Life Sc.

MAMMALIAN PHYSIOLOGY AND BIOCHEMISTRY

Nerve and muscle

Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction

Digestion

Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids

Respiration

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood

Excretion

Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism

Cardiovascular system

Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle

Endocrine system

Mechanism of action of hormones (insulin and steroids) Different endocrine glands– Structure and function of hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions; Nervous and endocrine coordination

Carbohydrate Metabolism

Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain

Lipid Metabolism

Biosynthesis and β oxidation of palmitic acid

Protein metabolism

Transamination, Deamination and Urea Cycle

Enzymes

Introduction, Mechanism of action, EnzymeKinetics, Inhibition and Regulation

ANIMAL BIOTECHNOLOGY

Concept and scope of biotechnology

Molecular Techniques in Gene manipulation

Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics) Restriction enzymes: Nomenclature, detailed study of Type II. Transformation techniques: Calcium chloride method and electroporation. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization Southern, Northern and Western blotting; DNA sequencing: Sanger method Polymerase Chain Reaction, DNA Finger Printing and DNA micro array

Genetically Modified Organisms

Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection, Applications of transgenic animals: Production of pharmaceuticals, production ofdonor organs, knockout mice.

Culture Techniques and Applications

Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia) Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy

APPLIED ZOOLOGY

Introduction to Host-parasite Relationship

Host, Definitive host, Intermediate host,Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis

Epidemiology of Diseases

Transmission, Prevention and control of diseases: Tuberculosis, typhoid

Parasitic Protozoa

Life history and pathogenicity of Entamoeba histolytica,Plasmodium vivax and Trypanosoma gambiense

Parasitic Helminthes

Life history and pathogenicity of Wuchereria bancrofti

Insects of Medical Importance

Medical importance and control of Anopheles, Culex, Aedes, Xenopsylla cheopis

Animal Husbandry

Preservation and artificial insemination incattle; Induction of early puberty and synchronization of estrus in cattle

Poultry Farming

Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs

IMMUNOLOGY

Overview of the Immune System

Introduction to basic concepts in immunology, components of immune system, principles of innate and adaptive immune system

Cells and Organs of the Immune System

Haematopoeisis, Cells of immune system and organs (primary and secondary lymphoid organs) of the immune system

Antigens

Basic properties of antigens, B and T cell epitopes, haptens and adjuvants

Antibodies

Structure, classes and function of antibodies, monoclonal antibodies, antigen antibody interactions as tools for research and diagnosis

Working of the immune system

Structure and functions of MHC, exogenous and endogenous pathways of antigen presentation and processing, Basic properties and functions of cytokines, Complement system: Components and pathways.

Immune system in health and disease

Gell and Coombs' classification and brief description of various types of hypersensitivities, Introduction to concepts of autoimmunity and immunodeficiency,

Vaccines

General introduction to vaccines, Various types of vaccines

REPRODUCTIVE BIOLOGY

Reproductive Endocrinology

Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

Functional anatomy of male reproduction

Outline and histological of male reproductive system in rat and human; Testis: Cellular functions, germ cell, system cell renewal;Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract

Functional anatomy of female reproduction

Outline and histological of female reproductive system in rat and human; Ovary: folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport inthe fallopian tubes; Sperm transport in the female tract, fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto – maternalrelationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation

Reproductive Health

Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning

GENERAL MICROBIOLOGY

Fundamentals, History and Evolution of Microbiology.

Classification of microorganisms: Microbial taxonomy, criteriaused including molecular approaches, Microbial phylogeny and current classification of bacteria.

Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure ofmajor groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

Cultivation and Maintenance of microorganisms:Nutritional categories of micro-organisms,methods of isolation, Purification and preservation.

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.

Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal.

Food Microbiology: Important microorganism infood Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods.Fermented Foods.

MEDICAL MICROBIOLOGY

Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels.

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: S.aureus, S.pyogenes, B.anthracis, C.perferinges, C.tetani, C.botulinum, C.diphtheriaeM.tuberculosis, M. leprae.

Morphology, pathogeneis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: E.coli, N. gonorrhoea, N. meningitidis, P. aeruginosa, S. typhi, S. dysenteriae, Y. pestis, B. abortus, H. influenzae, V. cholerae, M. pneumoniae, T. pallidum M. pneumoniae, Rickettsiaceae, Chlamydiae.

Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.

Fungal and Protozoan infections.Dermatophytoses (Trichophyton, Microsporun and Epidermophyton) Subcutaneous infection (Sporothrix, Cryptococcus), systemic infection (Histoplasma, Coccidoides) and opportunistic fungal infections (Candidiasis, Aspergillosis), Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis, Malaria).

MOLECULAR BIOLOGY

DNA structure and replication

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

DNA damage, repair and homologous recombination

DNA damage and repair: causes and types ofDNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

Transcription and RNA processing

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

Regulation of gene expression and translation

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotictranslation: ribosome structure and assembly, Charging of tRNA, aminoacyltRNAsynthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation.,Posttranslational modifications of proteins.

RECOMBINANT DNA TECHNOLOGY

Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificialchromosomes), Microinjection, Electroporation, Ultrasonication, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR.

Restriction and modification system, restriction mapping. Southernand Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription,. Genome mapping, DNA fingerprinting, Applications of Genetic Engineering

Genetic engineering in animals: Production and applicationsof transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).

Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis,Gene shuffling, production ofchimeric proteins, Protein engineering concepts and examples.

GENOMICS & PROTEOMICS

Introduction to Genomics, DNA sequencing methods– manual & automated: Maxam& Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. SelectedModel Organisms' Genomes and Databases.

Introduction to protein structure, Chemical properties of proteins.Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filteration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.

Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution.

Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. De novosequencing using mass spectrometric data.

BIOINFORMATICS

History of Bioinformatics.The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web.

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, PairwiseAlignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission.

Genome Annotation: Pattern and repeat finding, Gene identification tools.

BIO-ANALYTICAL TOOLS

Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation ofsub-cellular organelles and particles.

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno-electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.

BIOSTATISTICS

Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data.Measures ofcentral tendency and Dispersion.Measures of Skewness and Kurtosis.

Probability classical & axiomatic definition ofprobability, Theorems on total and compound probability), Elementary ideas of Binomial, Poisson and Normal distributions.

Methods of sampling, confidence level, critical region, testing ofhypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA)

Correlation and Regression.Emphasis on examples from Biological Sciences.

Reference site:

https://www.ugc.ac.in/ugc_notices.aspx?id=1077

Organic Chemistry

UNIT - I

[1] Basics of Organic Chemistry

Structure and Bonding: Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bonding, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes, resonances, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

Mechanism of Organic Reactions: Curved arrow notation, drawing electron movements with allows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions, Energy considerations. Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies).

[2] Spectroscopy

Ultraviolet (UV) absorption spectroscopy: absorption laws (Beer-Lambert law); molar absroptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. U.V. spectra of conjugated enes and enones.

