CIPET: IPT - BHUBANESWAR - JEE 2024

SYLLABUS

B.Tech. (Plastic Engineering/Manufacturing & Engineering Technology)

Question Paper Pattern:

'Multiple Choice' type question

Total 100 Questions, Total marks: 100, Duration: 2 hours

A. Mathematics: 15 -30 Questions

B. Physics: 15-30 Questions

C. Chemistry: 15-30 Questions

D. English: 5-10 Questions

E. General Knowledge and Current Affairs: 10 -15 Questions

Syllabus:

A. MATHEMATICS

SETS, RELATIONS AND FUNCTIONS: Sets and their representation: Union, intersection and complement of sets and their algebraic properties; Power set; Relation, Type of relations, equivalence relations, functions; one-one, into and onto functions, the composition of functions.

COMPLEX NUMBERS AND QUADRATIC EQUATIONS: Complex numbers as ordered pairs of reals, Representation of complex numbers in the form a + ib and their representation in a plane, Argand diagram, algebra of complex number, modulus and argument (or amplitude) of a complex number, square root of a complex number, triangle inequality, Quadratic equations in real and complex number system and their solutions Relations between roots and coefficient, nature of roots, the formation of quadratic equations with given roots.

MATRICES AND DETERMINANTS: Matrices, algebra of matrices, type of matrices, determinants and matrices of order two and three, properties of determinants, evaluation of determinants, area of triangles using determinants, Adjoint and evaluation of inverse of a square matrix using determinants and elementary transformations, Test of consistency and solution of simultaneous linear equations in two or three variables using determinants and matrices.

PERMUTATIONS AND COMBINATIONS: The fundamental principle of counting, permutation as an arrangement and combination as section, Meaning of P (n,r) and C (n,r), simple applications.

MATHEMATICAL INDUCTIONS: Principle of Mathematical Induction and its simple applications.

BINOMIAL THEOREM AND ITS SIMPLE APPLICATIONS: Binomial theorem for a positive integral index, general term and middle term, properties of Binomial coefficients and simple applications.

SEQUENCE AND SERIES: Arithmetic and Geometric progressions, insertion of arithmetic, geometricmeans between two given numbers, Relation between A.M and G.M sum up to n terms of special series;Sn, Sn2, Sn3. Arithmetico-Geometric progression.

LIMIT, CONTINUITY AND DIFFERENTIABILITY: Real – valued functions, algebra of functions, polynomials, rational, trigonometric, logarithmic and exponential functions, inverse function. Graphs of simple

functions. Limits, continuity and differentiability. Differentiation of the sum, difference, product and quotient of two functions. Differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit functions; derivatives of order up to two, Rolle's and Lagrange's Mean value Theorems, Applications of derivatives: Rate of change of quantities, monotonic Increasing and decreasing functions, Maxima and minima of functions of one variable, tangents and normal.

INTEGRAL CALCULAS: Integral as an anti-derivative, Fundamental Integrals involving algebraic, trigonometric, exponential and logarithms functions. Integrations by substitution, by parts and by partial functions. Integration using trigonometric identities. Evaluation of simple integrals of the type ∫d/ 2+a2, ∫d/√ 2±a2, ∫d/a2−2, ∫d √a2− 2, ∫d/a2+b+c, ∫d/√a2+ b+c, ∫(p+q)d /a2+b+c,
∫(p+q)d√a2+b+c, ∫√a2 ± 2d, ∫√2− a2d Integral as limit of a sum. The fundamental theorem of calculus, properties of definite integrals. Evaluation of definite integrals, determining areas of the regions bounded by simple curves in standard form.

DIFFRENTIAL EQUATIONS: Ordinary differential equations, their order and degree, the formation of differential equations, solution of differential equation by the method of separation of variables,solution of a homogeneous and linear differential equation of the type dy/dx + p(x)y = q(x).

CO-ORDINATE GEOMETRY: Cartesian system of rectangular coordinates in a plane, distance formula, sections formula, locus and its equation, translation of axes, the slope of a line, parallel and perpendicular lines, intercepts of a line on the co-ordinate axis. Straight line Various forms of equations of a line, intersection of lines, angles between two lines, conditions for concurrence of three lines, the distance of a point form a line, equations of internal and external by sectors of angles between two lines coordinate of the centroid, orthocentre and circumcentre of a triangle, equation of the family of lines passing through the point of intersection of two lines. Circle, conic sections A standard form of equations of a circle, the general form of the equation of a circle, its radius and central, equation of a circle when the endpoints of a diameter are given, points of intersection of a line and a circle with the centre at the origin and condition for a lineto be tangent to a circle, equation of the tangent, sections of conics, equations of conic sections (parabola, ellipse and hyperbola) in standard forms, condition for Y = mx +c to be a tangent and point (s) of tangency.

THREE DIMENSIONAL GEOMETRY: Coordinates of a point in space, the distance between two points, section formula, directions ratios and direction cosines, the angle between two intersecting lines. Skew lines, the shortest distance between them and its equation. Equations of a line and a plane in different forms, the intersection of a line and a plane, coplanar lines.

VECTOR ALGEBRA: Vectors and scalars, the addition of vectors, components of a vector in two dimensions and three-dimensional space, scalar and vector products, scalar and vector triple product.

STATISTICS AND PROBABILITY: Measures of discretion; calculation of mean, median, mode of grouped and ungrouped data calculation of standard deviation, variance and mean deviation for grouped and ungrouped data. Probability: Probability of an event, addition and multiplication theorems of probability, Baye's theorem, probability distribution of a random variate, Bernoulli trials and binomial distribution.

TRIGONOMETRY: Trigonometrical identities and equations, trigonometrical functions, inverse trigonometrical functions and their properties, heights and distance.

MATHEMATICAL REASONING: Statement logical operations and, or, implies, implied by, if and only if, understanding of tautology, contradiction, converse and contrapositive.

B. PHYSICS

PHYSICS AND MEASUREMENT: Physics, technology and society, S I Units, fundamental and derived units, least count, accuracy and precision of measuring instruments, Errors in measurement, Dimensions of Physics quantities, dimensional analysis and its applications.

KINEMATICS: The frame of reference, motion in a straight line, Position- time graph, speed and velocity; Uniform and non-uniform motion, average speed and instantaneous velocity, uniformly accelerated

motion, velocity- time, position-time graph, relations for uniformly accelerated motion, Scalars and Vectors, Vector.

Addition and subtraction, zero vector, scalar and vector products, Unit Vector, Resolution of a Vector. Relative Velocity, Motion in a plane, Projectile Motion, Uniform Circular Motion.

LAWS OF MOTION: Force and inertia, Newton's First law of motion; Momentum, Newton's Second Law of motion, Impulses;Newton's Third Law of motion. Law of conservation of linear momentum and its applications. Equilibrium of concurrent forces. Static and Kinetic friction, laws of friction, rolling friction. Dynamics of uniform circular motion: centripetal force and its applications.

WORK, ENERGY AND POWER: Work done by a content force and a variable force; kinetic and potential energies, work-energy theorem, power. The potential energy of spring conservation of mechanical energy, conservative and neoconservative forces; Elastic and inelastic collisions in one and two dimensions.

ROTATIONAL MOTION: Centre of the mass of a two-particle system, Centre of the mass of a rigid body; Basic concepts of rotational motion; a moment of a force; torque, angular momentum, conservation of angular momentum and its applications; the moment of inertia, the radius of gyration. Values of moments of inertia for simple geometrical objects, parallel and perpendicular axes theorems and their applications. Rigid body rotation equations of rotational motion.

GRAVITATION: The universal law of gravitation. Acceleration due to gravity and its variation withaltitude and depth. Kepler's law of planetary motion. Gravitational potential energy; gravitational potential. Escape velocity, Orbital velocity of a satellite. Geo stationary satellites.

PROPERTIES OF SOLIDS AND LIQUIDS: Elastic behaviour, Stress-strain relationship, Hooke's Law. Young's modulus, bulk modulus, modulus of rigidity. Pressure due to a fluid column; Pascal's law and its applications. Viscosity. Stokes' law. terminal velocity, streamline and turbulent flow. Reynolds number. Bernoulli's principle and its applications. Surface energy and surface tension, angle of contact, application of surface tension - drops, bubbles and capillary rise. Heat, temperature, thermal expansion; specific heat capacity, calorimetry; change of state, latent heat. Heat transfer-conduction, convection and radiation. Newton's law of cooling.

THERMODYNAMICS: Thermal equilibrium, zeroth law of thermodynamics, the concept of temperature. Heat, work and internal energy. The first law of thermodynamics. The second law of thermodynamics: reversible and irreversible processes. Carnot engine and its efficiency.

KINETIC THEORY OF GASES: Equation of state of a perfect gas, work done on compressing a gas,Kinetic theory of gases - assumptions, the concept of pressure. Kinetic energy and temperature: RMS speed of gas molecules: Degrees of freedom. Law of equipartition of energy, applications to specific heat capacities of gases; Mean free path. Avogadro's number.

OSCILLATIONS AND WAVES: Periodic motion - period, frequency, displacement as a function of time. Periodic functions. Simple harmonic motion (S.H.M.) and its equation; phase: oscillations of a spring - restoring force and force constant: energy in S.H.M. - Kinetic and potential energies; Simple pendulum - derivation of expression for its time period: Free, forced and damped oscillations, resonance. Wave motion. Longitudinal and transverse waves, speed of a wave. Displacement relation for a progressive wave. Principle of superposition of waves, a reflection of waves. Standing waves in strings and organ pipes, fundamental mode and harmonics. Beats. Doppler Effect in sound.

ELECTROSTATICS: Electric charges: Conservation of charge. Coulomb's law-forces between two point charges, forces between multiple charges: superposition principle and continuous charge distribution. Electric field: Electric field due to a point charge, Electric field lines. Electric dipole, Electric field due to a dipole. Torque on a dipole in a uniform electric field. Electric flux. Gauss's law and its applications to find field due to infinitely long uniformly charged straight wire, uniformly charged infiniteplane sheet and uniformly charged thin spherical shell. Electric potential and its calculation for a point charge, electric dipole and system of charges; Equipotential surfaces, Electrical potential energy of a system of two point charges in an electrostatic field. Conductors and insulators. Dielectrics and electric polarization, capacitor, the combination of capacitors in series and parallel, capacitance of a parallelplate capacitor with and without dielectric medium between the plates. Energy stored in a capacitor.

CURRENT ELECTRICITY: Electric current. Drift velocity. Ohm's law. Electrical resistance. Resistances of different materials. V-I characteristics of Ohmic and non-ohmic conductors. Electrical energy and power. Electrical resistivity. Colour code for resistors; Series and parallel combinations of resistors; Temperature dependence of resistance. Electric Cell and its Internal resistance, potential difference and emf of a cell, a combination of cells in series and parallel. Kirchhoff's laws and their applications. Wheatstone bridge. Metre Bridge. Potentiometer - principle and its applications.

MAGNETIC EFFECTS OF CURRENT AND MAGNETISM: Biot - Savart law and its application to current carrying circular loop. Ampere's law and its applications to infinitely long current carryingstraight wire and solenoid. Force on a moving charge in uniform magnetic and electric fields. Cyclotron. Force on a current-carrying conductor in a uniform magnetic field. The force between two parallel current carrying conductors definition of ampere. Torque experienced by a current loop in a uniform magnetic field: Moving coil galvanometer, its current sensitivity and conversion to ammeter and voltmeter. Current loop as a magnetic dipole and its magnetic dipole moment. Bar magnet as anequivalent solenoid, magnetic field lines; Earth's magnetic field and magnetic elements. Para-, dia- and ferromagnetic substances. Magnetic susceptibility and permeability. Hysteresis. Electromagnets and permanent magnets.

ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENTS: Electromagnetic induction:Faraday's law. Induced emf and current: Lenz's Law, Eddy currents. Self and mutual inductance. Alternating currents, peak and RMS value of alternating current/ voltage: reactance and impedance: LCR series circuit, resonance: Quality factor, power in AC circuits, wattless current. AC generator and transformer.

ELECTROMAGNETIC WAVES: Electromagnetic waves and their characteristics, Transverse nature of electromagnetic waves, Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet. X-rays. Gamma rays), Applications of e.m. waves.

OPTICS: Reflection and refraction of light at plane and spherical surfaces, mirror formula. Total internal reflection and its applications. Deviation and Dispersion of light by a; prism; Lens Formula. Magnification. Power of a Lens. Combination of thin lenses in contact. Microscope and Astronomical Telescope (reflecting and refracting) and their magnifying powers. Wave optics: wave front and Huygens' principle. Laws of reflection and refraction using Huygens principle. Interference, Young's
double-slit experiment and expression for fringe width, coherent sources and sustained interference of light. Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and astronomical telescopes. Polarization, plane-polarized light: Brewster's law, uses of plane-polarized light and Polaroid.

DUAL NATURE OF MATTER AND RADIATION: Dual nature of radiation. Photoelectric effect. Hertz and Lenard's observations; Einstein's photoelectric equation: particle nature of light. Matter waves-wave nature of particle, de Broglie relation. DavissonGermer experiment.

ATOMS AND NUCLEI: Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, atomic masses, isotopes, isobars: isotones. Radioactivity- alpha. beta and gamma particles/rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number, nuclear fission and fusion.

ELECTRONIC DEVICES: Semiconductors; semiconductor diode: 1- V characteristics in forward and reverse bias; diode as a rectifier; I-V characteristics of LED. the photodiode, solar cell and Zener diode; Zener diode as a voltage regulator. Junction transistor, transistor action, characteristics of a transistor: transistor as an amplifier (common emitter configuration) and oscillator. Logic gates (OR. AND. NOT. NAND and NOR). Transistor as a switch.

COMMUNICATION SYSTEMS: Propagation of electromagnetic waves in the atmosphere; Sky and space wave propagation. Need for modulation. Amplitude and Frequency Modulation, Bandwidth ofsignals. the bandwidth of Transmission medium, Basic Elements of a Communication System (Block Diagram only).

C. CHEMISTRY

a) PHYSICAL CHEMISTRY

SOME BASIC CONCEPTS IN CHEMISTRY: Matter and its nature, Dalton's atomic theory: Concept of atom, molecule, element and compound: Physical quantities and their measurements in Chemistry, precision and accuracy, significant figures. S.I.Units, dimensional analysis: Laws of chemical combination;Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae: Chemical equations and stoichiometry.

STATES OF MATTER: Classification of matter into solid, liquid and gaseous states. Gaseous State: Measurable properties of gases: Gas laws - Boyle's law, Charle's law. Graham's law of diffusion. Avogadro's law, Dalton's law of partial pressure; Concept of Absolute scale of temperature; Ideal gas equation; Kinetic theory of gases (only postulates); Concept of average, root mean square and most probable velocities; Real gases, deviation from Ideal behaviour, compressibility factor and van der Waals equation. Liquid State: Properties of liquids - vapour pressure, viscosity and surface tension and effect of temperature on them (qualitative treatment only). Solid State: Classification of solids: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea); Bragg's Law and its applications: Unit cell and lattices, packing in solids (fcc, bcc and hcp lattices), voids, calculations involving unit cell parameters, an imperfection in solids; Electrical and magnetic properties.

ATOMIC STRUCTURE: Thomson and Rutherford atomic models and their limitations; Nature of electromagnetic radiation, photoelectric effect; Spectrum of the hydrogen atom. Bohr model of a hydrogen atom - its postulates, derivation of the relations for the energy of the electron and radii of the different orbits, limitations of Bohr's model; Dual nature of matter, de Broglie's relationship. Heisenberg uncertainty principle. Elementary ideas of quantum mechanics, quantum mechanics, the quantum mechanical model of the atom, its important features. Concept of atomic orbitals as one-electron wave functions: Variation of Ψ and $\Psi 2$ with r for 1s and 2s orbitals; various quantum numbers (principal, angular momentum and magnetic quantum numbers) and their significance; shapes of s, p and d - orbitals, electron spin and spin quantum number: Rules for filling electrons in orbitals – Aufbau principle. Pauli's exclusion principle and Hund's rule, electronic configuration of elements, extra stability of half-filled and completely filled orbitals.

CHEMICAL BONDING AND MOLECULAR STRUCTURE: Kossel - Lewis approach to chemical bond formation, the concept of ionic and covalent bonds. Ionic Bonding: Formation of ionic bonds, factors affecting the formation of ionic bonds; calculation of lattice enthalpy. Covalent Bonding: Concept of electronegativity. Fajan's rule, dipole moment: Valence Shell Electron Pair Repulsion (VSEPR) theory and shapes of simple molecules. Quantum mechanical approach to covalent bonding: Valence bond theory - its important features, the concept of hybridization involving s, p and d orbitals; Resonance. Molecular Orbital Theory - Its important features. LCAOs, types of molecular orbitals (bonding, antibonding), sigma and pi-bonds, molecular orbital electronic configurations of homonuclear diatomic molecules, the concept of bond order, bond length and bond energy. Elementary idea of metallic bonding. Hydrogen bonding and its applications.

CHEMICAL THERMODYNAMICS: Fundamentals of thermodynamics: System and surroundings, extensive and intensive properties, state functions, types of processes. The first law of thermodynamics
- Concept of work, heat internal energy and enthalpy, heat capacity, molar heat capacity; Hess's law of constant heat summation; Enthalpies of bond dissociation, combustion, formation, atomization, sublimation, phase transition, hydration, ionization and solution. The second law of thermodynamics - Spontaneity of processes; ΔS of the universe and ΔG of the system as criteria for spontaneity. ΔG° (Standard Gibbs energy change) and equilibrium constant.

SOLUTIONS: Different methods for expressing the concentration of solution - molality, molarity, mole fraction, percentage (by volume and mass both), the vapour pressure of solutions and Raoult's Law - Ideal and non-ideal solutions, vapour pressure - composition, plots for ideal and non-ideal solutions; Colligative properties of dilute solutions - a relative lowering of vapour pressure, depression of freezing point, the elevation of boiling point and osmotic pressure; Determination of molecular mass using colligative properties; Abnormal value of molar mass, van't Hoff factor and its significance.

EQUILIBRIUM: Meaning of equilibrium, the concept of dynamic equilibrium. Equilibria involving physical processes: Solid-liquid, liquid - gas and solid-gas equilibria, Henry's law. General characteristics of equilibrium involving physical processes. Equilibrium involving chemical processes: Law of chemical equilibrium, equilibrium constants (Kp and Kc) and their significance, the significance of ΔG and ΔG° in chemical equilibrium, factors affecting equilibrium concentration, pressure, temperature, the effect of catalyst; Le Chatelier's principle. Ionic equilibrium: Weak and strong electrolytes, ionization of electrolytes, various concepts of acids and bases (Arrhenius. Bronsted - Lowry and Lewis) and their ionization, acid-base equilibria (including multistage ionization) and ionization constants, ionization of water. pH scale, common ion effect, hydrolysis of salts and pH of their solutions, the solubility of sparingly soluble salts and solubility products, buffer solutions.

REDOX REACTIONS AND ELECTROCHEMISTRY: Electronic concepts of oxidation and reduction, redox reactions, oxidation number, rules for assigning oxidation number, balancing of redox reactions. Electrolytic and metallic conduction, conductance in electrolytic solutions, molar conductivities and their variation with concentration: Kohlrausch's law and its applications. Electrochemical cells - Electrolytic and Galvanic cells, different types of electrodes, electrode potentials including standard electrode potential, half - cell and cell reactions, emf of a Galvanic cell and its measurement: Nernst equation and its applications; Relationship between cell potential and Gibbs' energy change: Dry cell and lead accumulator; Fuel cells.

CHEMICAL KINETICS: Rate of a chemical reaction, factors affecting the rate of reactions: concentration, temperature, pressure and catalyst; elementary and complex reactions, order and molecularity of reactions, rate law, rate constant and its units, differential and integral forms of zero and first-order reactions, their characteristics and half-lives, the effect of temperature on the rate of reactions, Arrhenius theory, activation energy and its calculation, collision theory of bimolecular gaseous reactions (no derivation).

SURFACE CHEMISTRY: Adsorption- Physisorption and chemisorption and their characteristics, factors affecting adsorption of gases on solids - Freundlich and Langmuir adsorption isotherms, adsorption from solutions. Catalysis - Homogeneous and heterogeneous, activity and selectivity of solid catalysts, enzyme catalysis and its mechanism. Colloidal state- distinction among true solutions, colloids and suspensions, classification of colloids - lyophilic. lyophobic; multimolecular. macromolecular and associated colloids (micelles), preparation and properties of colloids - Tyndall effect. Brownian movement, electrophoresis, dialysis, coagulation and flocculation: Emulsions and their characteristics.

b) INORGANIC CHEMISTRY

CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES: Modem periodic law and present form of the periodic table, s, p. d and f block elements, periodic trends in properties of elements atomic and ionic radii, ionization enthalpy, electron gain enthalpy, valence, oxidation states and chemical reactivity.

GENERAL PRINCIPLES AND PROCESSES OF ISOLATION OF METALS: Modes of occurrence of elements in nature, minerals, ores; Steps involved in the extraction of metals - concentration, reduction (chemical and electrolytic methods) and refining with special reference to the extraction of Al. Cu, Zn, and Fe;

Thermodynamic and electrochemical principles involved in the extraction of metals.

HYDROGEN: Position of hydrogen in periodic table, isotopes, preparation, properties and uses of hydrogen; Physical and chemical properties of water and heavy water; Structure, preparation, reactions and uses of hydrogen peroxide; Classification of hydrides - ionic, covalent and interstitial; Hydrogen as a fuel.

S -BLOCK ELEMENTS (ALKALI AND ALKALINE EARTH METALS): Group -1 and 2 Elements General introduction, electronic configuration and general trends in physical and chemical properties of elements, anomalous properties of the first element of each group, diagonal relationships. Preparation and properties of some important compounds - sodium carbonate and sodium hydroxide and sodium hydrogen carbonate; Industrial uses of lime, limestone. Plaster of Paris and cement: Biological significance of Na, K. Mg and Ca.

P- BLOCK ELEMENTS: Group -13 to Group 18 Elements General Introduction: Electronic configuration and general trends in physical and chemical properties of elements across the periods and down the groups; unique behaviour of the first element in each group. Group wise study of the p - block elements Group - 13 Preparation, properties and uses of boron and aluminium; Structure, properties anduses of borax, boric acid, diborane, boron trifluoride, aluminium chloride and alums. Group -14 The tendency for catenation; Structure, properties and uses of Allotropes and oxides of carbon, silicon tetrachloride, silicates, zeolites and silicones. Group -15 Properties and uses of nitrogen and phosphorus; Allotrophic forms of phosphorus; Preparation, properties, structure and uses of ammonia, nitric acid, phosphine and phosphorus halides, (PCl_3. PCl_5); Structures of oxides and oxoacids of nitrogen and phosphorus. Group -16 Preparation, properties, structures and uses of ozone: Allotropic forms of sulphur; Preparation, properties, structures and uses of sulphuric acid (including its industrial preparation); Structures of oxoacids of sulphur. Group-17 Preparation, properties and uses of hydrochloric acid; Trends in the acidic nature of hydrogen halides; Structures of Interhalogen compounds and oxides and oxoacids of halogens. Group-18 Occurrence and uses of noble gases; Structures of fluorides and oxides of xenon.

d - and f- BLOCK ELEMENTS: Transition Elements General introduction, electronicconfiguration, occurrence and characteristics, general trends in properties of the first-row transition elements - physical properties, ionization enthalpy, oxidation states, atomic radii, colour, catalytic behaviour, magnetic properties, complex formation, interstitial compounds, alloy formation; Preparation, properties and uses of $K_2Cr_2O_7$, and $KMnO_4$. Inner Transition Elements Lanthanoids - Electronic configuration, oxidation states and lanthanoid contraction.Actinoids - Electronic configuration and oxidation states.

CO-ORDINATION COMPOUNDS: Introduction to co-ordination compounds. Werner's theory; ligands, co-ordination number, denticity. chelation; IUPAC nomenclature of mononuclear co--ordinationcompounds, isomerism; Bonding-Valence bond approach and basic ideas of Crystal field theory, colour and magnetic properties; Importance of co- ordination compounds (in qualitative analysis, extraction of metals and in biological systems).

ENVIRONMENTAL CHEMISTRY: Environmental pollution - Atmospheric, water and soil. Atmospheric pollution - Tropospheric and Stratospheric Tropospheric pollutants - Gaseous pollutants: Oxides of carbon, nitrogen and sulphur, hydrocarbons; their sources, harmful effects and prevention; Greenhouse effect and Global warming: Acid rain; Particulate pollutants: Smoke, dust, smog, fumes, mist; their sources, harmful effects and prevention. Stratospheric pollution- Formation and breakdown of ozone, depletion of the ozone layer - its mechanism and effects. Water Pollution - Major pollutants such as. pathogens, organic wastes and chemical pollutants; their harmful effects and prevention. Soil pollution - Major pollutants such as; Pesticides (insecticides. herbicides and fungicides), their harmful effects and prevention. Strategies to control environmental pollution.

C) ORGANIC CHEMISTRY

PURIFICATION AND CHARACTERISATION OF ORGANIC COMPOUNDS: Purification -Crystallization, sublimation, distillation, differential extraction and chromatography - principles and their applications. Qualitative analysis - Detection of nitrogen, sulphur, phosphorus and halogens. Quantitative analysis (basic principles only) - Estimation of carbon, hydrogen, nitrogen, halogens, sulphur, phosphorus. Calculations of empirical formulae and molecular formulae: Numerical problems inorganic quantitative analysis.

SOME BASIC PRINCIPLES OF ORGANIC CHEMISTRY: Tetravalency of carbon: Shapes of simple molecules - hybridization (s and p): Classification of organic compounds based on functional groups: and those containing halogens, oxygen, nitrogen and sulphur; Homologous series: Isomerism - structural and stereoisomerism. Nomenclature (Trivial and IUPAC) Covalent bond fission - Homolytic and heterolytic: free radicals, carbocations and carbanions; stability of carbocations and free radicals, electrophiles and nucleophiles. Electronic displacement in a covalent bond - Inductive effect, electromeric effect, resonance and hyperconjugation. Common types of organic reactionsSubstitution, addition, elimination and rearrangement.

HYDROCARBONS: Classification, isomerism, IUPAC nomenclature, general methods of preparation, properties and reactions. Alkanes - Conformations: Sawhorse and Newman projections (of ethane): Mechanism of halogenation of alkanes. Alkenes - Geometrical isomerism: Mechanism of electrophilic addition: addition of hydrogen, halogens, water, hydrogen halides (Markownikoffs and peroxide effect): Ozonolysis and polymerization. Alkynes - Acidic character: Addition of hydrogen, halogens, water and hydrogen halides: Polymerization. Aromatic hydrocarbons - Nomenclature, benzene - structure and aromaticity: Mechanism of electrophilic substitution: halogenation, nitration. Friedel - Craft's alkylation and acylation, directive influence of the functional group in mono-substituted benzene.

ORGANIC COMPOUNDS CONTAINING HALOGENS: General methods of preparation, properties and reactions; Nature of C-X bond; Mechanisms of substitution reactions. Uses; Environmental effects of chloroform, iodoform freons and DDT.

UNIT 23: ORGANIC COMPOUNDS CONTAINING OXYGEN: General methods of preparation, properties, reactions and uses. ALCOHOLS, PHENOLS AND ETHERS Alcohols: Identification of primary, secondary and tertiary alcohols: mechanism of dehydration. Phenols: Acidic nature, electrophilic substitution reactions: halogenation. nitration and sulphonation. Reimer - Tiemann reaction. Ethers: Structure.Aldehyde and Ketones: Nature of carbonyl group; Nucleophilic addition to >C=O group, relative reactivities of aldehydes and ketones; Important reactions such as - Nucleophilic addition reactions (addition of HCN. NH3, and its derivatives), Grignard reagent; oxidation: reduction (Wolf Kishner and Clemmensen); the acidity of α-hydrogen. aldol condensation, Cannizzaro reaction. Haloform reaction, Chemical tests to distinguish between aldehydes and Ketones. Carboxylic Acids Acidic strength and factors affecting it,

ORGANIC COMPOUNDS CONTAINING NITROGEN: General methods of preparation. Properties, reactions and uses. Amines: Nomenclature, classification structure, basic character and identification of primary, secondary and tertiary amines and their basic character. Diazonium Salts: Importance in synthetic organic chemistry.

POLYMERS: General introduction and classification of polymers, general methods of polymerization, - Addition and condensation, copolymerization. Natural and synthetic, rubber and vulcanization, some important polymers with emphasis on their monomers and uses – polythene, nylon, polyester and bakelite.

BIOMOLECULES: General introduction and importance of biomolecules. CARBOHYDRATES - Classification;

aldoses and ketoses: monosaccharides (glucose and fructose) and constituent monosaccharides of oligosaccharides (sucrose, lactose and maltose). PROTEINS - Elementary Idea of α-amino acids, peptide bond, polypeptides. Proteins: primary, secondary, tertiary and quaternary structure (qualitative idea only), denaturation of proteins, enzymes. VITAMINS – Classification and functions. NUCLEIC ACIDS – Chemical constitution of DNA and RNA. Biological functions of nucleic acids.

CHEMISTRY IN EVERYDAY LIFE: Chemicals in Medicines - Analgesics, tranquillizers, antiseptics, disinfectants, antimicrobials, anti-fertility drugs, antibiotics, antacids. Anti-histamines - their meaning and common examples. Chemicals in food - Preservatives, artificial sweetening agents - common examples. Cleansing Agents - Soaps and detergents, cleansing action.

PRINCIPLES RELATED TO PRACTICAL CHEMISTRY: Detection of extra elements (Nitrogen, Sulphur, halogens) in organic compounds; Detection of the following functional groups; hydroxyl (alcoholic and phenolic), carbonyl (aldehyde and ketones) carboxyl and amino groups in organic compounds. • The chemistry involved in the preparation of the following: Inorganic compounds; Mohr's salt, potash alum. Organic compounds: Acetanilide, p-nitro acetanilide, aniline yellow, iodoform. • The chemistry involved in the titrimetric exercises – Acids, bases and the use of indicators, oxalic-acid vs $KMnO_4$, Mohr's salt vs $KMnO_4$ • Chemical principles involved in the qualitative salt analysts: Cations – Pb^{2+}, Cu^{2+}, Al^{3+}, Fe^{3+}, Zn^{2+}, Ni^{2+} , Ca^{2+}, Ba^{2+}, Mg^{2+}, NH^{4+} Anions- CO_3^{2-}, S^{2-} ,SO_4^{2-}, NO^{3-} , NO^{2-}, Cl^- , Br^- ,I^- (Insoluble salts excluded).

Chemical principles involved in the following experiments: 1. Enthalpy of solution of $CuSO_4$ 2. Enthalpy of neutralization of strong acid and strong base 3. Preparation of lyophilic and lyophobic sols. 4. Kinetic study of the reaction of iodide ion with hydrogen peroxide at room temperature

D. ENGLISH

Grammar Verbal Reasoning, Synonyms, Antonyms, Plurals, Sentence Completion.

B.Tech (Lateral Entry for B.Sc. students)

Question Paper Pattern:

'Multiple Choice' type question

Total 100 Questions, Total marks: 100, Duration: 2 hours

A. Core Subjects: 60-70 Questions

B. English: 5-10 Questions

C. Mathematics: 5 -10 Questions

D. General Knowledge and Current Affairs: 10 -15 Questions

Syllabus:

A. CORE SUBJECTS

• Organic Chemistry • Name Reactions • Polymer Chemistry • Chemical Kinetics and Photochemistry • Functional Groups • Spectroscopy. • Hydrocarbons and their Halogen Derivatives. • Atomic Structure, Chemical Bonding, & Periodic Properties. • Bio-molecules. • Qualitative and Quantitative Analyses • Physical Chemistry and Analytical Chemistry

B. ENGLISH

• Grammar Verbal Reasoning • Synonyms • Antonyms • Plurals • Sentence Completion

C. MATHEMATICS

• Numerical Aptitude • Ratios and Proportion • Average and Percentages • Profit and loss

D. GENERAL KNOWLEDGE AND CURRENT AFFAIRS

B.Tech (Lateral Entry for diploma holders)

Question Paper Pattern:

'Multiple Choice' type question

Total 100 Questions, Total marks: 100, Duration: 2 hours

A. Engineering Mathematics: 15 -30 Questions

B. Engineering Mechanics: 15-30 Questions

C. Basic Electrical & Electronics: 15-20 Questions

D. Chemistry: 15-20 Questions

E. English: 10-15 Questions

F. General Knowledge and Current Affairs: 10 -15 Questions

Syllabus:

A. ENGINEERING MATHEMATICS

Algebra: Definition of complex number, Conjugate of complex number, Modulus and amplitude of a complex number. Algebra of complex numbers. Cube root of unity and their properties, De'Moivre's theorem and its application, Permutation, Combination, Binomial Theorem for any rational index, Relationship between Binomial coefficients. Determinant and Matrices: Properties of determinants. Crammer's Rule, Types of matrices, Transpose, Adjoint and inverse of a matrix upto third order. Solution of simultaneous equation by matrix method. Trigonometry: Trigonometrical ratios, multiple and submultiple angles, solution of trigonometrical equations, Properties of triangles, Inverse circular function and its properties. Analytical Geometry: Distance formula, Division formula, Area of trapezium, Area of Triangle, Equation of straight lines in different form, Distance of a point from a line, Equation of circle in different forms. Vector Algebra: Definition, Algebra of vectors, Position Vector, Resolution of vector into components, normal vector, unit vector, Scalar and Vector product of two vectors and their application, scalar triple product and its application. Calculus: Limit and continuity of function, Derivativeof standard functions, Derivative of composite functions. Differentiation of implicit functions, Differentiation of function in parametric form, Differentiation using logarithm, Differentiation of a function with respect to another function, Successive differentiation in simple cases, Maxima, minima and point of inflection, Partial derivative, Euler's theorem for homogeneous functions. Standard methods of integration (by parts, by substitution, by partial fraction etc.). Definite integrals and their properties. Area bounded by curves. Ordinary Differential Equation: Order and degree of differential equation, formation of differential equation. Solution of first order and first degree differential equation. (Linear and homogeneous) Coordinate Geometry of three Dimension: Distance and Division formulae, Direction cosine and direction ratio of a line, condition of perpendicularity and parallelism, Equation of plane under different conditions, angle between two planes, Distance of a point from a plane, General equation of a sphere, Equation of a sphere with given diameter. Probability and Statistics: Measures of central tendency (Mean, Median, Mode), Measures of dispersion (Mean Deviation, Standard Deviation and Variance), Definition of probability, equally likely, Mutually exclusive and independent events. Addition theorem of probability.

B. ENGINEERING MECHANICS

Force and Moments Force and its effects, Classification of forces, Principle of Transmissibility, Principle of Superposition, Action and Reaction, Tension and Compression, Free Body Diagram. Co-planer concurrent forces: Resultant of forces, Equilibrium of forces and equilibrant, Parallelogram law of forces and determination of the resultant of two concurrent forces, Components and resolve parts of a force, Principle of resolution of a force and any number of forces, Analytical determination of resultant of number of concurrent forces, Lami's Theorem, Triangle law of forces and polygon law of forces. Coplanar non-concurrent forces: Moment of a force, Statement and proof of Varignon's theorem, Conditions of

equilibrium, Determination of resultant of two like and unlike parallel forces, Couple and its moment, Various types of supports with their reactions, Simple problems on coplanar non concurrentforces with the help of free body diagram. Center of Gravity and Moment of Inertia Centroid and Center of Gravity(C.G.), Expression for C.G. of straight line (uniform rod),triangle, rectangle, circular, semicircular lamina. Expression for C.G. of solids like hemisphere and cone (Expression only). Different types of engineering sections (symmetrical and non-symmetrical built up sections). Location of the C.G. of the above sections. Definition of Moment of Inertia (M.I.) of plain figure as second moment of area. Perpendicular axes theorem, parallel axis theorem. M.I. of plane lamina like rectangle, triangle, circle, and semicircle (from 1st principle) M.I. of different engineering sections. Friction Frictional force, angleof friction, limiting friction, co-efficient of friction, Laws of Static Friction. Simple problems on ladder, Body on Inclined planes with applied force parallel to the plane and horizontal, Screw Jack. Gear Drive Various types of gears, Gear terminology, Velocity ratio and expression for the velocity ratio for simple gears. Types of gear trains (simple and compound gear trains) Simple Lifting Machine Definition of a machine. Simple and compound lifting machines. Mechanical Advantage (MA), Velocity Ratio (VR) and efficiency of lifting machine. Relationship between MA, VR and efficiency. Laws of machine, Friction in machines, Friction in terms of load and friction in terms of effort. Reversible machine and self-locking machine. Condition of reversibility of a machine. Velocity Ratio and efficiency of 1st, 2nd & 3rd system of pulleys; Simple and differential wheel & axle, Screw jack. Simple Stress and Strain Stress, strain, tensile, compressive and shear types of stress and strain, Hooke's Law of elasticity, Poisson's ratio, Elastic limit, Elastics Constants (E, G &K) relationship between E,G &K, Stress-strain curve and salient points on stress-strain curve for ductile material. Simple problems on stress and strain in case of material with uniform cross section. Dynamics Kinematics and kinetics of a particle, Principle of Dynamics:-Newton's laws of motion, D'Alembert's Principle and its application. Motion of particle acted upon by a constant force. Engineering Application of Work, Power and Energy: Work done, force- displacement diagram, Work done in stretching a spring, Power, Indicated Power, Brake Power and efficiency. Kinetic and potential energy & its application, Force, Momentum and Impulse, Conservation of energy and linear momentum, Collision of elastic bodies, Co-efficient of restitution (e), Velocity after impact. Impact of body with a fixed plane.

C. BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

C 1. BASIC ELECTRICAL ENGINEERING

Fundamentals and AC Theory: Concept of Source and Load, Ohm's Law, Concept of resistance, Series and Parallel DC circuits, Kirchhoff's Laws, Faraday's Laws of Electromagnetic Induction, Fleming's Left 7 Hand Rule and Right Hand Rule. Generation of alternating emf, Difference between DC and AC, Amplitude, Cycle, Time period, Frequency, Phase, Phase Angle, Phase Difference, Instantaneous value, RMS value, Average value, Amplitude factor and Form factor, Phasor diagram representation of AC values, AC through pure resistance, inductance and capacitance, AC through RL, RC and RLC circuits, Impedance Triangle and Power Triangle. Conversion of Electrical Energy:. DC machine and its main parts.DC generators: Principle of operation and emf equation. DC motors: Principle of operation, classification, torque equation and applied voltage V-back emf Eb relation. Starters used for DC motors, Use of different types of DC generators and motors, Concept of single phase Transformer and itsapplication, Principle of operation of Three-phase and Single-phase Induction Motors. Power Billing: Calculation of Power used in small electrical appliances and installation, Calculation of Energy consumption in small electrical installations, Earthing installation, types (Pipe and Plate earthing) and uses. Measuring Instruments and Storage Devices: Introduction to measuring instruments, Expression for Torque in measuring instruments, Use of PMMC and MI type of instruments (Ammeters and Voltmeters). Connection diagram of AC/DC ammeter, voltmeter, energy meter and wattmeter for single phase electrical system only, Introduction to storage devices and their types. Charging, Discharging and Maintenance of Lead Acid battery.

C 2. BASIC ELECTRONICS ENGINEERING

Electronic Devices: Classification of material according to electrical conductivity (Conductor, Semiconductor & Insulator) with respect to energy band diagram only. Principle of working and use of PN junction diode, Zener diode and Light Emitting Diode (LED), Integrated circuits (I.C) & its advantages. Electronic Circuits: Principles of working of different types of Rectifiers with their merits and demerits, Transistor, Different types of Transistor Configuration and state output and input current gain relationship in CE, CB and CC configuration (No mathematical derivation), Need of biasing and explain different types of biasing with circuit diagram (only CE configuration), Amplifiers (concept), Working principles of single phase CE amplifier. Communication System: Basic communication system (concept & explanation with help of Block diagram), Concept of Modulation and Demodulation, Difference between them, Different types of Modulations (AM, FM and PM) based on signal, carrier and modulated wave (Only Concept, No Mathematical Derivations). Transducers And Measuring Instruments: Concept of Transducer and sensor with their differences, Working principle of photo emissive, photoconductive, photovoltaic transducer and its application, Multimeter and its applications.

D. CHEMISTRY

SOME BASIC CONCEPTS IN CHEMISTRY: Matter and its nature, Dalton's atomic theory: Concept of atom, molecule, element and compound: Physical quantities and their measurements in Chemistry, precision and accuracy, significant figures. S.I.Units, dimensional analysis: Laws of chemical combination;Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae: Chemical equations and stoichiometry.

STATES OF MATTER: Classification of matter into solid, liquid and gaseous states. Gaseous State: Measurable properties of gases: Gas laws - Boyle's law, Charle's law. Graham's law of diffusion. Avogadro's law, Dalton's law of partial pressure; Concept of Absolute scale of temperature; Ideal gas equation; Kinetic theory of gases (only postulates); Concept of average, root mean square and most probable velocities; Real gases, deviation from Ideal behaviour, compressibility factor and van der Waalsequation. Liquid State: Properties of liquids - vapour pressure, viscosity and surface tension and effect oftemperature on them (qualitative treatment only). Solid State: Classification of solids: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea); Bragg's Law and its applications: Unit cell and lattices, packing in solids (fcc, bcc and hcp lattices), voids, calculations involving unit cell parameters, an imperfection in solids; Electrical and magnetic properties.

ATOMIC STRUCTURE: Thomson and Rutherford atomic models and their limitations; Nature of electromagnetic radiation, photoelectric effect; Spectrum of the hydrogen atom. Bohr model of a hydrogen atom - its postulates, derivation of the relations for the energy of the electron and radii of the different orbits, limitations of Bohr's model; Dual nature of matter, de Broglie's relationship. Heisenberg uncertainty principle. Elementary ideas of quantum mechanics, quantum mechanics, the quantum mechanical model of the atom, its important features. Concept of atomic orbitals as one-electron wave functions: Variation of Ψ and $\Psi 2$ with r for 1s and 2s orbitals; various quantum numbers (principal, angular momentum and magnetic quantum numbers) and their significance; shapes of s, p and d - orbitals, electron spin and spin quantum number: Rules for filling electrons in orbitals – Aufbau principle. Pauli's exclusion principle and Hund's rule, electronic configuration of elements, extra stability of half-filled and completely filled orbitals.

CHEMICAL BONDING AND MOLECULAR STRUCTURE: Kossel - Lewis approach to chemical bond formation, the concept of ionic and covalent bonds. Ionic Bonding: Formation of ionic bonds, factors affecting the formation of ionic bonds; calculation of lattice enthalpy. Covalent Bonding: Concept of electronegativity. Fajan's rule, dipole moment: Valence Shell Electron Pair Repulsion (VSEPR) theory and shapes of simple molecules. Quantum mechanical approach to covalent bonding: Valence bond theory - its important features, the concept of hybridization involving s, p and d orbitals; Resonance. Molecular Orbital Theory - Its important features. LCAOs, types of molecular orbitals (bonding, antibonding), sigma and pi-bonds, molecular orbital electronic configurations of homonuclear diatomic molecules, the concept

of bond order, bond length and bond energy. Elementary idea of metallic bonding. Hydrogen bonding and its applications.

SOLUTIONS: Different methods for expressing the concentration of solution - molality, molarity, mole fraction, percentage (by volume and mass both), the vapour pressure of solutions and Raoult's Law
- Ideal and non-ideal solutions, vapour pressure - composition, plots for ideal and non-ideal solutions; Colligative properties of dilute solutions - a relative lowering of vapour pressure, depression of freezing point, the elevation of boiling point and osmotic pressure; Determination of molecular mass using colligative properties; Abnormal value of molar mass, van't Hoff factor and its significance.
SURFACE CHEMISTRY: Adsorption- Physisorption and chemisorption and their characteristics, factors affecting adsorption of gases on solids - Freundlich and Langmuir adsorption isotherms, adsorption from solutions. Catalysis - Homogeneous and heterogeneous, activity and selectivity of solid catalysts, enzyme catalysis and its mechanism. Colloidal state- distinction among true solutions, colloids and suspensions, classification of colloids - lyophilic. lyophobic; multimolecular. macromolecular and associated colloids (micelles), preparation and properties of colloids - Tyndall effect. Brownian movement, electrophoresis, dialysis, coagulation and flocculation: Emulsions and their characteristics.

ENVIRONMENTAL CHEMISTRY: Environmental pollution - Atmospheric, water and soil. Atmospheric pollution - Tropospheric and Stratospheric Tropospheric pollutants - