and eukaryotic cells**
   a) Cell wall and Cell Membrane: physical structure of model membranes in prokaryotes and eukaryotes, lipid bilayer, membrane proteins, other constituents; diffusion, osmosis, active transport, regulation of intracellular transport and electrical properties.
   b) Structural organization and functions of cell organelles, Cytoskeletons structure and motility function.
   c) Organization of genomes: genes and chromosomes, Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.
   d) Cell division and cell cycle, Apoptosis, Necrosis and Autophagy.

4) **Cellular processes**
   a) DNA replication, repair and recombination
   b) Transcription of various types of RNAs and their processing and modifications.
   c) Protein synthesis, processing and transport of proteins. Regulation of Translation- global vs mRNA-specific. Translation inhibitors, Post-translational modifications of proteins. Protein trafficking and transport.
   d) Control of gene expression at transcription and translation level
   e) Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways.
   f) Innate and adaptive immune system: Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. Monoclonal antibodies, antigen-antibody interactions.

5) **Recombinant DNA Technology**
   a) Enzymes used in Recombinant DNA technology.
   b) Isolation and purification of DNA (genomic and plasmid) and RNA. Various methods of separation, characterization of nucleic acids including Southern and Northern hybridizations.
   c) Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors and their purification. Western blotting.
   d) Generation of genomic and cDNA libraries.
   e) Isolation and amplification of specific nucleic acid sequences, PCR, RT PCR and qRT PCR
   f) DNA sequencing methods, strategies for genome sequencing.
   g) Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques.
   h) Analysis of DNA polymorphism: RFLP, RAPD and AFLP techniques.

6. Genetics, Phylogeny & Evolution

   a) Chromosomal inheritance: Principles of Mendelian inheritance, codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, linkage and cross-over, sex-linked inheritance, Mutations, Population Genetics and Hardy-Weinberg equilibrium.
   b) Extrachromosomal inheritance: Maternal inheritance (mitochondria and chloroplast)
   c) Genetic analysis: Linkage maps, mapping with molecular markers, tetrad analysis, gene transfer in bacteria: transformation, conjugation, transduction, sex-duction, fine structure analysis of gene.
   d) DNA finger printing and its applications, DNA bar coding,

7. **Genomics and Proteomics**

   a) Introduction to Genomics: Structure and organization of prokaryotic and eukaryotic genomes ;Similarity searches; Pairwise and multiple alignments; Phylogenetics; Tools for genome analysis– PCR, RFLP, DNA fingerprinting, RAPD, Automated DNA sequencing; Linkage and pedigree analysis; Construction of genetic maps; Physical maps, FISH to identify chromosome landmarks.
   b) DNA Microarray technology: Basic principles and design: cDNA and oligonucleotide
   c) Arrays; Applications: Global gene expression analysis, Comparative transcriptomics, Differential gene expression; Genotyping/SNP detection; Detection technology; Computational analysis of microarray data.

d) Proteomics: Outline of a typical proteomics experiment; Identification and analysis of proteins by 2D analysis; Spot visualization and picking; Tryptic digestion of protein and peptide fingerprinting; Mass spectrometry; ion source (MALDI, spray sources); analyzer (ToF, quadrupole, quadrupole ion trap) and detector; ELISA, pull-down assays (using GST-tagged protein), Yeast two hybrid system, Phage display.

8. **Biosafety**

Biosafety: Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines.

Syllabus:Life Sciences

1. MOLECULES AND THEIR INTERACTION RELAVENT TO BIOLOGY

A. Structure of atoms, molecules and chemical bonds.
B. Composition, structure and function of biomolecules (carbohydrates, lipids,proteins, nucleic acids and vitamins).
C. Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobicinteraction, etc.).
D. Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).
E. Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, grouptransfer, biological energy transducers.
F. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.
G. Conformation of proteins (Ramachandran plot, secondary structure, domains, motifand folds).
H. Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).
I. Stability of proteins and nucleic acids.
J. Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

2. CELLULAR ORGANIZATION

A) Membrane structure and function.B) Structural organization and function of intracellular organelles. C) Organization of genes and chromosomes. D) Cell division and cell cycle. E) Microbial Physiology.

3. FUNDAMENTAL PROCESSES

A)DNAreplication, repair an drecombinationB) RNA synthesis and processing C) Protein synthesis and processing D) Control of gene expression at transcription and translation level

4. CELL COMMUNICATION AND CELL SIGNALING

A) Host parasite interaction.B) Cell signaling.C) Cellular communication D) Cancer E) Innate and adaptive immune system.

5. DEVELOPMENTAL BIOLOGY

A) Basic concepts of development B) Gametogenesis, fertilization and early development C) Morphogenesis and organogenesis in animals D) Morphogenesis and organogenesis in plants E) Programmed cell death, aging and senescence

6. SYSTEM PHYSIOLOGY – PLANT

A. PhotosynthesisB. Respiration and photorespiration C. Nitrogen metabolismD. Plant hormones E. Sensory photobiology F. Solute transport and photoassimilate translocation G. Secondary metabolites H. Stress physiology

7.SYSTEM PHYSIOLOGY – ANIMAL

A. Blood and circulation B. Cardiovascular SystemC. Respiratory system D. Nervous system E. Sense organs F. Excretory system G. Thermoregulation H. Stress and adaptationI. Digestive system J. Endocrinology and reproduction.

8. INHERITANCE BIOLOGY

A) Mendelian principles B) Concept of gene C) Extensions of Mendelian principles D) Gene mapping methods E) Extra chromosomal inheritance F) Microbial genetics G) Human genetics H)Quantitativegenetics I) Mutation J) Structural and numerical alterations of chromosomes K) Recombination

9. DIVERSITY OF LIFE FORMS

A. Principles & methods of taxonomyB. Levels of structural organization
C. Outline classification of plants, animals & microorganisms D. Natural history of Indian subcontinent E. Organisms of health & agricultural importance F. Organisms of conservation concern

10. ECOLOGICAL PRINCIPLES

The Environment, Habitat and Niche, Population Ecology, Species Interactions, Community Ecolog Ecological Succession, Ecosystem Ecology, Biogeography, Applied Ecology, Conservation Biology.

EVOLUTION AND BEHAVIOUR

A. Evolutionary theories. B. Origin of life C. Paleontology and Evolutionary History. D. Molecular Evolution E.Population genetics F. Brain, Behavior and Evolution.

12. APPLIED BIOLOGY:

A. Microbial fermentation and production of small and macro molecules.

B. Application of immunological principles, vaccines, diagnostics. Tissueand cell culture methods for plants and animals.

C. Transgenic animals and plants, molecular approaches to diagnosis andstrain identification.

D. Genomics and its application to health and agriculture, including genetherapy.

E. Bioresource and uses of biodiversity.

F. Breeding in plants and animals, including marker – assisted selection.

G. Bioremediation and phytoremediation.

H. Biosensors.

13. METHODS IN BIOLOGY

A. Molecular Biology and Recombinant DNA methods B. Histochemical and ImmunotechniquesC Biophysical Method.D Statisitcal Methods

E. Radiolabeling techniquesF. Microscopic techniques:G. Electrophysiological methodsH. Methods in field biology.

Biochemistry syllabus

Biomolecules

Carbohydrates and Lipids

The molecular logic of life: The chemical unity of diverse living organisms, composition of living matter. 1. Macromolecules and their monomeric subunits. 2 Properties of Water:The pH scale, measurement of pH, pH metry, acid base titration curves.Buffers, biological buffer systems. 3 Carbohydrates: Classification, basic chemical structure, general reaction and properties. 4 Lipids: Classification, structure and function of major lipid subclasses-acylglycerols, circulating lipids, Separation techniques Lipoproteins, chylomicrons, LDL, HDL, and VLDL. Pathological changes in lipid levels. Formation of micelles, monolayers, bilayer, liposomes. 5 Vitamins and Co-enzymes: Classification, water-soluble and fat-soluble vitamins. Structure, dietary requirements, deficiency conditions, coenzyme forms.

Proteins

Amino acids: Classification, Properties, reactions, rare amino acids, and separation techniques. Protein classification: Reactions, functions, properties peptide synthesis. Solid phase synthesis. Structure: a) Peptide bond, end group analysis, sequencing. b) Secondary: X ray diffraction, alpha-helix bets- structure, β-helix, super secondary structure. c) Tertiary Structure: Forces stabilizing, unfolding/ refolding expt. Prediction of tertiary Structure. d) Quaternary structure – hemoglobin. e) Ramachandran plot. f) Helix coil transitions, Vander Walls, electrostatic, Hydrogen bonding, and hydrophobic interactions. g) Energy terms in Biopolymer conformational calculation.

Nucleic Acids

Molecules of Heredity: Structure of DNA and RNA, DNA as genetic, material, Double helix. Semi conservative mechanism of replication.Nearestneighbor analysis. Denaturation and renaturation A, B, and Z forms of DNA. Denaturation and renaturation, A, B and Z forms of DNA.

Membrane Biology

Cell wall and Cell Membrane: physical structure of model membranes in prokaryotes and eukaryotes, lipid bilayer, membrane proteins, other constituents; diffusion, osmosis, active transport, regulation of intracellular transport and electrical properties.

Enzymes

Introduction to enzymes.Types of enzymatic reaction mechanisms, Michaelis-Menten kinetics.Competitive, Non-competitive and Un-competitive inhibition.Bi-substrate reaction kinetics.Allostery.

Bioenergetics and Metabolism

Survey of metabolism: Carbon, oxygen, nitrogen cycle catabolism, use of mutants and isotopes in the study of metabolism, compartmentation, food chain and energy flow. Cell bioenergetics: First and second law of thermodynamic, internal energy, enthalpy, entropy, concept of free energy, standard free energy change of a chemical reaction, redox potentials, ATP and high energy phosphate compounds. Carbohydrate, lipids and nucleic acid metabolism, Electron transport chain and oxidative phosphorylation, Glycogen metabolism,Photosynthesis, Nitrogen Metabolism

Molecular Biology

DNA replication, recombination and repair.Transcription and splicing, Protein synthesis.Protein targeting: Eukaryotic chromosome and gene expression.Molecular virology

Cell Biology

Structural organization and functions of cell organelles, Cytoskeletons structure and motility function.Organization of genomes: genes and chromosomes, Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.Cell division and cell cycle and their control, Apoptosis, Necrosis and Autophagy and Cellular Signaling

Immunology

Cellular basis of immunity: immunological memory, specificity, diversity, discrimination between self and non self, primary and secondary lymphoid organs, cell mediated and humoral immune responses, T and B

lymphocytes, autoimmune reactions. Antigen and antibody: antigen, antigenic determinant, immunopoten... structure of antibody, constant and variable regions, Fab, F(ab2) and Fc fragments, different classes of antibodies and their functions, fine structures of antibodies, X ray diffraction studies, isotypes, allotypes and idiotypes, Measurement of antigen- antibody interaction, diffusion, immunodiffusion, immunoelectrophoresis, radioimmunoassay, immunoflorescence, ELISA, Western blotting Clonal selection theory of antibody production, monoclonal and polyclonal antibodies, poly reactive antibodies, catalytic antibodies, abzymes. Complement system: classical and alternate pathway. T lymphocytes and cell mediated immunity, T cell sub populations, immune response genes, MHC gene complex, polymorphism, graft rejection, graft versus host response. Hypersensitivity, immunodeficiency diseases.Vaccines, interferon, AIDS. Blood antigens: blood group substances and Rh factor.

Recombinant DNA Technology and Applications

Restriction and Modification systems in E. coli and their use in recombinant library constructions. 2. Restriction and Modification enzymes and their uses. Basic techniques for RDT including Agarose gel electrophoresis, PAGE, Pulse field electrophoresis. Basic Biology of plasmids including their replication, copy number, Incompatibility of Plasmids, and development of Plasmid Vectors.Cloning and expressions vectors, Basic DNA sequencing methods, Introduction to next generation sequencing (NGS). Polymerase chain reaction and its application in research.Oligonucleotide synthesis, purification, and its application in screening of libraries, cloning and mutagenesis.Synthetic gene assembly.Strategies for constructing cDNA libraries and screening using Nucleic acid and antibody probes. Subtractive Libraries, Expression based strategies for cloning of functional genes, Differential mRNA display. Strategies for constructing Genomic libraries and screening using nucleic acid probes.Understanding of Operons Lac, Trp, Arabinose, Tetracycline and their applications in studying biological processes and development of Vectors.Use of Tags to aid solubility and Purification.DNA safety guidelines and regulatory aspects.

Biophysical Techniques

UV and visible Spectophotometry, IR and NMR Spectrophotometry.Membrane filtration and dialysis: Nitrocellulose, fibre glass, Polycarbonate filters, Dialysis and Concentration, Reverse Dialysis, Freeze drying, lyophilization. Chromatography, Electrophoresis, Southern, Northern, Western transfers, Isoelectric focusing finger printing, DNA sequencing Capillary Electrophoresis.

Sedimentation: Theory, Preparatory and analytical ultracentrifuges, factors affecting sedimentation velocity, sedimentation coefficient, measurement of S, Zonal centrifugation, DNA analysis, Determination of molecular weight by sedimentation, diffusion and sedimentation equilibrium methods. Specific example of application.Partial specific volume and the diffusion coefficient, Measurement of partial specific volume and diffusion coefficients.Viscosity: Theory, effect of macromolecules on the viscosity of a solution, measurement, molecular weight determination.

Isotope Tracer Technique: Types of radiations, measurement scintillation and gamma counters. Background noise quenching, Applications.Interaction of radiation with matter, passage of neutrons through, matter, interaction of gamma rays with matter, units of measuring radiation absorption, Radiation dosimetry, Radiolysis of water, free radicals in water. Autoradiography

Computer Science and Information Technology syallbus for B.E/B.Tech

Engineering Mathematics

Discrete Mathematics: Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions.

Linear Algebra: Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.

Calculus: Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration.

Probability: Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.

Digital Logic

Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Computer Organization and Architecture

Machine instructions and addressing modes. ALU, data□path and control unit. Instruction pipelining. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).

Programming and Data Structures

Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, bina...

s, graphs.

Algorithms

Searching, sorting, hashing. Asymptotic worst case time and space complexity.

Algorithm design techniques: greedy, dynamic programming and divide□and□conquer. Graph search, minimum spanning trees, shortest paths.

Theory of Computation

Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and contex-free languages, pumping lemma. Turing machines and undecidability.

Compiler Design

Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation.

Operating System

Processes, threads, inter□process communication, concurrency and synchronization.

Deadlock. CPU scheduling. Memory management and virtual memory. File systems.

Databases

ER model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

Computer Networks

Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

ELCTRONICS AND INSTRUMENTATION SYLLABUS (B.E/B. TECH)

ELECTRONIC DEVICES

Semiconductor properties, band structure of semiconductors, semiconductor materials, P - N junction creation, width of the depletion region, voltage-current characteristics of diodes, factors affecting the reverse current, transient behaviour. Transistor fundamentals: Formation of a transistor, current gain, d.c. characteristics, low frequency characteristics, base resistance, power gain, high frequency properties of transistors. Field effect transistors - Construction, Characteristics (JFET, MOSFET, Power MOS).

CIRCUIT THEORY

Systems Concepts: Causality, linearity and time-invariance, Principle of superposition, Circuit as a system, Integro-differential equation representation, duality. Passive Elements and Sources: Mathematical representation of ideal resistors, inductors and capacitors, Real or non-ideal passive elements, Ideal independent voltage and current sources, Dependent sources. DC Circuits: Ohm's law revisited, ohmic and non-ohmic elements, Kirchoff's current and voltage laws, Series and parallel circuits, Maxwell's mesh current method, Node voltage method, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.

ELECTRONIC CIRCUITS-I

Introduction to diode circuits; Rectifier, Clipper and Clamper. Introduction to amplifier circuits. Classification of amplifiers - Basic transistor amplifier circuits. Biasing techniques and bias stability. RC-coupled amplifier. Concept of controlled current source and power gain. Simplified hybrid model. Amplifier topologies; Analysis of CE amplifier using simplified hybrid model. JFET amplifiers, biasing techniques, source follower and common source amplifiers.Transistor and FET differential amplifiers.

DIGITAL ELECTRONICS

Number systems and codes - Positional number system, Radix conversion, Different types of BCD, ASCII, EBCDIC, Gray. Binary Arithmetic - R's and (R-1)'s complement representation, Subtraction using 1's and 2's complement representation, Concept of overflow, BCD addition. Fundamental logic operators, Boolean Algebra. Combinational Logic Design – Definition, Truth Table, SOP and POS realization from truth table, Examples of combinational logic design : Adder / Subtractor circuits; 2's complement ripple carry adder/subtractor circuit, Parity generator/checker circuit, Circuit for Binary to Gray and Gray to Binary conversion. Encoder, Decoder, Demultiplexer and Multiplexer, Function realization using decoder and multiplexer. Sequential machine design - Concept of Moore and Mealy machine, State transition diagram and State transition table, Various memory elements, NAND-latch and its use, Clocked flip-flops, SR, JK, D, T. Timing constraints on edge triggered flip-flops; Changing one type of Flip-flop to another type, Design of sequence detector. Asynchronous and synchronous counter design. Different types of registers.

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Programmable Logic Devices – PROM, PLA, PAL, FPGA. Integrated Circuit Logic Families - TTL, PMOS, NMOS, CMOS. Semiconductor memories: ROM, RAM.

ELECTRONIC CIRCUITS-II

Types and classification of amplifiers (e.g. modes of operation Class A, Class B, Class C Class D etc. amplifiers), Frequency response of small signal amplifiers, Power amplifiers, push-pull, complementary symmetry, quasi-complimentary symmetry. Principle of operation of feedback amplifiers and their analysis and characteristics for voltage feedback and current feedback types.

ANALOG INTEGRATED CIRCUITS

Operational Amplifier Fundamentals: Amplifier Fundamentals, Op-Amp Characteristics. Op- Amp in open loop comparator mode, Different applications, Linear Op-Amp Circuits: Basic Op-Amp Circuits, V-I Converter with floating and grounded load, Current amplifier, Difference amplifier, Instrumentation amplifier, Analysis of some typical Op-Amp circuits.

Non-linear Op-Amp Circuits: Schmitt trigger and applications, Precision rectifiers, Analog switches, Peak detectors, S/H circuits. Practical Op-Amp limitations: D.C errors, Slew rate, Frequency response, Noise effect, Frequency compensation.

DIGITAL SIGNAL PROCESSING

Discrete-time description of signals: Discrete-time sequences, their frequency domain behaviour, comparison with analog signals, convolution of two sequences, sampling a

continuous function to generate a sequence, reconstruction of continuous-time signals from discrete-time sequences. Discrete-time description of systems: Unit-sample response of a system, Stability criterion for discrete-time systems, Causality criterion for discrete-time systems, Linear constant-coefficient difference equations. Discrete-time Fourier transform: Definition of Discrete-time Fourier transform, properties of DTFT for real-valued sequences, the inverse DTFT.

SIGNAL PROCESSING AND TRANSMISSION

Signals: Representation of signals; Generalized periodic waveforms, trigonometric and exponential Fourier series, Fourier transform, Convolution, Correlation, Energy and power spectral densities. Transmission Line: Parameters. Modulation: Amplitude modulation - representation, frequency spectrum, power relations; Generation of AM, linear and nonlinear modulation; Single sideband (SSB) techniques - generation, carrier suppression, suppression of unwanted sideband, extensions of SSB, pilot carrier systems, vestigial sideband transmission. Frequency modulation - Theory of FM and PM, Generation of FM, Pre-emphasis and de-emphasis, Circuit schemes and comparisons, VCO's - circuits and applications. Transmitters and receivers: AM and FM transmitters - basic characteristics.

M. Sc. PHYSICS Syllabus

Mathematical Methods of Physics

Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem. Green's function. Partial differential equations (Laplace, wave and heat equations in two and three dimensions). Elements of computational techniques: root of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, Solution of first order differential equation using Runge- Kutta method. Finite difference methods. Tensors. Introductory group theory: SU(2), O(3).

Classical Mechanics

Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Central force motions. Two body Collisions - scattering in laboratory and Centre of mass frames. Rigid body dynamics- moment of inertia tensor. Non-inertial frames and pseudoforces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of relativity- Lorentz transformations, relativistic kinematics and mass–energy equivalence. Dynamical systems, Phase space dynamics, stability analysis. Poisson brackets and canonical transformations. Symmetry, invariance and Noether's theorem. Hamilton-Jacobi theory.

Electromagnetic Theory

Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in

space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields. Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Transmission lines and wave guides. Radiation- from moving charges and dipoles and retarded potentials.

Quantum Mechanics

Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom. Stern-Gerlach experiment. Time- independent perturbation theory and applications. Variational method. Time dependent perturbation theory and Fermi's golden rule, selection rules. Identical particles, Pauli exclusion principle, spin-statistics connection. Spin-orbit coupling, fine structure. WKB approximation. Elementary theory of scattering: phase shifts, partial waves, Born approximation. Relativistic quantum mechanics: Klein-Gordon and Dirac equations. Semi-classical theory of radiation.

Thermodynamic and Statistical Physics

Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro- and macro-states. Micro-canonical,canonica and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law. First- and second-order phase transitions. Diamagnetism, paramagnetism, and ferromagnetism. Ising model. Bose-Einstein condensation. Diffusion equation. Random walk and Brownian motion. Introduction to nonequilibrium processes.

Electronics and Experimental Methods

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo-detectors, LEDs). Operational amplifiers and their applications. Digital techniques and applications (registers, counters, comparators and similar circuits). A/D and D/A converters. Microprocessor and microcontroller basics. Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting, Linear and nonlinear curve fitting, chi-square test. Transducers (temperature, pressure/vacuum, magnetic fields, vibration, optical, and particle detectors). Measurement and control. Signal conditioning and recovery. Impedance matching, amplification (Op-amp based, instrumentation amp, feedback), filtering and noise reduction, shielding and grounding. Fourier transforms, lock-in detector, box-car integrator, modulation techniques. High frequency devices (including generators and detectors).

Atomic & Molecular Physics

Quantum states of an electron in an atom. Electron spin. Spectrum of helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electron spin resonance. Nuclear magnetic resonance, chemical shift. Frank-Condon principle. Born-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

Condensed Matter Physics

Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors. Superconductivity: type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasi crystals.

Nuclear and Particle Physics

Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semi-empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Rotational spectra. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions.Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, baryons and mesons. C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction. Relativistic kinematics.

MCA SYLLABUS

Introduction to Programming

Introduction to computing: block architecture of a computer, bit, bytes, memory, representation of numbers in memory. Introduction to problem solving: Basic concepts of an algorithm, program design methods, flowcharts. Introduction to C programming: A Brief History of C, C is middle-level Language, is a Structured Language, Complier Vs Interpreters, The Form of a C Program, Library & Linking, Compilation & Execution process of C Program . Variables, Data Types, Operator & Expression: Character Set, Token, Identifier & Keyword, Constant, Integer, Floating Point, Character, String, Enumeration, Data Types in C, Data Declaration & Definition Operator & Expression, Arithmetic, Relational, Logical, Increment & Decrement, Bit wise, Assignment, Conditional, Precedence & Associability of Operators. Control Statement: Introduction, Selection Statements, Nested if, if-else-if, The ? Alternative, The Conditional Expression, switch, Nested switch, Iteration Statements, for loop, while loop, do-while loop, Jump Statements, Goto& label, break & continue, exit() function Array & String: Single Dimension Arrays, Accessing array elements, Initializing an array, Multidimensional Arrays, Initializing the arrays, Memory Representation, Accessing array elements, String Manipulation Functions, searching, sorting an array. Function: Introduction, advantages of modular design, prototype declaration, Arguments & local variables, Returning Function Results by reference & Call by value, passing arrays to a function, Recursion. Storage Class & Scope: Meaning of Terms, Scope - Block scope & file scope, Storage Classes Automatic Storage, Extern Storage, Static, Storage, Register Storage. Pointers: Introduction, Memory Organization, The basics of Pointer, The Pointer operator Application of Pointer, Pointer Expression, Declaration of Pointer, Initializing Pointer, De-referencing Pointer, Void Pointer, Pointer Arithmetic, Precedence of &, * operators Pointer to Pointer, Constant Pointer, Dynamic memory allocation, passing pointer to a function, array of pointers, accessing arrays using pointers, handling strings using pointers. Structure, Union, Enumeration &typedef: Structures, Declaration and Initializing Structure, Accessing Structure members, Structure, Assignments, Arrays of Structure, Passing, Structure to function, Structure Pointer, Unions, C Preprocessor: Introduction, Preprocessor Directive, Macro Substitution, File Inclusion directive, Conditional Compilation. File handling: Introduction, File Pointer, Defining & Opening a File, Closing a File, Input/Output Operations on Files, Operations on Text mode files and binary mode files, Error Handling During I/O Operation, Random Access To Files, Command Line Arguments.

Data and File Structures

Fundamentals of algorithm analysis, Time and space complexity of algorithms, Elementary data structures and their applications. Arrays, Binary trees, Searching & Sorting, Linear Search, Binary search, Hashing Internal and External sort, Insertion sort, Bubble sort, Selection sort, Quicksort, Merge sort. Radix sort, Bucket sort, Counting sort. Files and their organizations; Tree, Sequential, random, Hashed, indexed, Inverted files.

Computer Organization and Architecture:

Introduction to basic structures and operational concepts, Instruction formats, Instruction execution, sequencing, Addressing modes, Stacks, Queues. Control unit – Concepts, Fetching and storing word from/in main memory, Register transfers, Operations, execution of a complete instruction. Hardwired control, Microprogrammed control, Concept of horizontal and vertical, microprogramming, Nanoprogramming, Concepts of pipelining. Fixed point Arithmetic - Arithmetic and logical operations of signed numbers and their implementation, Concepts of floating point numbers and operations, Bit-slice processors and Emulation. Memory – Basic concepts, RAM, ROM – different types, Characteristics, Cache memories, Performance (memory interleaving, hit rate etc.), Memory hierarchy -virtual memory – address translation, Secondary memories. Input/output organization: memory mapped, standard (isolated) and linear selection techniques of I/O addressing. Data transfer through programmed I/O, interrupt and DMA I/O processors. Data transfer over synchronous and asynchronous buses; discussions on some standard interface buses. Brief introduction to RISC processors and parallel processing techniques.

Opeerating Systems:

Introduction to Operating Systems. Concept of batch-processing, multi-programming, time sharing, real time operations. Process Management: Concept of process, state diagram, process control block; scheduling of processes – criteria, types of scheduling, non-preemptive and preemptive scheduling algorithms like: FCFS, Shortest Job First/Next (SJF/N), Shortest Remaining Time Next (SRTN), Round Robin (RR), Highest Response ratio Next (HRN), Priority based scheduling, different Multilevel queue scheduling etc. Threads – concept, process vs thread, kernel and user threads, multithreading models. Inter-process Communication (IPC) – Shared

memory, message, FIFO, concept of semaphore, critical region, monitor . Process Synchronization: concepts, race condition, critical section problem and its solutions; synchronization tools- semaphore, monitor etc.; discussion of synchronization problems like producer-consumer, readers-writers, dining philosophers, sleeping-barber etc. Deadlock – conditions, resource allocation graph, prevention techniques, avoidance technique – Banker's algorithm and related algorithms. Memory management: Address space and address translation; static partitioning, dynamic partitioning, different types of fragmentation, paging, segmentation, swapping, virtual memory, demand paging, page size, page table, page replacement algorithms – FIFO, LRU, Optimal page replacement, Variants of LRU. thrashing, working set strategy. File Management: File and operations on it, file organization and access; file allocation; directory structures, file sharing, file protection. Device management: Magnetic disks, disk scheduling- criteria, algorithms – FCFS, SSTF, SCAN, C-SCAN, LOOK, etc, disk management – formatting, boot block, disk free space management techniques, concept of RAID. Protection and Security: Concepts of domain, Access matrix and its implementation, access control, Security of systems- concepts, threats- Trojan horse, virus, worms etc, introduction to cryptography as security tool, user authentication

Object Oriented Programming:

C++: Overview of Procedural Feature: Concept of Reference variable, Default Parameters to Function, Function overloading. Fundamental Object Oriented Features: Class and Object, Abstraction/ Encapsulation, Access Specifier. Static Members, Friend Function. Constructor and Destructor. Operator Overloading. Inheritance. Abstract Class, Run time polymorphism, Virtual Base Class. File Handling. Exception Handling. Class Template and Function Template

Database Management System:

Relational Model: Relation, Attribute, Key, Foreign Key and other Relational Constraints. Database Design: ER Diagram, Mapping and Participation Constraints, Weak Entity Set,Aggregation, Extended ER diagram, Design of Database Tables from ER/EER Diagram. Languages: Relation Algebra, Relational Calculus. Structured Query Language. Functional Dependency: Concepts of Functional Dependency, Normalization, Multivalued Dependency. Database Storage: Fixed/Variable Length Record, Ordered/Unordered file and Operations on them bIndexing: Primary/Clustering/Secondary/Multilevel Index, B/B+ Tree based Indexing, Hashing. Query Optimization: Search Strategies, Expression level Optimization, Join strategies. Database Security. Transaction and Recovery: Concept of Transaction and its States, Log based Recovery, Checkpoint. Concurrency Control: Lock based Protocol, Time Stamp based Protocol, Recoverable Schedule. Advanced Concepts: Object-oriented database concepts and other query languages.

Data Communication and Networking:

Introduction: Uses of Computer Networks, Types of Computer Networks, OSI Reference Model,Example Networks

Physical Layer: Data and signal fundamentals, Transmission impairments, Attenuation, Distortion,Noise, Data rate limits for noisy and noiseless channels, Performance. Digital Transmission – Problems with digital transmission, Different line coding schemes, Block coding schemes, Scrambling techniques, Analog to digital encoding. Analog Transmission. Transmission Media - Guided (wired) media – Twisted pair cable, Coaxial cable and Fibre optic cable, Unguided (wireless) media – Different propagation modes, Radio waves, Terrestrial microwaves, Satellite communication. Concept of multiplexing, Frequency division multiplexing, Time division multiplexing – Synchronous and Statistical time division multiplexing, Handling variable length data, Pulse stuffing. Concept of spreading spectrum, Frequency hopping spread spectrum and Direct sequence spread spectrum. Data Link Layer: Link Layer Services, Error detection and Correction Techniques, Multi AccessProtocols, Link Layer Addressing, Ethernet, Hubs, Switches and Switches, Point to Point Protocol, Asynchronous Transfer Mode, Multiprotocol Label Switching. Network Layer: Introduction, Virtual Circuit and Datagram Networks, IP Addressing, Subnetting,Routing Algorithms (Link State, Distance Vector, Hierarchical), Routing in the Internet (RIP, OSPF, BGP), Broadcast and Multicast Routing Algorithms, Routers,ICMP, IPv6 . Transport Layer: Introduction to Transport Layer Services, Connectionless Transport: UDP, Principlesof Reliable Data Transfer, Connection Oriented Transport: TCP, Principles of Congestion Control, TCP Congestion Control, Sockets, Quality of services (QOS). Application Layer: Web and HTTP, Domain Name Space (DNS), Electronic Mail (SMTP, MIME,IMAP, POP3), File Transfer Protocol, Cryptography.

Theory of Computing:

Finite Automata and Regular Languages : DFA, NFA, Recognition of a language by an automaton, Equivalence of DFA and NFA, Minimization of FA, Equivalence of FAs, Pumping Lemma for Regular Languages, Closure Properties of Regular Sets. Context-free Languages and Push-Down Automata:Non-regular languages, CFLs, Closure properties of CFLs. Grammars, Ambiguity, Push-Down Automata, Pumping Lemma for CFL. Turing Machines: Introduction to Context Sensitive Languages and Grammers, Turing Machines and its variants, Universal TMs, Halting Problem, Recursive Functions and Sets, Recursively Enumerable Sets, Arithmetization of TMs.

• Basics of Complexity Theory : Space and Time Complexity, Ram programs and TMs, PTIME, NP, PSPACE etc., Polynomial reducibility.

Design and Analysis of Algorithms:

Complexity Analysis : Complexity measures, Worst, Best and Average Case, Upper and Lower bounds,

Order Notations. Divide and Conquer Technique: Binary Search, Merge Sort, Quick Sort, Multiplication of Large Integers. Sorting : Comparison Tree, Lower bound on comparison-based sorting, Sorting in LinearTime, Counting Sort, Radix Sort.. Greedy Algorithms. Minimum spanning tree, Union find, Set cover, Huffman coding, Fractional. Knapsack Problem. Dynamic Programming. Matrix Chain Multiplication, Longest Common Subsequence, 0-1 Knapsack Problem, Traveling Salesman. Introduction to Branch and Bound and backtracking techniques. Introduction to NP-completeness . Classes of Problems, Easy and Hard Problems, Concept of Reduction, The classes P, NP, NP-hard and NP-complete, Proving NP-completeness, Examples of NP-complete problems such as 3SAT, CLIQUE, VERTEX COVER etc.

System Software and Compiler:

Introduction to system softwares. Assembler: functions, features, design of one pass and two pass assemblers

Macroprocessors: functions, features and design. Introduction to Compiler, Different phases and passes of compiler

Lexical Analysis: Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Finitestate machines and regular expressions and their applications to lexical analysis, Implementation of lexical analyzers. Syntax Analysis: Role of the parser, Formal grammars and their application to syntax analysis, Context free grammars, Derivation and parse trees, Top Down parsing, LL(1) grammars, Predictive Parsing, Bottom-up-parsing, Shift Reduce Parsing, LR(0) grammars, LR parsing algorithms. Syntax Directed Translation: Syntax directed definitions, Construction of syntax trees, Bottom-up evaluation of S-attributed definitions, L-attributed definitions. Runtime Environments: Source Language issues, Storage Organization, Storage Allocation strategies, Access to non-local names, Parameter passing mechanism. Intermediate Code Generation: Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples) Code Optimization and generation: Introduction, Basic blocks and flow graphs,Transformation of basic blocks, DAG representation of basic blocks, Principle sources of optimization, Loops in flow graph, Peephole optimization. Issues in the design of code generator, Register allocation and assignment. Loader and Linkers: Basic Concepts of Linkers and Loader Functions, Boot Loaders, Linking Loaders, Linkage Editors, Dynamic Linking Concept of Editor and text editor, Interpreters, Simulator, Text editors - Overview of the Editing Process - User Interface – Editor Structure. - Interactive debugging systems - Debugging functions and capabilities – Relationship with other parts of the

system – User-Interface Criteria.

Web Technology

Introduction to web technology. Mark-up languages for presentation: SGML and HTML, DOM, XML

Scripting language (JavaScript/ VBScript etc.) and DHTML. XML Processing Technologies for Data Representation; DOM, SAX for XML. Server side programming (Servlet, ASP, JSP etc.)

Web Clients: Browsers, cookies, spiders, search engines and agents. Web Proxies. Web services: Design and modeling of web services, Technologies for implementing web services. Web Servers Web Caching and Content Distribution. Load Balancing. Web Security and Firewalls. Web Protocols: TCP, IP and HTTP, SMTP, POP3, FTP

MATHEMATICAL SCIENCES SYLLABUS

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals.

Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions.

Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle,

derangements. Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's Ø- function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation

groups, Cayley's theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal

domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions, Galois Theory.

Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

Ordinary Differential Equations (ODEs):

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs.

General theory of homogenous and non-homogeneous linear ODEs, variation of parameters,

Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs):

Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis :

Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Calculus of Variations:

Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations:

Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics:

Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's

principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations. Descriptive statistics, exploratory data analysis Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case). Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution, Poisson and birth-and-death processes. Standard discrete and continuous univariate distributions. sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range. Methods of estimation, properties of estimators, confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests, likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests. Simple nonparametric tests for one and two sample problems, rank correlation and test for independence.

Elementary Bayesian inference. Gauss-Markov models, estimability of parameters, best linear unbiased estimators, confidence intervals, tests for linear hypotheses. Analysis of variance and covariance. Fixed, random and mixed effects models.

Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression. Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation. Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods.

Completely randomized designs, randomized block designs and Latin-square designs. Connectedness and orthogonality of block designs, BIBD. 2K factorial experiments: confounding and construction. Hazard function and failure rates, censoring and life testing, series and parallel systems. Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.

M.sc Forensic science syllabus

FORENSIC SCIENCE AND CRIMINAL JUSTICE SYSTEM

Forensic Science: Basic principles and its significance. History & development of forensic science. Nature and scope of forensic science. Organizational structure of Forensic Science Laboratories at central & State level. Ethics in Forensic science.

Scene of crime: Types, protection of scene of crime, preservation (recording) of scene of crime- photography and sketching methods. **Physical evidence:** Meaning, Types, search methods, collection and preservation, Forwarding. Chain of custody. Collection, preservation, packing and forwarding of: blood, semen and other biological stains, firearm exhibits, documents, fingerprint, viscera, hair & fiber, glass, soil and dust, petroleum products, drugs and poisons, etc. **Crime:** Definition, theories of causation of crime: Pre-classical and Neo-classical, constitutional, geographical, economic, psychological, sociological, Multiple- causation approach. General factors of crime, forms of punishment in brief.

Indian Penal Code: Introduction, General exceptions, Offences against person, Offences against property, Attempt to suicide, Sexual offences. **Criminal Procedure Code:** Introduction and general idea of sections: 291-93, 154, 155, 156, 157, 158, 159, 160, 161, 162, 172, 173, 174, 175, And 176. **Indian Evidence Act** Introduction and general idea of sections: 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, And 159. **Criminal Justice System:** Police organization at district, state & central level. Organization of courts in India

Jurisdiction of courts in criminal cases, prosecution, F.I.R., case diary, roznamacha. **Report Writing and Evidence Evaluation:** Report formats of crime scene and laboratory findings. **Court Testimony:** Admissibility of expert testimony, pro court preparation & court appearance, examination in chief & re-examination, cross examination.

MEDICAL JURISPRUDENCE

Concept of Medical Jurisprudence: Brief knowledge about legal procedures in Courts, inquest, Criminal courts and their powers, Subpoena & oath of medical expert. Recording of Medical experts evidence in courts. Types of Medical evidence. Kinds of witness and rules for giving evidence.

Personal Identity: Definition and importance. Parameters contributing to personal identity- Race, Sex, Age, Complexion, features & Photographs, Anthropometry, Fingerprints, Footprints, Tattoo marks, Occupational marks, Handwriting, Clothes & Ornaments, Voice & Speech, DNA, Superimposition techniques for skull. Disputed paternity.

Post-Mortem Examination: Importance, post-mortem report format, external & internal examination in brief. Viscera & its preservation. Examination of decomposed and mutilated bodies. Precaution to be taken during post mortem examination. Exhumation. Cause of death.

Wounds: Wounds & its types, Medico-legal aspects, post mortem & ante mortem wounds, General characteristics of injuries from burns, scalds, lightning, electricity and radiation. Forensic importance of wounds.

Deaths in its Medico-legal aspects: Modes of Death (Coma, Syncope, Asphyxia), Sudden death. Sign of Death, cessation of vital functions, changes in the Eye & Skin, cooling of body, post-mortem lividity, cadaveric changes in the muscles, putrefaction, adipocere & mummification. Estimation of time since Death.

QUESTIONED DOCUMENTS, FINGER PRINTS AND IMPRESSIONS

Documents and Writing Instruments: Questioned document and their types. Instruments used to prepare documents, ink & its type, physical & chemical examination, paper & its type, manufacturing and examination of paper. Collection, handling, preservation and forwarding of documents seized from scene of crime. **Examination of Documents:** Preliminary examination of documents, instruments required for examination. Handwriting- class & individual characteristics, basis of handwriting comparison, making of exemplar, variations in handwriting. Signature, Genuine & forged signatures and their examination. Digital signature.

Forged & Typed Documents: Alteration- Erasure, Addition, Obliteration and Sheet insertion. Secret writing & its decipherment. Charred documents & their decipherment. Indented writing.

Typewriting- Class and individual characters & their comparison. Printed matter and their examination.

Finger Prints: History of finger print, formation of ridges, finger print patterns, ridge characteristics, ridge count, ridge tracing etc. Classification of finger print- primary, secondary, single digit, etc. Computerization of finger print and finger print bureau.

Examination of Finger Prints & Other Impressions: Types of fingerprint, latent, visible and plastic prints, location of finger print, development of latent prints by physical and chemical methods. Photography of finger prints. Foot and footwear prints, gait pattern, casting of print on different surfaces and their comparison. Examination of tyre and skid mark on different surfaces and calculation of speed of vehicle. Forensic importance of lip print, bite mark and palm print.

INSTRUMENTAL METHODS- PHYSICAL

Basic Concept of Spectroscopy:
Basic Concept of Atomic and Molecular Spectra:
Ultraviolet-visible and Infrared Spectrophotometry:

Atomic Absorption / Emission andX-RaySpectrometry

Radiochemical Techniques:

INSTRUMENTAL METHODS- CHEMICAL

General idea and basic principle of distillation, Various types of distillation techniques Sample treatment techniques – Centrifuge, Filtration, Evaporation, Crystallization etc. Distribution Law, Solvent extraction technique like LLE, SPE, micro SPE. **Chromatographic techniques:** Theory of chromatography, Classification of chromatography, General idea on planar chromatography, Column chromatography, Adsorption, Partition chromatography,General principles and working of Planer chromatography: TLC, PC, HPTLC Forensic Application of planar chromatography

General principles and working of Column Chromatography Selection of mobile phase, column and detectors Ion-exchange chromatography Brief idea on working of HPLC, GC, Ion Exchange Chromatography, Exclusion (Permeation) chromatography, Affinity chromatography etc.

Forensic Application of column chromatography, Electrophoretic techniques: General principles, Classification of electrophoresis Factors affecting electrophoresis, Preparative, Horizontal, Vertical, two dimensional electrophoresis Brief idea of Low voltage electrophoresis, High voltag electrophoresis, Gel electrophoresis, Isoelectric focusing etc General idea and working of Capillary Electrophoresis Forensic Application of electrophoresis, electrochemical techniques: General principles Electron transport process, Polarography and variants.**Mass Spectrometry (MS):** Principle and Instrumentation, Correlation of MS with molecular structure. A brief idea about the various forms of Mass Spectrometry Coupling MS with GC, LC, and

CE etc. Application of MS in Forensic Science

FORENSIC CHEMISTRY AND EXPLOSIVES

Forensic Chemistry and its Scope Analysis of beverages: Alcohol and Non- alcoholic, country made liquor, illicit liquor Drugs of abuse: Introduction, Classification, Narcotic drugs & psychotropic substances, drugs of abuse in sports. Brief Introduction to Drugs and cosmetic act, Excise Act, NDPS Act Analysis of Gold and Other metals in cheating cases.

Examination of Petroleum Products: Distillation & Fractionation, various fraction and their commercial uses. Standard methods of analysis of petroleum products for adulteration Trap cases: purpose, examination of chemicals used in trap case Cement: Composition, types and Forensic analysis, Mortar & Concrete

Fires: Nature and Chemistry of fire, Classification, Igniters of fires, Phases of fires, Main types of fires, Examination of scene of fires Arson: Relevant IPC sections, Motives, Analysis of Accelerants

Explosives: Classification, Comparison & characterization of explosives, Military & Commercial explosives, Detection of Explosophores (anions), Detection of Black powder, Nitrocellulose and Dynamite, Quantitative determination.

FORENSIC TOXICOLOGY AND PHARMACOLOGY

Forensic Toxicology: Introduction, concept and Significance Poisons: Definition, Classification of poisons, Types of poisoning sign and symptoms of poisoning, mode of action, factors modifying the action of poisons, Toxicological exhibits in fatal and survival cases, their preservation Treatment in cases of poisoning, Analysis report, Extraction, Isolation and Clean-up procedures: Non-volatile organic poison,Stas-otto, Dovbriey Nickolls (Ammonium sulphate) method, acid digest and Valov (Tungstate) methods, Solid phase micro extraction techniques, Solvent extraction methods Volatile Poisons: Industrial solvent acid and basic Distillation Toxic Cations: Dry Ashing and Wet digestion process Toxic Anions: Dialysis method total alcoholic extract

General Study and Analysis: Barbiturates, methaqualone, Hydromorphine, Methadone, Meprobamate, Mescaline, Amphetamines, LDS, Heroin, Cannabinoids, Phinothiazines Insecticides: Types, General methods for their analysis Alkaloids: Definition, classification, Isolation and General characterization.

Forensic Examination of Metallic Poisons: Arsenic, Mercury, Lead, Bismuth, Copper, Aluminium, Iron, Barium, Zinc Analysis of Ethyl Alcohol in blood and urine, illicit liquor, Methanol, Acetone, Chloroform, Phenol Snake venoms and Poisons, Irrespirable gases, Forensic Pharmacological studies: Absorption, Distribution, Metabolism, Pathways of drug metabolism General studies and Analysis of some vegetable poisons, Opium, Abrus, Cynanogenetic glycosides, Dhatura, Marking nuts, Nux-vomica, Oleander and Aconite

INSTRUMENTAL METHODS :General principles of Biological/chemical Analysis :Centrifugation Techniques, Enzyme Techniques, Immunochemical Techniques, Molecular Biology Techniques

FORENSIC SEROLOGY AND DNA PROFILING

Amino Acids: Definition, classification, General properties and reaction. **Proteins:** Definition, classification, General properties and reaction/detection. **Carbohydrates:** Definition, classification and detection.
Basic Concepts of Genetics: Mendelian genetics, genotypes, phenotypes, mutation, multiple alleles. Biochemical Markers of Individuality: General Understanding, classification of markers, Biochemical basis of genetic variation. Expression of Gene and Gene Mapping. Analysis of protein by electrophoresis and related methods. Protein polymorphism and characterization by electrophoretic methods.

Immunology: Immuno System, Immuno response, Antigens, haptens and adjuvant

Immunoglobulin: Structure and function, raising of anti-sera, Antigen-Antibody reaction. **Lectins:** what are lectins and their forensic significance.

Origin of species : Determination of human and animal origin form bones, hair, flesh, nails, skin, teeth, body tissue, fluids/stains viz. blood, menstrual blood, semen, saliva, sweat, tear, pus, vomit etc., through immuno-diffusion and immuno- electrophoresis, cross reactivity among closely related species.

Blood groups : History, biochemistry and genetics of ABO, Rh, Mn and other systems, Methods of ABO blood grouping (absorption-inhibition, mixed agglutination and absorption elution) from blood stains and other body fluids/stains viz. menstrual blood, semen, saliva, sweat, tear, pus, vomit, hair, bone, nail etc. blood group specific ABH substances, determination of secretor/non secretor status, Lewis antigen, Bombay Blood group, Polymorphic enzymes typing- PGM, ESD, EAP, AK, etc., and their forensic significance, HLA typing, Role of serogenetic markers in individualization, paternity disputes etc.
DNA Profiling: Structure of DNA, Damage to DNA, Variation in DNA, DNA as excellent polymorphic marker, Basis of DNA typing. DNA typing technique - RFLP, PCR, Amplification, PCR based typing methods such as HLA DQ A1 Ampli-Type $^{(R)}$ PM Polymarkers, D 1580, STR, Gender ID, mt-DNA methods with their merits and demerits. Comparison of RFLP and PCR based method.

FORENSIC BIOLOGY

Scope of Forensic Biology, Cell Biology - Structure and function of cell, Basic concept of anatomy and physiology of digestive, respiratory, skeleton, nervous, excretory and reproductive system etc.

Body Fluids/Stains/Tissues: Blood: Compositon, histology, examination of blood and blood stains, Identification of lochial and menstrual stains by various methods. **Semen:** Composition, St. of spermatozoa, Forensic methods of detection and identification of semen and seminal stain examination. Identification and examination of other body fluids/stains- vaginal, saliva, urine, pus, faeces, vomit, milk, sweat & tears. **Forensic Odontology:**Dentition pattern, types and structure of teeth, age determination-identity of person, role in mass disaster, disease of teeth and their significance in personal identification. Identification of burnt bones, recovery and identification of skeletal remains in accident cases and mass disasters. Facial reconstruction.

Hair and Fibers

Hair: Structure, Forensic examination of Hair including determination of origin race, sex, site, etc.**Fibres:** Type and Forensic aspects of fiber examination - fluorescent, optical properties, refractive index, birefringence, dye analysis etc and natural fiber.

Forensic Botany

Various types of wood, timber varieties, seeds and leaves - their identification and matching. Diatoms - Types morphology, methods of isolation from different tissue and forensic importance of planktons-especially diatom, forensic significance in drowning cases. Study and identification of pollen grains, Identification of starch grains, powder and stains of spices etc, Paper and Paper Pulp identification, Microscopic and biochemical examination of pulp material etc. Isolation, classification and identification of microbial organism.

Forensic Entomology: General Entomology, Significance of terrestrial and aquatic insects in forensic investigations and their role in crime detection, insect's succession and its relationship to determine time since death. Impact of ecological factors on insect's developments.

Wild Life Forensic: Introduction and Importance of wild life, Protected and endangered species of Animals and Plants, Wild life species - Identification and examination of physical evidence by conventional and modern methods, Identification of Pug marks of various animals. Census of wild life population. Wild life/Environment Protection Act.

FORENSIC BALLISTICS AND PHOTOGRAPHY

History and background of Firearms, their classification and characteristics, various components of small arms, smooth bore and rifled firearm, different systems and their functions, rifling - purpose of rifling, types of rifling, trigger and firing mechanism, cartridge-firing mechanism, Projectile velocity determination identification of origin, improvised/country-made/imitative firearms and their constructional features.

Types of ammunition, classification and constructional features of different types of cartridges, types of primers and priming composition, propellants and their compositions, various types of bullets and compositional aspects, latest trends in their manufacturing and design, smooth bore firearm projectile, identification of origin, improvised ammunition and safety aspects for handling firearms.

Internal and External Ballistics: Definition, ignition of propellants, shape and size of propellants, manner of burning, various factors affecting the internal ballistics; lock time, ignition time, barrel time, erosion, corrosion and gas cutting, equation of motion of projectile, principal problem's of exterior ballistics, vacuum trajectory, effect of air resistance on trajectory, base drag, yaw, shape of projectile and stability, trajectory computation, ballistics coefficient and limiting velocity, Ballistics tables, measurements of trajectory parameters, introduction to automated system of trajectory computation and automated management of ballistics data.

Terminal Ballistics - Effect of projectile on hitting the target: function of bullet shape, striking velocity, striking angle of intermediate target, Tumbling of bullets, effect of instability of bullet, effect of intermediate targets, influence of range, Cavitations - temporary and permanent cavities, Ricochet and its effects, stopping power, Wound Ballistics; Threshold velocity for penetration of skin/flesh/bones, preparation of gel block, penetration of projectiles in gel block and other targets, nature of wounds of entry, exit, initial track with various ranges and velocities with various types of projectiles, explosive wounds, evaluation of injuries caused due to shot-gun, rifle, handguns and country made firearms, methods of measurements of wound ballistics parameters, post-mortem and anti-mortem firearm injuries.

Principles and practice of identification of firearms, ammunition and their components, different types of marks produced during firing process on cartridge firing pin marks, breech face marks, chamber marks, extractor and ejector marks and on bullet-number/direction of lands and grooves, striation marks on lands and grooves, identification of various parts of firearms, techniques for obtaining test material from various types of weapons and their linkage with fired ammunition, class and individual characteristics, determination of range of fire-burning, scorching, blackening, tattooing and metal fouling, shots dispersion and GSR distribution, time of firing- different method employed, and their limitations, stereo & comparison microscopy, automatic bullet and cartridge comparison system.

Analysis of Gunshot Residues - Mechanism of formation of GSR, source and collection, spot test, chemical test, identification of shooter and instrumental methods of GSR Analysis, Management and reconstruction of crime scene; suicide, murder and accidental and self defense cases, Arms and explosives Act.

Photography: Basic principles and techniques of photography, cameras and lenses, exposing, developments and printing, Different kinds of developers and fixtures, modern developments in photography, linkage of cameras and film negatives, digital photography, digital water marking and digital imaging, photogrammetry, videography/ high speed videogaphy, crime scene and laboratory photography.

FORENSIC PHYSICS AND CYBER FORENSIC

Glass: Nature, composition, types, fractures, forensic marks and forensic examinations.
Dust and soil: Nature, composition and forensic examinations.**Paint:** Nature, composition, types and forensic examinations.**Building material:** Types of cement and their composition, Determination of adulterants by physical, chemical and instrumental methods, Examination of brick, Analysis of Cement Mortar and Cement concrete. **Tool marks:** Types of tool marks: Compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and lifting of marks, forensic examinations. Restoration of erased / obliterated marks. Examination of wire/ cables, counterfeit coins. Physical matching of severed / broken objects. **Speaker identification and tape authentication:** Voice production theory-vocal anatomy, Speech signal processing & pattern recognition- basic factors of sound in speech, acoustic characteristics of speech signal, Fourier analysis, frequency & time domain representation of speech signal, analogue to digital signal and conversion, Fast Fourier transform, quantization, digitization and speech enhancement, analysis of audio-video signal for authenticity, Introduction to the techniques of pattern recognition and comparison.

Computer forensic: what is computer forensic? Basic introduction to computers, hardware and accessories, operating system and software. Cyber crime- Definition, crimes on internet, hacking, virus, worms, cookies, obscenity and pornography. Programme manipulation. Software piracy, intellectual property and computer security. Encryption and decryption methods.

Computers and networking: concept of network security and cyber crime investigation.Basic of security planning: Multi layered security, intrusion triangle, removingintrusion opportunities, importance of physical security, protecting server, work station and network devices, protection of removable storage disks.Cryptography and steganography.Cyber crime investigation. **Relevant section of Information technology Act 2000.**

M.Sc. Instrumentation science syllabus

Integrated Circuits and Linear Techniques

PN junction diode- IV characteristics – Rectifiers: Half Wall Rectifier , Full Wall Rectifier ,Bridge Rectifier, filters-Zener diode, junction transistor, Transistor construction, Input and output characteristics of CE, CB and CC configurations, Power transistors. FET – IV characteristics, VP, JFET, small signal model, LF and HF equivalent circuits , CS and CD amplifiers ,cascade and cascade , Darlington connection , MOSFET - Characteristics , enhancement and depletion

Basics of Operational Amplifiers: CE Amplifier, Differential Amplifier using transistor, Operational Amplifier- construction, working, characteristics, performance specifications (IC LM 741, LM 324, OP07), Operational Amplifier with negative feedback: Effect of negative feedback on input resistance, output resistance, bandwidth, gain, offset voltage for inverting, non-inverting and differential amplifier.

Linear applications: summing, scaling, averaging, applications of Operational Amplifiers with inverting, non inverting and differential configurations, Instrumentation Amplifier, Differentiator, Integrator, V to I , I to V converter, Log Antilog configurations, Operational Amplifier with positive feedback: Effect of positive feedback on performance of amplifier, Oscillator, Wien Bridge, Phase shift, Comparators, Zero crossing detector, Schmitt trigger, Precision Rectifier, Applications of above configurations

Timer: IC 555, internal block diagram, working, modes, specifications and its applications, 8038 pulse generator, Voltage Regulator: Theory, Performance specifications, Linear and Switch mode regulators, IC723, Theory and applications, IC 78XX, IC 79XX regulators, Power Supply Design

Number System & Logic Design Minimization Techniques Introduction: Binary, Hexadecimal numbers, octal numbers, number conversion and their arithmetic,

Signed Binary number representation: Signed Magnitude, 1's complement and 2's Complement representation.

Binary, Octal, Hexadecimal Arithmetic: 2's complement, arithmetic.

Codes: BCD, Excess-3, Gray code, Error detecting & correcting Codes, ASCII Code and code, conversions., BCD Arithmetic.

Boolean algebra: Truth tables and Boolean algebra. Idealized logic gates and symbols. DeMorgan's

Axiomatic definition of Boolean algebra, Basic theorems and properties of Boolean algebra.

Logic minimization: Representation of truth-table, SOP form, POS form, Simplification of logical functions, Minimization of SOP and POS forms, Don't care Conditions.

Reduction techniques: K-Maps up to 4 variables and Quine-McClusky techniques.

Logic Families Standard characteristics: Speed, power dissipation, fan-in, fan-out, current and voltage, parameters, noise margin, operating temperature etc.

ECL, NMOS, PMOS families: Basic circuits, Standard TTL characteristics, Operation of TTL NAND gate. TTL Configurations- Active pull-up, Wired AND, totem pole, open collector.

CMOS: CMOS Inverter, CMOS characteristics, CMOS configurations- Wired Logic, Open drain outputs, Detail comparison, of TTL & CMOS

Interfacing: TTL to CMOS and CMOS to TTL, Tristate Logic

Combinational Logic Circuits: - Half- Adder, Full Adder, Half Subtract or, Full Subtractor, BCD adder, look ahead and carry, parity generator and checker , magnitude comparator ,code convertors

Decoders- Working of decoder, implementation of expressions using decoders ,IC 74138 , BCD to 7 segment decoder circuits , BCD to 7 segment decoder/driver IC 7448/7447, **Encoders--** working of encoders, priority encoders, IC 74148

Multiplexers (MUX):- Working of MUX, Implementation of expression using MUX (IC 74153, 74151).

Demultiplexers (DEMUX):- Working of DeMUX, Implementation of expression using DEMUX

Test and Measuring Instruments

Static and Dynamic characteristics of instruments, dead zone, hysteresis, threshold, resolution, input & output impedance, loading effects, fundamentals of measurements, Types of Error, Statistical Analysis, Probability of Errors, Limiting Errors , calibration of instruments, traceability, calibration report & certification.

DC bridges: Wheatstone bridge and Kelvin bridge design, bridge sensitivity, errors in bridge circuits, null type and deflection type bridges, current sensitive and voltage sensitive bridges, applications of DC bridges

Signal Converters: I To P / P To I Converter, Temperature to Voltage Converter, Conversion To Frequency, Period, or Time Duration, Measurement of Phase Difference Using X-OR and SR Flip-Flop Method, Measurement of Active And Reactive Power of Supply Line, Lock-in Amplifiers, Variable Oscillators, Direct Sensor Microcontroller Interfacing.

Isolation Techniques: Transformer Isolation, Optical Isolation, Digital Techniques For Optical Isolation, Hall-Effect Principle and Measurement of Displacement, Current And Power Using Hall Sensors, Amplifications of Low Level Signals, Guarding, Shielding.

Electronic Instruments for Measuring Basic Parameters: Amplified DC meter, AC Voltmeter, True- RMS responding Voltmeter, Electronic multi-meter, Digital voltmeter, Vector Voltmeter.

Digital Instruments: Block diagram, principle of operation, Accuracy of Measurement Digital Multimeter, Kilo Watt Hour meter, Phase meter, Digital Tachometer, Ultrasonic Distance meter, Digital Thermometer, DSO, Frequency meter.

Instrument for Generation and Analysis of Waveforms: Introduction, The Sine Wave Generator, Frequency Synthesized Signal Generator, Frequency Divider Generator, Signal Generator Modulation, Sweep Frequency Generator, Pulse and Square Wave Generator, Function Generator, Wave Analyzers, Harmonic Distortion Analyzer, Spectrum Analyzer.

Industrial Automation

Introduction: Overview, OSI reference model, Transmission media : Copper cable, Coaxial cables, Twisted-pair cable, Connector standards, Earthing/grounding, Fiber-optic cable components, Fiber-optic cable parameters

Open control network: RS-232 overview, RS-232 interface standard, RS-232 troubleshooting, Typical RS-232 problems, RS-485 overview, The RS-485 interface standard, RS-485 troubleshooting Current loop

and RS-485 converters overview, TCP/IP overview, Internet layer protocols (packet transport), Modbus overview, Modbus protocol structure, Modbus troubleshooting

Analytical Instrumentation

Introduction to Chemical instrumental analysis, advantages over classical methods, classification: Spectral, electro analytical and separative methods, Interaction of radiation with matter, Laws of photometry (Beer and Lambert's law), Deviation from Beer's law, working of filters, prism and grating monochromators, concept of design of analytical instrument. Introduction to Electroanalytical methods, potentiometry, voltametry, coulometry.

Separative Methods:

A. Mass Spectrometer(MS): Principle, ionisation methods, mass analyzer types - magnetic deflection type, time of flight, quadrupole, double focusing, detectors for MS.

B. Chromatography: Classification, Gas chromatography: principle, constructional details, GC detectors, High Performance Liquid Chromatography (HPLC): principle, constructional details, HPLC detectors

Radioactive instrumentation and Refractometry:

A. X-ray spectrometry: Instrumentation for X-ray spectrometry, X-ray diffractometer: Bragg's law, Auger emission spectroscopy, Electron spectroscopy for chemical analysis(ESCA).

B. Radiation detectors: Ionisation chamber, Geiger-Muller counter, proportional counter, scintillation counters,

C. Refractometry: Principle, Abbe and Differential refractometer.

SYLLABUS FOR M.A PSYCHOLOGY

Perceptual Processes

FOUNDATION OF PSYCHOLOGY

Perceptual organization,Theories of perceptual organization, Gestalt view on perception,Behaviouristic view on perception, Physiological view on perception.

Memory:

Definition and nature of memory,Models of memory,Structural model of memory, Information processing model- STM, LTM, iconic and echoic memory, Levels of processing model: Encoding, Storing Retrieval memory training.

Thinking:

Nature and type,Thinking and imagination,Theories of thinking,Role of set in thinking.

Attention:

Meaning, characteristic and types of attention, Determinants of attention,Sustained attention,Theories of attention,Function and distraction of attention.

Creativity:

Definition and nature,Measurement of creativity,Factors influencing creativity, Aspects of creativity.

Introduction:

RESEARCH MYTHOLOGY

Meaning, objective, types, limitations and important of research, Stages of research, Hypothesis: Meaning criteria and process of formulating hypothesis, Types of Hypothesis: Directional, non directional and null hypothesis.

Research Design:

Meaning, purpose and types of research design, Experimental Design and non- experimental design, Advantages and disadvantages of experimental design, Variable: Meaning, types

Techniques of controlling extraneous variables - elimination, constancy, balancing, counterbalancing, randomization.

Sampling:

Meaning.Types of sample : Probability sample - Random sample, stratifies, sample cluster sample. Non-probability sample - Quota, accidental, purposive systematic snowball, Dense sample. Sampling error.

Interview and Questionnaire:

Meaning and types of interview, Sources of bias in interview, Questionnaire - Definition, types, merits and

...erits, Characteristics of good and usable questionnaire.

Construction of a psychological test.

Nature, Characteristics,Steps involved in the constructions of a Psychological test.

Historical background

SOCIAL PSYCHOLOGY

Development of Social Psychology, Status of Social Psychology in India, Modern trends in Social Psychology.

Person perception:

Nature and determinates, Social Perception- Nature and group affiliation, Perceptual defense, Perceptual accentuation, Subliminal perception.

Altruism:

Pro-social behaviour- Nature,Internal factors ,Characteristics of the helper and the helped, Ways of increasing pro-social behaviour.

Prejudice:

Nature and development, Theories, Development of prejudice in Indian children, Reduction of prejudice.

Attitude:

Nature and definition of attitude, Development and formation of attitude.Theories of attitude organization, Fastinzer's cognitive dissonance theory, Rosenberg's Affective cognitive theory, Kellman's Three process theory.

COUNSELING

Nature, Scope and goals, Historical development, Current status, Counseling as a help in different profession.

Techniques of counselling: Theory, goals, method, advantages and limitations, Psychodynamic approach: Freud, Jung, Adler,Neo-Freudian: Erik Erikson, Karen Horney. ,Humanistic approach: Abraham Maslow, Phenomenological: Carl Rogers.

Counseling Application

Child and adolescents counseling, Family counseling, Career counseling, Crisis intervention counseling.

Ethical Dimension of counseling.

Legal consideration in counseling, Ethical consideration in counseling.

Indian approach to counseling.

Yoga, Mediation in counseling.

ABNORMAL PSYCHOLOGY

Psychodynamic Model, Humanistic Model, Biological Model, Socio-cultural Model.

Psychosomatic disorders-

Peptic ulcer, Asthma, Hypertension and migraine Nature, Types, Treatment.

Anxiety Disorders

Phobia, Anxiety, Obsessive-Compulsive, Dissociative (conversion) disorders.

Schizophrenic disorder:

Meaning and definition, Symptoms, Clinical features, Etiology and management.

Mood disorders:

Meaning and definition, Types, Symptoms, Etiology and management.

ORGANIZATIONAL PSYCHOLOGY

Organizational Psychology:

Nature.,Structure and Theories- Classical, Neoclassical. Modern, Current status.

Problem of Employees:

Employer- employees relationship, Style of supervision, Role of a supervisor, Traits of a good supervisor,

Training of a supervisor.

Communication:

Meaning and nature of communication, Types of communication, Barriers to communication and Measures of effective communication.

Job Satisfaction and Incentive:

Concept and determinants, Theories of job satisfaction: Maslow, Vroom, Hertzberg, Stogdill, Measurement of job satisfaction, Methods to improve job satisfaction.

Organizational culture:

Meaning, Characteristics, Creating and sustaining culture, Learning culture in organization.

HEALTH PSYCHOLOGY

Introduction: Health Promotion and Disease Prevention:

Definition, models of health behavior, scope and application of health psychology, Neuroendocrine and neurotransmitter model of stress.

Behavioral risk factor: Smoking, drug and alcohol use, unsafe sexual behaivour, diet, sedentary life style.

Stress and personality and social support as psycho-Linkage of ill health:

Cardio-vascular disorders, Cancer, AIDS/HIV, Diabetes mellitus, Pain.

Maintaining health:

Biological, Socio-Cultural, Psychological, Economic, Spiritually-oriented interventions.

Mental Hygiene:

Aspects of mental hygiene, Aims and objectives of mental hygiene, Scope of mental hygiene, Symptoms of mentally healthy person, Mental hygiene of mentally healthy person.

Communicable Diseases: Definition, types, characteristics, etiology and treatment. Tuberculosis,Gonorrhea, Syphilis, Common cold.

Introduction

STATISTICSMeaning, type and application of statistics in psychology, Difference between parametric and non-parametric statistics. Measurement in psychology:Meaning, Level of measurement, Use of measurement, Difference between psychological and physical measurement.

The Normal Distribution:

Nature and properties, Application of normal distribution curve.

Deviations from normality

Skewness and its type, Kurtosis and its type.

Measurement of co-efficient of correlation:

Nature, Type, Utility of correlation, Methods of computation of correlation Pearson's product moment correlation,Biserial correlation method, Point biserial correlation method.

Hypothesis testing and making inferences:

Significance of mean difference, Computation of t- value (correlated and unc ontrolled.), Interpretation of t- value, Level of significance.

Non-parametric statistics:

Assumptions and Calculations, Man Whitney U-test, Kendall Coefficient of Concordance, Friedman's Two way Analysis of Variance.

EDUCATIONAL PSYCHOLOGY

Definition and aims, Scope of educational psychology, Significance, Limitations of Education.

Class room teaching:

Special plans of students grouping for classroom teaching, The problem of individual differences,

Different plans and their psychological aspects.

Heterogeneous group. Inter class grouping, individualinstruction, Homogenous grouping.

Education for exceptional children.

Meaning and characteristics of exceptional children, Advantage and disadvantages of labeling exceptional children, Gifted children education, Adjustment of gifted and talented children.

Educational for Special Children.

Adjustment and education of children with attention deficit disorder (ADD), Attention deficit hyperactivity disorder (ADHD), Adjustment and education of children with hearing impairment.

Educational Technology and Programmed Training:

Meaning and importance of educational technology, Meaning of programmed learning, Skinner's view points towards programmed learning.

ENVIRONMENTAL PSYCHOLOGY

Introduction

Definition and scope, Methods, Method: Survey research, Field studies, Experimental method.

Theoretical Approach:

Environmental behaviour theories, Environmental load theory, Behavioural constraint theory, Environmental Stress theory.

CLINICAL PSYCHOLOGY

Foundation of Clinical Psychology:

Concept, aims of clinical psychology,Application of clinical Psychology, Current status of clinical psychology

Clinical Psychologists in Action:

Roles in child guidance clinic, Industrial and vocational guidance clinics, Educational institutions and mental hospitals, Penal institutions.

Psycho-diagnosis:

Meaning and types of psychodiagnosis, Meaning and nature of clinical interview, Types of clinical interview.

Meaning and types of psychological tests.

Clinical Assessment:

Meaning and nature of clinical assessment, Components and process of clinical assessment, Stages and techniques of clinical assessment.

Psychotherapies:

Freudian Psychoanalytic Therapy: Meaning, goal, method, merits and limitations of Freudian psychoanalytic therapy.

Cognitive Therapy: Beck cognitive therapy, Rational emotive therapy: Meaning, goal, method, merits and limitations.

Behaviour Therapy: Meaning and techniques of behavior therapy: Systematic desensitization, aversion, flooding, contingency management; merits and limitations.

Group Therapy: Meaning, method, types, merits and limitations, Shock Therapy: Meaning, method, merits and limitations.

PERSONLITY THEORIES

Personality: Concept, Approaches, Ideographic Nomothetic, Types and trait, Indian approach to personality.

Psychoanalytic strategies: Freud, Adler, Jung.

The dispositional strategy: Murray's need theory, Mc Clelland- Atkinson approach to personality.

The Phenomenological Strategy: Maslow need hierarchy theory, Lewin's filed theory

Determinates of personality: Biological, Socio-cultural, Economic.