Infrared (I.R.) absorption spectroscopy: molecular vibrations, Hooke's law, selection rules, intensity and position of I.R. bands, measurement of I.R. spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of I.R. spectra of simple organic compounds.

Nuclear magnetic resonance (NMR) spectroscopy: Proton magnetic resonance(1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift andmolecular structure, spin-spin splitting and coupling constants, areas of signals,interpretation of 1H NMR spectra of simple organic molecules such as ethylbromide, ethanol, acetaldehyde, 1, 1, 2-tribromoethane, ethyl acetate, tolueneand acetophenone, Problems pertaining to the structures elucidation of simpleorganic compounds using UV, IR and 1H NMR spectroscopic, techniques.

[3] Stereochemistry of Organic Compounds

Concept of isomerism, Types of isomerism, Difference between configuration and conformation.

Optical isomerism: elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, disasteromers, threo and erythro diastereomers, meso compounds, resolution of enantionmer, inversion, retention and recemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

Geometric isomerism:determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Conformational isomerism: conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives, Newman projection and Sawhorse formulae, Fischer and flying wedge formulae.

UNIT - II

[1] Alkanes and Cycloalkanes

IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atom in alkanes, Isomerism in alkanes, sources methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes, Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity.

Cycloalkanes: Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strain less rings. The case of cyclopropane ring, banana bonds.

[2] Alkenes, Cycloalkenes, Dienes and Alkynes

Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halids, regioselectivity in alcohol dehydration, The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes, mechanism involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroborationoxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with KMnO4, Polymerization of alkenes, Substitution at the allylic and vinylic positions of alkenes, Industrial applications of ethylene and propene.

Methods of formation, conformation and chemical reactions of cycloalkenes, Nomenclature and classification of dienes, isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, 1, 2 and 1, 4 additions, Diels-Alder reaction.

Nomenclature, structure and bonding in alkynes, Methods of formation, Chemical reactions of alkynes, acidity of alkynes, Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization.

[3] Arenes and Aromaticity

Nomenclature of benzene derivatives, The aryl group, Aromatic nucleus and side chain, Structure of benzene; molecular formula and kekule structure, stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture.

Aromaticity: The Huckle rule, aromatic ions.

Aromatic electrophilic substitution - general pattern of the mechanism, role of s and p complexes, Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio, Side chain reactions of benzene derivatives, Birch reduction; Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and Anthracene

[4] Alkyl and Aryl Halides

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 reactions with energy profile diagrams. Polyhalogen compounds : Chloroform, carbon tetrachloride;

Methods of formation of aryl halides, nuclear and side chain reactions; The addition-elimination and the elimination-addition mechanisms of nucleophilc aromatic substitution reactions;

Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides, Synthesis and uses of DDT and BHC.

[5] Alcohols and Phenols

Classification and nomenclature, Monohydric alcohols: nomenclature, methods of formation by reduction of Aldehydes, Ketones, Carboxylic acids and Esters, Hydrogen bonding, Acidic nature, Reactions of alcohols.

Dihydric alcohols: nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [Pb(OAc)4 and HIO4] and pinacolpinacolone rearrangement.

Trihydric alcohols: nomenclature, methods of formation, chemical reactions of glycerol.

Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols: electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman syntheis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

[6] Ethers and Epoxides

Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions - cleavage and autoxidation, Ziesel's method. Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

[7] Aldehydes and Ketones

Nomenclature and structure of the carbonyl groups, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1, 3-dithianes, synthesis of ketones from nitrites and from carboxylic acids, Physical properties. Mechanism of nucleophillic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction.

Use of acetals as protecting group, Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones An introduction to α, β - unsaturated aldehydes and Ketones.

[8] Carboxylic acids and Derivatives

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength, Preparation of carboxylic acids, Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction, Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids, Mechanism of decarboxylation.

Methods of formation and chemical reactions of halo acids, Hydroxy acids: malic, trartaric, citric acids.Methods of formation and chemical reactions of unsaturated monocarboxylic acids.Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.

Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anyhydrides.

Relative stability of acyl derivatives, Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reaction. Mechanisms of esterificaton and hydrolysis (acidic and basic)

[9] Organic Synthesis via Enolates

Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate,Synthesis of ethyl acetoacetate: the Claisen condensation, Keto-enoltautomerism of ethyl acetoacetate.Alkylation of 1, 3-dithianes, Alkylation and acylation of enamines.

UNIT - III

[1] Organic Compounds of Nitrogen

Preparation of nitroalkanes and nitroarenes, Chemical reactions of nitroalkanes. Mechanisms of nuclephilc substitution in nitroarenes and their reductions in acidic, neutral and alkaline media, Picric acid.

Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties, Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts, Preparation of alkyl and aryl amines (reduction of nitro compounds, nitrities), reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reactions of amines, electrophilic aromatic substituton in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

[2] Organometallic Compounds

Organomagnesium compounds : the Grignard reagents, formation, structure and chemical reactions.
Organozinc compounds: formation and chemical reactions.
Organolithium compounds: formation and chemical reactions.

[3] Organosulphur Compounds

Nomenclature, structural formation, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and Sulphaguanidine.

[4] Hetrocyclic Compounds

Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution, Mechanism of nucleophilic substitution reaction in pyridine derivatives, Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and six membered heterocycles, Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Nepieralski synthesis, Mechanism of electrophilc substitution reactions of indole, quinoline and isoquinoline.

[5] Carbohydrates

Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides, Erythro and threo diastereomers, Conversion of glucose intro mannose, Formation of glcosides, ethers and esters, Determination of ring size of monosaccharides, Cyclic structure of D(+)-glucose, Mechanism of mutarotation.

Structures of ribose and deoxyribose

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

[6] Amino Acids, Peptides, Proteins and Nucleic Acids

Classification, structure and stereochemistry of amino acids, Acid-base behaviour isoelectric point and electrophoresis, Preparation and reactions of α-amino acids, Structure and nomenclature of peptides and proteins,Classification of proteins, peptide structure determination, end group analysis,selective hydrolysis of peptides, classical peptide synthesis, solid-phaseeptide synthesis, Structures of peptides and proteins, Levels of proteinstructure, Protein denaturation/ renaturation;

Nucleic acids : Introduction, constituents of nucleic acids, Ribonucleosides andribonucleotides, The double helical structure of DNA.

[7] Fats, Oils and Detergents

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils, Saponification value, iodine value, acid value, Soaps, synthetic detergents, alkyl and aryl sulphonates.

[8] Synthetic Polymers

Addition or chain-growth polymerization, Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers, Condensation or step growth-polymerization, Polyesters, plyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes, Natural and synthetic rubbers, Elementary idea of organic conducting polymers.

[9] Synthetic Dyes

Colour and constitution (electronic Concept), Classification of dyes, Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet, phenolphthalein, fluorescein, Alizarin and Indigo.

Inorganic Chemistry Syllabus

➢ Atomic Structure

Bohr model of hydrogen atom, Bohr's equation for the energy of electron in hydrogen atom, the hydrogen spectrum, limitations of Bohr theory, photoelectric effect, idea of de Broglie matter waves, Heisenberg's uncertainity principle and its significance, Schrodinger wave equation (derivation not expected), wave functions, significance of ψ (psi) and ψ2 , atomic orbitals, Nodal planes in atomic orbitals, quantum numbers (n, l, m), Zeeman effect, Stern-Gerlac experiment, spin quantum number (s), shapes of s, p and d orbitals. Aufbau and Pauli's exclusion principles, Hund's rule, energy level diagram of a multielectron atom, concept of effective nuclear charge, Slater's rules and applications, Electronic configuration of atoms.

➢ Periodic Properties

Periodic trends in atomic volume, atomic and ionic radii, ionisation enthalpy, electron affinity(electron gain enthalpy), electronegativity and metallic character, Pauling's electronegativity scale, Classification of elements as s,p,d& f block.

➢ Chemical Bonding

Ionic bond – nature of ionic bond, properties of ionic compounds, radius ratio and coordination number, factors favouring the formation of ionic compounds. Lattice energy, Born-Lande equation with derivation, factors affecting lattice enthalpy, Born-Haber cycle and its applications, solvation enthalpy and solubility of ionic compounds. Covalent bond- valence bond theory and its limitations, concept of resonance, resonance energy, hybridisation and shapes of simple molecules (BeF_2, PCl_3, PCl_5, SF_6, CH_4, Ethane, ethane and ethyne) VSEPR theory, shapes of molecules and ions (NH_3, XeF_6, ClF_3, NH_4+ , H_3O+). Molecular orbital theory – LCAO method, molecular orbital energy diagram and properties of homo and hetero diatomic molecules (N_2, O_2, CO and NO), bond strength and bond energy. Polarisation of covalent bond, polarising power and polarisability of ions, Fajan's rule. Dipole moment and molecular structure – percentage ionic character from dipole moment. Metallic bonding – free electron theory, valence bond theory and band theory, explanation of metallic properties based on these theories. 15 Weak chemical forces – hydrogen bond, inter and intra molecular hydrogen bonds, effects of hydrogen bonding, van der Waals forces.

➢ Nuclear Chemistry

Nuclear particles, nuclear forces, nuclear size, nuclear density, stability of nucleus, binding energy, magic numbers, packing fraction, n/p ratio. Nuclear models – liquid drop model and shell model. Natural radioactivity, modes of decay, decay constant, half-life period, average life, radioactive equilibrium, Geiger-Nuttal rule, units of radioactivity, radiation dosage. Induced radioactivity, nuclear reactions induced by charged projectiles, neutrons and γ rays, fission reactions, fusion reactions, spallation reactions, preparation of transuranic elements, Q values of nuclear reactions. Fertile and fissile isotopes, chain reaction, stellar energy.

➢ Acids, Bases and Non Aqueous Solvents

Lowery-bronsted and Lewis concepts of acids and bases-introduction to SHAB principle. Generalproperties- classification- self ionization and levelling effect- reaction in non-aqueous solvents - protic andaprotic non aqueous solvents- examples- solutions of metals in liquid ammonia-

Physical Chemistry Syllabus

1. Gaseous state: Deviation of real gases from ideal behavior. Vander-Waals equation of state. Critical phenomenon. The Vander-Waal's equation and critical state. Derivation of relationship between critical constants and van der Waal's constants. The law of corresponding states, reduced equation of states. Joule Thomson effect and inversion temperature of a gas. Kinetic theory of gases, ideal gas laws based on kinetic theory. Collision in a gas- mean free path, collision diameter, collision number.

2.Liquid state: Intermolecular forces, structure of liquids (qualitative description). Structural differences between solids, liquids and gases. Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). Liquid crystals, the mesomorphic state: Classification of liquid crystals in to Smectic and Nematic, differences between liquid crystal and solid / liquid. Application of liquid crystals as LCD devices.

3. Solid state: Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl.Imperfection in crystals: point defect-Schottky and Frankel defects.

4. Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono and diprotic acids. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.

5. Atomic structure and elementary quantum mechanics: Black body radiation, heat capacities of solids, Rayleigh Jeans law, Planck's radiation law, photoelectric effect, Limitations of classical mechanics, Compton effect, De Broglie's hypothesis. Heisenberg's uncertainty principle, Schrodinger's wave equation and its importance. Physical interpretation of the wave function, significance of Δ and $\Delta 2$, a particle in a box, energy levels, wave functions and probability densities. Schrodinger wave equation for H-atom. Separation of variables, radial and angular functions (only equation), hydrogen like wave functions, quantum numbers and their importance.

6. **Thermodynamics:**Intensive and extensive variables; state and path functions; isolated, closed and open systems.

First law: Concept of heat, Q, work, W, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of Q, W, ΔU and ΔH for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions. Thermochemistry: Heats of reactions: standard states;

enthalpy of formation and enthalpy of combustion and its applications; effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions.
Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

7. **Electrochemistry:** Arrhenius theory of electrolytic dissociation, Hydrolysis of salts, hydrolysis constant, buffer solutions, indicators and theory of acid-base indicators. Migration of ions: transference number and its determination by Hittorf methods. Conductance of electrolyte solutions, molar conductance of electrolyte and its splitting into ionic molar conductance, Kohlrausch law of independent migration of ions, ionic mobility. Application of conductance measurements: determination of degree of dissociation and dissociation constant of weak electrolytes/acids, solubility of sparingly soluble salts, and Conductometric titrations.

8. Nuclear Chemistry: Nucleus and its classification, nuclear forces, nuclear binding energy, stability of nucleus. Radioactivity: Radioactive elements, general characteristics of radioactive decay, decay kinetics (decay constant, half life, mean life period), units of radioactivity.

9. Solutions and Colligative Properties: Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

10. **Phase Equilibria**: Statement and meaning of the terms – Phase, Component and degrees of freedom, Gibb's Phase rule, phase equilibria of one component system – water system. Phase equilibria of two-component system – Solid-Liquid equilibria, simple eutectic – Pb-Ag system, desilverisation of lead. Solid solutions – compound with congruent melting point – Mg- Zn system and incongruent melting point – NaCl-H2O system

11. **Electrochemical Cells:** Reactions in reversible cells, free energy and *Emf*of reversible cell. Single electrode potential (Nernst equation), its measurement and sign convention. Standard electrode potential. *Emf*of reversible cell from electrode potentials. Types of reversible activities, pH, and equilibrium constant. Potentiometric titration. Concentration cells with and without transference. Liquid junction potential and its elimination.

12. Colloids& surface chemistry: Definition of colloids. Classification of colloids. Solids in liquids (sols): preparations and properties – (including Kinetic, Optical and

Electricalstabilityof colloids) Protective action. Hardy–Schultz law, Gold number. Liquids in liquids(emulsions): Types of emulsions, preparation and emusifier. Liquids in solids(gels); Classification, preparations and properties, General applications of colloids. Micelles: Classification of surface active agents. Surfactant action, micellization and micellar interactions, Structure of micelles – spherical and laminar. Critical micellar concentration (CMC). Factors affecting the CMC of surfactants. Counter ion binding to micelles.

13. Chemical Kinetics: Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

14. **Photochemistry:** Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical 34 reactions in biochemical processes, photostationary states, chemiluminescence.

15.**Quantum Chemistry:** Postulates of quantum mechanics, quantum mechanical operators and commutation rules, Schrödinger equation and its application to free particle and —particle-in-a-box‖ (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wave functions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wave functions. Vibrational energy of diatomic molecules and zero-point energy. Angular momentum. Rigid rotator model of rotation of diatomic molecule. Schrödinger equation in Cartesian and spherical polar (Derivation not required). Separation of variables. Spherical harmonics. Discussion of solution (Qualitative). Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

16. Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H2 +. Bonding and antibonding orbitals. Qualitative extension to H2. Comparison of LCAO-MO and VB treatments of H2 (only wave functions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH).

Syllabus of Electronics:

Basic Electronics
Electronic Circuits & Special Purpose devices
Linear Integrated Circuits & C Programming
Digital Electronics
Communication I
Microprocessors & Instrumentation
Communication II
Microcontrollers

1) DC and AC response of electronic passive components

Review of passive components – R, L & C Voltage and current sources–ideal and practical, conversion from voltage source to current source and vice versa, numerical problems.

Transient analysis of RC and RL circuits: Series RC circuit excited by DC source- charging& discharging of a capacitor through resistor- circuit diagram and qualitative study, charge/voltage at any instant during charging and discharging–equations (mention only - no derivations), graphical representation, RC time constant, numerical problems.Series RL circuit excited by DC source: circuit diagram and qualitative study, current at any instant during growth and decay–equations (mention only - no derivations), graphical representation, RL time constant, numerical problems.

AC applied to Series RC and RL circuits: Impedance of series RC & RL circuits (qualitative study-no derivations), Numerical problems. AC applied to Series and parallel RLC circuit(qualitative study–no derivations), series and parallel resonance, condition for resonance, resonant frequency, band width, significance of quality factor, numerical problems.

Transformer: Principle, construction and working; Switches: SPST, SPDT, DPST and DPDT, fuse and electromagnetic relay, MCB and ELCB, RCCB– brief note on each.

2) Network theorems

Review of Ohms law, Kirchhoff's laws, voltage divider and current divider theorems, open and short circuits. Thevenin's theorem, Norton's theorem and interconversion, superposition theorem statements and steps involved, reciprocity theorem statement, maximum power transfer theorem-derivation, numerical problems on all theorems.

3) Semiconductor Basics, Semiconductor Diode and its applications

Semiconductor Basics: Energy band in solids (metal, semiconductor and insulators), concept of effectivemass, density of states, carrier concentration at normal equilibrium in intrinsic semiconductors, derivationof Fermi level for intrinsic semiconductors, donors, acceptors, majority carriers (electrons and holes),dependence of Fermi level on temperature and doping concentration.

Diode: p-n junction diode, formation of depletion layer, space charge at a junction. Derivation of electrostatic potential difference at thermal equilibrium, depletion width and depletion capacitance of abrupt p-n junction. Diode equations and the I-V characteristic. Zener and Avalanche mechanism, Zenerdiode.

4) TRANSISTOR

Bipolar Junction Transistor: Construction, principle & working of NPN transistor, terminology. Configuration – CE, CB, CC (mention only). Definition of α, β and γ and their interrelations, leakage currents(mention only), numerical problems.

Study of CE Characteristics - different regions. Experimental circuit and procedure.

Study of CB Characteristics - different regions, Base width modulation-Early effect.

Transistor biasing – need for biasing, DC load line, operating point, thermal runaway, stability and stability factor (mention the equation-no derivation)

Different types of biasing– Fixed bias(base bias) without and with R_E, collector to base bias, voltage divider bias and emitter bias ($+V_{CC}$ and $-V_{EE}$ bias) –circuit diagrams and their working, Q point expressions for voltage divider biasing only with numerical problems.
Transistor as a switch – circuit and working. Darlington pair and its applications (mention only).
Junction Field Effect Transistor (JFET) – types (mention only), construction and working of N channel FET, characteristics, FET parameters and their relationships, comparison of FET with BJT.

5) Number systems & Codes

Binary, hexadecimal – conversion from binary to decimal and vice-versa, binary to hexadecimal and vice-versa, decimal to hexadecimal and vice versa, addition and subtraction of binary numbers and hexadecimal numbers. Subtraction using 2's complement, signed number arithmetic – addition. Types of codes–BCD code, gray code, gray to binary conversion and vice versa, excess – 3 Code - self complementing property, ASCII and EBCDIC.

Electronic Circuits & Special Purpose devices

6) Small Signal Amplifiers

Classification of amplifiers based on different criteria, small signal CE amplifiercircuit, working, frequency response, r_e model for CE configuration, derivation for Av, expressions for Z_{in} and Z_{out}. Numerical problems on A_v, Z_{in} and Z_{out}. Swamped amplifier and CC amplifier circuit diagrams & applications (mention only).
Multistage amplifiers qualitative study of cascaded stages, overall gain of multistage amplifier, loading Effect. Numerical problems on $A=A_1A_2$. Types of couplingRC coupled, transformer coupled and direct coupled (only circuit diagrams and frequency response graph, advantages and disadvantages for each). Darlington amplifier-circuit diagram and its characteristic features.
JFET amplifier in CS mode – circuit and operation, equivalent circuit and expression for voltage gain (derivation).Numerical problems.

7) Power and Tuned amplifiers

Difference between voltage and power amplifier, classification of power amplifiers-Class A, Class B, Class C and their comparisons. Class A single ended power amplifier–working. Transformer coupled Class A power amplifier-working, overall efficiency (derivation). Circuit operation of complementary symmetry class B push pull power amplifier (no derivation), crossover distortion, heat sinks. Tuned amplifiers - single tuned and double tuned amplifiers, circuit diagram, working and frequency response for each, limitations of single tuned amplifier, brief note on use of tuned amplifiers in communication circuits.

8) Differential amplifier

Circuit diagram, different configurations (mention only) – working, dc and ac analysis (r_e model) of dual input balanced output differential amplifier – tail current, expressions for Q point, differential gain, common mode gain, C.M.R.R, input impedance and output impedances.
Current Mirror – circuit diagram and working, differential amplifier with current mirror– circuit diagram and working (explanation of increase in C.M.R.R).

9) Oscillators

Sinusoidal Oscillatorsdamped and undamped oscillations, basic principle of oscillator, positive feedback, barkhausen criterion, classification of oscillatorsLC, RC and crystal oscillators. Collpitt & Hartley oscillators using transistors – circuit diagrams, working derivations) and numerical problems. Equivalent circuit of a piezo electric crystal, working of Colpitt crystal oscillator. Types of RC

oscillators (mention only). Multivibrator–types, block diagrams of astable, monostable & bistable multivibrators with waveforms. Circuit diagram and working of astable Multivibrator using transistors (no derivation).

10) Special purpose devices

MOSFET types, circuit symbols of depletion type MOSFET (both N channel and P Channel). Circuit symbols of enhancement type MOSFET(both N channel and P channel). N channel enhancement type MOSFET working, characteristic curves (without experimental circuit).

UJT Basic construction, equivalent circuit, intrinsic standoff ratio, working, characteristics and relaxation oscillator-expression. Numerical problems.

SCR working, V-I characteristics, full wave controlled rectifier-derivations for average values of load current and voltage, numerical problems.

Triac and Diac – circuit symbol, basic constructional features, operation and applications (mention only).

LED– circuit symbol, operation and applications (mention only) and 7 segment display- common cathode and common anode (mention only), pin/segment identification- display of decimal digits.

LCD – types, applications (mention only), advantages over LED.

Tunnel diode, varactor diode, photo diode, photo Transistor & solar cell – circuit symbol, characteristics, applications (mention only).

LINEAR INTEGRATED CIRCUITS

11) Integrated circuit and operational amplifier

Integrated circuit, Advantages and disadvantages of ICs, scale of integration- classification of ICs by structure and by function (mention only), IC terminology, fabrication of monolithic IC – steps involved in the fabrication of a NPN transistor (epitaxial planar diffusion process).

Operational amplifiers- block diagram, equivalent circuit, various parameters op-amp -input bias current, input offset voltage, output offset voltage, CMRR, slew rate, SVRR, Characteristics of ideal and practical op-amps. Mention 3 different op-amp ICs (Mono, dual and quad op-amp ICs(mention only). 741, OP 07, LM 308, etc. and their comparison with respect to parameters, limitations of op-amp in open loop mode.

Op - Amp with negative feedback: Inverting amplifier- derivations for Av, concept of virtual short and virtual ground. Non- inverting amplifier derivations for Av. Voltage follower-circuit and features, Summing amplifier/adder and subtractor derivation for the output voltage. Averaging amplifier, scale changer, numerical problems.

Integrator, differentiator- derivation for the output voltage, output waveforms for sine and square wave inputs, small signal half wave rectifier-circuit and working.

12) Applications of operational amplifier

Open loop applications: comparator-circuit and characteristics, schmitt trigger-circuit and waveforms, schmitt trigger ICs (mention only). First order active filters- low pass, high pass, band pass, band reject and all pass filters. Circuit diagrams, derivation for cutoff frequency and numerical problems for low pass and high pass filters only. Instrumentation amplifier – circuit and working.

Phase-shift & Wein bridge oscillator using op-amp: circuit, working, expression for frequency of oscillation (no derivation), numerical problems. Fixed and variable IC regulators IC 78xx and IC 79xx -concepts only, IC LM317- output voltage equation (mention only) and simple numerical problems.

555 timer: functional block diagram, Multivibrator–types (mention only), Circuit diagram and Astable Multivibrator – circuit with 555 timer and working, equation for frequency of oscillations (no derivation),numerical problems. Circuit of monostable multivibrator using 555.

DIGITAL ELECTRONICS

13) Boolean algebra and Logic gates

Boolean algebra- Positive and negative logic. Boolean laws. De Morgan's theorems, simplification of Boolean expressions-SOP and POS. Logic gates- basic logic gates-AND, OR, NOT, logic symbol and truth table. Derived logic gates (NAND,NOR, XOR & XNOR). Universal property of NOR and NAND gates. K-map-3 and 4 variable expressions. Pulse characteristics, logic Families-classification of digital ICs. Characteristics of logic families, circuit description of TTL NAND gate with totem pole and open collector.

TTL IC terminology. Circuit description of CMOS inverter, comparision of TTL and CMOS families.

14) Combinational logic circuits

Combinational logic circuits-half adder, full adder, half subtractor, full subtractor. Two bit comparator. Encoder, decimal to BCD priority encoder. 2:4 decoder using AND gates, 3:8 decoder using NAND gates, BCD to decimal decoder, BCD to 7 segment decoder, 4:1 multiplexer, 1:4 demultiplexer using gates. D-A conversion 4 bit binary weighted resistor type, circuit and working. Circuit of R-2R ladderconcept only.

A-D conversioncharacteristics, successive approximation ADC. (mention the relevant ICs for all).

15) Sequential logic circuits

RS latch, NAND and NOR latches, Flipflops, clocked RS F/F, edge triggering and level triggering, D F/F and edge triggered J-K F/F, T F/F, edge triggered M/S JK flip flop, clear & preset inputs. Registers and counters- 4bit serial in serial out, serial in Parallel out, parallel in serial out, parallel in parallel out, applications. Ring counter, Johnson counter applications. Asynchronous counters-Logic diagram, Truth table and timing diagrams of 3 bit ripple counter, 3 bit Up-Down counter and modified counters. Synchronous counter- design using K-maps (for mod 3 & mod 5 counters only).

Programmable Logic devices – basic concepts. Types of PLDs (mention only) - SPLDs□ROM, PLA, PAL and GAL. CPLD and FPGA.

16) Data flow Modeling and Behavioral Modeling

Data flow Modeling: Continuous assignment, net declaration assignments, delays, net delays and examples. Behavioral Modeling: Procedural constructs, timing controls, block statement, procedural assignments, conditional statement, loop statement, procedural continuous assignment, Illustrative Examples derivations) and numerical problems. Equivalent circuit of a piezo electric crystal, working of Colpitt crystal oscillator. Types of RC oscillators (mention only).

Multivibrator–types, block diagrams of astable, monostable & bistable multivibrators with waveforms. Circuit diagram and working of astable Multivibrator using transistors (no derivation).

COMMUNICATION-I

17) Noise and Transmission lines

Noise-Introduction, internal and external noises, signal to noise ratio and noise figure-numerical examples. Transmission lines - types and equivalent circuit of T-lines, primary and secondary constants. reflection co-efficient, VSWR and CSWR-numerical examples, losses and distortions in

T-lines. propagation of waves-ground wave, sky-wave and space wave propagations, ionosphere and its effects.

18) Analog Modulation techniques

Block diagram of electronic communication system. modulation-need and types of modulation-AM, FM & PM. Amplitude modulation – representation, modulation index, expression for instantaneous voltage, power relations, frequency spectrum, DSBFC, DSBSC and SSBSC (mention only), AM collector modulator. Limitations of AM. FM - definition, modulation index, FM frequency spectrum diagram, bandwidth requirements, frequency deviation and carrier swing, FM generator-varactor diode modulator. Block diagram of AM transmitter and FM transmitter with AFC, qualitative study of pre-emphasis. Comparison of AM and FM, numerical examples.

19) Radio Receivers

Demodulation- AM detection – principles of detection, linear diode and Transistor detector-circuits, principle of working and waveforms, FM detector – principle, slope detector-circuit, working. AM superheterodyne receiver– principle, block diagram, function of each stage with waveform, qualitative study of AGC. FM superheterodyne receiver– principle, block diagram, function of each stage with waveform, qualitative study of de-emphasis. Characteristics of radio receivers-qualitative study of sensitivity, selectivity, signal to noise ratio, fidelity, stability, image frequency and its rejection.

20) Antennas

Radiation mechanism, wire Radiators in space-resonant antennas-radiation pattern and current distribution for different lengths, non - resonant antenna, antenna parameters-gain, directive gain, power gain, bandwidth, beam width, polarisation, efficiency, radiation resistance, total effective resistance, derivation for the power radiated by antenna and expression for radiation resistance. Ungrounded and grounded antennas, effect of antenna height. Folded dipole, numerical examples wherever applicable. Qualitative study of helical antenna and loop antenna.

21) Television

Introduction, scanning, interlaced scanning, T.V. camera tube, composite video signal – blanking and synchronizing pulses, vestigial side band transmission, TV systems and standards – comparison between American and European systems. Block diagrams of monochrome TV transmitter and receiver. basic principles of colour TV, primary and 16 of 22
secondary colours, colour combinations, chromo and luminance processing as per PAL system. Colour TV receiver (PAL). Concept of CCTV, HDTV, Picture in Picture, Picture phones, TV games, numerical examples wherever applicable.

EL-502T MICROPROSSESOR and ELECTRONIC INSTRUMENTATION

22) Introduction to Microprocessor

Introduction, applications, basic block diagram, speed, word size, memory capacity, classification of microprocessors (mention different microprocessors being used)

Microprocessor 8085: Features, architecture -block diagram, internal registers, register pairs, flags, stack pointer, program counter, types of buses. Multiplexed address and data bus, generation of control signals, pin description of microprocessor 8085.

8085 Instructions-Operation code, Operand & Mnemonics. Instruction set of 8085, instruction classification, addressing modes, instruction format. Data transfer instructions, arithmetic

instructions, increment & decrement instructions, logical instructions, branch instructions and machine control instructions.

23) Stack operations and Microprocessor Programming

Stack operations, subroutine calls and return operations. Delay loops, use of counters, timing diagrams-instruction cycle, machine cycle, T- states, time delay-numerical examples.

Programs for data transfer and memory operations (direct & indirect addressing), addition and subtraction of two 8-bit & 16- bit numbers, multiplication, display of smallest / largest number in a given array of numbers, sorting of numbers in descending / ascending order. Number of 1's and 0's in a given byte, testing for zero condition. 1's and 2's complements. Verification of truth tables of logic gates, program to add two N byte numbers, program to generate Fibonacci series up to the limit, program to find the factorial of a number, program to find the GCD of two integer numbers.

24) I/O instructions and Interfacing

I/O instructions and, interrupts in 8085. Basic interfacing concepts, compatible ICs of □P 8085, data transfer, synchronous I/O data transfer using interrupts. Memory interfacing – address decoding, interfacing RAM and ROM. Interfacings I/O devices– input port, output port, IN & OUT instructions, interfacing input devices (interfacing matrix key board-block diagram), interfacing output devices (LED display interfacing-block diagram). PPI IC 8255– features, pin diagram, functional block diagram, ports & their modes.

25) Measurement systems, Transducers & Electronic Instrumentation

Introduction to general measurement system – characteristics - definition –static & dynamic, Transducers, types – resistive, capacitive and inductive transducers, strain gauge, LVDT (variable inductive transducers) temperature transducers- thermo couple, thermistors – ultrasonic temperature transducer, photoelectric transducers, pressure transducers-MIC and and loud speaker, signal conditioning (concept only), amplifier – chopper amplifier –carrier amplifier - lock in amplifier

26) Introduction to Bio-medical instruments

Origin of bio-electric signals, resting & action potential – propagation, physiological transducers – active & passive transducer for medical application – diagnostic & analytical equipments -electrodes for ECG, EEG, and EMG, block diagram of ECG and EEG systems.

COMMUNICATION-II

27) Digital communication

Introduction to pulse and digital communications, digital radio, sampling theorem, types- PAM, PWM, PPM, PCM – quantization, advantages and applications, digital modulations (FSK, PSK, and ASK). Advantage and disadvantages of digital transmission, characteristics of data transmission circuits – Shannon limit for information capacity, bandwidth requirements, data transmission speed, noise, cross talk, echo suppressors, distortion and equalizer, MODEM– modes, classification, interfacing (RS232).

28) RADAR Systems

RADAR– principles, frequencies and powers used in RADAR, maximum Unambiguous range, detailed block diagram of pulsed RADAR system, RADAR range equation-derivation, factors influencing maximum range, effect of ground on RADAR antenna characteristics, Doppler effect, MTI RADAR-block diagram, CW RADAR-block diagram, advantages, applications and limitations, FM CW RADAR-block diagram, numerical examples wherever applicable.

29) Satellite communication

Introduction, need, satellite orbits, advantages and disadvantages of geostationary satellites. Satellite visibility, satellite system – space segment, block diagrams of satellite sub systems, up link, down link, cross link, transponders (C- Band), effect of solar eclipse, path loss, ground station, simplified

block diagram of earth station. Satellite access – TDMA, FDMA, CDMA concepts, comparison of TDMA and FDMA, Satellite antenna (parabolic dish antenna), GPS-services like SPS & PPS.

30) Optical Fiber Communication

Introduction – need for OFC. Block diagram of OFC system. Fiber optic cables, light propagation through fiber – step index fiber, graded index fiber, Snell's law, numerical aperture (derivation). Types of optical fiber cables, light sources – requirements, LEDs and semiconductor laser diodes. Photo detectors – PN, PIN and avalanche photodiodes. Losses in optical fibers – Rayleigh scattering, absorption, leaky modes, bending, joint junction losses. Advantages and disadvantages of OFC over metallic cables.

31) Cellular Communication and Wireless LANs

Concept of cellular mobile communication – cell and cell splitting, frequency bands used in cellular communication, absolute RF channel numbers (ARFCN), frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram) of cellular mobile communication network, CDMA technology, CDMA overview, simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3G and 4G concepts. Major components of local area network- Primary characteristics of ethernet-mobile IP, OSI model, wireless LAN requirements-concept of Bluetooth, WiFi and WiMAX.

MICROCONTROLLERS

32) Introduction to Microcontrollers

Basic block diagram, comparison of microcontroller with microprocessors, comparison of 8 bit, 16 bit and 32 bit microcontrollers. Overview of 8051 series–comparison of 8051, 8052, 8031.

Other Microcontroller families (Mention only) – Maxim 89C420, 89C440, 89C450

Atmel Corporation AT89C51, AT 89LV51, AT89C1051, AT89C2051, AT89C52.

MICROCONTROLLER 8051- architecture -internal block diagram, key features of 8051, pin diagram, memory organization, Internal RAM memory, Internal ROM. General purpose data memory, special purpose/function registers, external memory.

Counters and timers – 8051 oscillator and clock, program counter, TCON, TMOD, timer counter interrupts, timer modes of operation. Input / output ports and circuits/ configurations, serial data input / output – SCON, PCON, serial data transmission modes.

33) 8051- Interrupts, Addressing modes and Instruction set

Interrupts – IE, IP, time flag interrupts, serial port interrupt, external interrupts, reset, interrupt control, interrupt priority, interrupt destinations & software generated interrupts.

Addressing modes–immediate addressing, register addressing, direct and indirect addressing,

Data transfer instructions – internal data move, external data move, code memory read-only data move, Push and Pop and data exchange instructions.

Logical Instructions – byte level logical operations, bit level logical operations, rotate and swap operations.

Arithmetic Instructions – flags, incrementing and decrementing, addition, subtraction, multiplication and division, decimal arithmetic, simple programs in assembly language.

34) Interfacing with 8051

Basic interfacing concepts and interrupts, Programming8051 interrupts, programming Timer interrupts, programming the external hardware interrupts.

Schematic diagrams and basic concepts of Interfacing of 8051 to keyboard, seven segment display, stepper motor, DAC, ADC and traffic light controller circuits.

35) PIC microcontrollers

Core features of PIC microcontrollers, overview of various PIC microcontroller series.

PIC 16F877A-features, pin diagram, I/O ports, interfacing with LCD

Syllabus B.Sc. Physics

1) Mechanics and Properties of Matter:

a)Newton's law of motion: Force – Mass – Momentum and Impulse, Law of Conservation of Linear Momentum – Collision – Elastic and Inelastic collision – Newton□s law of impact. Coefficient of restitution – Impact of moving sphere on a fixed plane – Direct and Oblique impact of moving two smooth spheres – Calculation of final velocities – Laws of Kinetic energy – Projectile motion – Frictional forces – Center of mass of solid objects – Conservation of Momentum in a system of particles.

b) Dynamics of a System of Particles: Centre of Mass. Conservation of Momentum. Idea of Conservation of Momentum from Newton's Third Law. Impulse. Momentum of Variable Mass System : Motion of Rocket. Work and Energy Theorem :- Work and Kinetic Energy Theorem. Conservative and NonConservative Forces. Potential Energy. Energy Diagram. Stable and Unstable Equilibrium. Gravitational Potential Energy. Elastic Potential Energy. Force as Gradient of Potential Energy. Work and Potential energy. Work done by Non-conservative Forces. Law of Conservation of Energy.

c) Gravitation – Newton□s law of gravitation – kepler□s law of planetary motion – Mass of earth – Gravitational field and potential at a point inside and outside a spherical shell – Mass and density of earth – Determination of G (Boy□s method) – Variation of „g□ with altitude, depth and latitude- Earthquake – seismograph – modern application of seismology – Satellites – Orbital velocity – Escape velocity – Stationary satellite – Jet plane – Rocket – Principle, theory – Velocity of rocket at any instant – Rocket propulsion systems – specific impulse – multistage rocket – Shape of the rocket.

d) Modulus of rigidity, Poisson's ratio, relation connecting different elastic- constants, twisting couple of a cylinder(solid and hallow), Statical method (Barton's method), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever (neglecting mass), Young modulus by bending of beam, Viscosity, Poiseulle's equation of liquid flow through a narrow tube, Damped harmonic oscillations, Compound pendulum, Ballistic galvanometer.

e) Fluids – Flow of a Fluid – Rate of flow – Vicosity – Coefficient of Viscosity – Critical velocity – Laminar and Vortex flow – Poiseuille equation for flow of liquid through a tube – Experimental determination of „ □ - Poiseuille□s method and Stoke□s method – Ostwald Viscometer – Determination of Viscosity of gases – Rankine□s method for the determination of Viscosity of a gas – Surface tension – Free energy of a surface and surface tension – Excess pressure inside a liquid drop and inside a soap bubble – Work done in blowing a bubble – Angle of contact – Capillary rise – Experimental determination of surface tension by capillary *rise – Pitot tube and Venturi meter – Bernoullie□s theorem.*

2) Thermal Physics and Acoustics

a) Isothermal and adiabatic changes. Definition – Specific heat capacity (Cv and Cp) – derivation of equations for both Cv and Cp of gas – relation between Cp and Cv. Calorimetry –

Joly's differential steam calorimeter for finding Cv –Callender and Barnes continuous flow method to determine Cp.

b) Kinetic theory of gases – Mean free path –Transport phenomena –diffusion, viscosity and thermal conductivity. Maxwell□s law of distribution of molecular velocities (no derivation) – expression for mean velocity, mean square velocity, most probable velocity – experimental verification by toothed wheel method. Degrees of freedom – Law of equipartition of energy – Liquefaction of gases –Liquefaction of air by Linde□s method – properties of Helium I and Helium II – Adiabatic demagnetization.

c) Transmission of heat – thermal conductivity –thermal diffusivity. Rectilinear flow of heat – Ingen Hausz experiment – Lees□ disc method of determination of thermal conductivity of bad conductor. Radiation –Black body Radiation – Wien□s law, Rayleigh-Jeans law and Planck□s law (no derivation) –Stefan□s law and its experimental verification – solar constant and experimental determination

d) Zeroth first law of thermodynamics – Reversible and Irreversible process – Second law of thermodynamics – Carnot□s engine – derivation of efficiency – Carnot□s theorem – statement. Entropy –change of entropy in reversible and irreversible process – change of entropy in conversion of ice into steam. Third law of thermodynamics.

e) Probability –phase space – elements of phase space – microstate and macro state – probability distribution –fundamental postulates of statistical mechanics – entropy and probability – elementary ideas of Maxwell-Boltzmann, Fermi –Dirac and Bose –Einstein statistics.

f) Real gases : Behavior of Real Gases:- Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. p-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling.

3) OPTICS and Spectroscopy

a) Interference:Conditions for sustained interference, Theory of interference, Lloyd's mirror, Achromatic fringes. Interference in parallel and wedge shaped films, Colour of thin films. Newton's rings and Michelson interferometer and their applications. Multiple beam interference in parallel film and Fabry-Perot interferometer.

b) Michelson's Interferometer: (1) Idea of form of fringes (No Theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, (5) Standardization of Meter and (6) Visibility of Fringes.

c) Coherence: Temporal and Spatial Coherence. Theory of Partial Coherence. Coherence Time and Coherence Length. Purity of a Spectrum Line.

d) Diffraction:Fresnel's diffraction, Zone plate, diffraction due to straight edge. Fraunhofer diffraction due to single and double slits, plane transmission grating and its resolving power. Polarization: Polarized light and its mathematical representation, Production of polarized light by reflection, refraction and scattering. Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light. Optical activity and Fresnel's theory, Biquartzpolarimeter.

e) Fraunhofer diffraction: Diffraction due to (1) a Single Slit, (2) a Double Slit and (3) a Plane Transmission Grating. Rayleigh's criterion of resolution. Resolving Power and Dispersive Power of a Plane Diffraction Grating.

f) Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves.

g) Spectroscopy: Classification as line banded continuous spectra. Infrared Spectroscopy, Raman Effect,Basic concept of Raman spectroscopy- nuclear magnet resonance, nuclear Quadrapolar resonance, Mossbauer spectroscopy Electron Spin Resonance. Fiver optic

4) Electricity and Electromagnetism

a) Coulomb's law – Gauss law – Its proof and applications – Capacitance – Principle – Expressions for the capacitance. Dielectric Properties of Matter Dielectrics:- Electric Field in Matter. Dielectric Constant. Parallel Plate Capacitor with a Dielectric. Polarization, Polarization Charges and Polarization Vector. Electric Susceptibility. Gauss's law in Dielectrics. Displacement vector D. Relations between the three Electric Vectors. Capacitors filled with Dielectrics. Kirchoff's laws - Application to wheatstone's bridge – Sensitiveness of bridge – Carey Foster's bridge – Determination of the resistance – Theory – Principle of potentiometer – Determination of internal resistance of the cell using potentiometer – Calibration of ammeter and voltmeter – Low & high range – Seeback effect –Faraday's laws of Electrolysis - ionic velocities and mobilities. Calculation and experimental determination of ionic mobilities - transport number. Thermoelectricity- Peltier effect - Experimental determination of Peltier coefficient - Thomson coefficient – experimental determination of Thomson coefficient - application of thermodynamics to a thermocouple and connected relations - thermoelectric diagram and uses.

b) Growth and decay of current in a circuit containing resistance and inductance – growth and decay of charge in a circuit containing resistance and capacitor - growth and decay of charge in an LCR circuit - condition for the discharge to be oscillatory - frequency of oscillation - network analysis - Thevenin and Norton's Theorems.

c) AC Voltage and current - Power factor and current values in and AC circuit containing LCR circuit - series and Parallel resonant circuits - AC motors - single phase, three phase – star and delta connections - electric fuses - circuit breakers.

d) Biot and Savart's law - magnetic field intensity due to a solenoid carrying current – effect of iron core in a solenoid - Helmholtz galvanometer - moving coil ballistic galvanometer – theory - damping correction - determination of the absolute capacity of a condenser using B.G.

e) Faraday's laws of electromagnetic induction - inductor and inductance - determination of self-inductance of a coil using Anderson method - mutual inductance – experimental determination of absolute mutual inductance - coefficient of coupling - Earth inductor - uses of earth inductor - measurement of horizontal component of the earth's magnetic field measurement of vertical component of earth's magnetic field - calibration of B.G. – Induction coil and its uses

5) Classical and Quantum Mechanics:

a)Particles and Waves

Inadequacies in Classical Physics. Blackbody Radiation : Quantum Theory of Light.Photoelectric Effect. Compton Effect. Franck-Hertz experiment. Wave Nature of Matter :DeBroglie Hypothesis. Wave-Particle Duality. Davisson-Germer Experiment. Wave descriptionof Particles by Wave Packets. Group and Phase Velocities and Relation between them. TwoSlitExperiment with Electrons. Probability. Wave Amplitude and Wave Functions. Heisenberg's Uncertainty Principle (Uncertainty Relations involving Canonical Pair ofVariables) : Derivation from Wave Packets. γ-ray Microscope.

b) Quantum Mechanics

Basic Postulates and Formalism :- Energy, Momentum and Hamiltonian Operators.Time-independent Schrödinger Wave Equation for Stationary States. Properties of WaveFunction. Interpretation of Wave Function. Probability Density and Probability. Conditionsfor Physical Acceptability of Wave Functions. Normalization. Linearity and SuperpositionPrinciples. Eigenvalues and Eigenfunctions. Expectation Values. Wave Function of a FreeParticle.

c) Applications of Schrödinger Wave Equation:

Eigen Functions and Eigenvalues for a Particle in a One Dimensional Box. Bound State Problems: General Features of a Bound Particle System, (1) One DimensionalSimple Harmonic Oscillator : Energy Levels and Wave Functions. Zero Point Energy

d)Quantum Theory of Hydrogen Atom: Particle in a Spherically Symmetric Potential.Schrodinger Equation. Separation of Variables. Radial Solutions and Principal QuantumNumber, Orbital and Magnetic Quantum Numbers. Quantization of Energy and AngularMomentum. Space Quantization. Electron Probability Density. Radiative Transitions.Selection Rules.

e) Scattering Problems in One Dimension :- (1) Finite Potential Step : Reflection andTransmission. Stationary Solutions. Probability Current. Attractive and Repulsive PotentialBarriers. (2) Quantum Phenomenon of Tunneling : Tunnel Effect. Tunnel Diode (QualitativeDescription). (3) Finite Potential Well (Square Well).

6) Atomic and Nuclear physics

a) Introduction – Bohr atom model (no derivation) – application of Bohr's theory –Excitationand ionization of atoms. Sommer field relativistic atom model –Elliptical orbits –relativistic variation of atomic mass– application to the fine structure of spectral lines,vector atom model –spatial

quantization and spinning electron hypothesis –Stern andGerlach experiment –Quantum numbers –coupling schemes –Pauli's exclusion principles– electronic structure of atoms.

b) X rays –characteristics and continuous X ray –its prosperities- application – Duane and Hunt law –Mosley's law and its importance. Compton effect- theory and experimentalverification. Zeeman effect-theory and experiment – Anomalous Zeeman effect – starkeffect (Quantitative only)

c) Isotopes –isotones –isobars–Atomic mass unit –properties of the nucleus –nuclear binding energy –Nuclear forces –Yukawa's theory (no derivation).Models of Nuclear structure –Liquid drop model –Binding Energy formula – Shell Model –Collective Model.

d) Laws of radio activity –half life period –mean life –Radio carbon dating. α ray – range ofα particle – Geiger Nuttal law-experimental determination by Geiger Nuttal lawdisintegration energy – theory of α decay. β rays, β- rays spectra – origin-neutrino theoryof β decay-electron capture. □ rays- determination of wavelengths by diamond crystalspectrometer – origin of rays – internal conversion. Unit V Nuclear transmutations by α particles, protons, deuterons, neutrons and electrons –photo disintegration –nuclear fission –energy release. Nuclear fusion –Thermo nuclear reactionscontrolled thermo nuclear reaction. Principle and action of atom bomb and hydrogen bomb. Nuclear reactors –General features of nuclear reactors – different types of nuclear reactors – pressurized water reactor –boiling water reactor – fast breeder reactor.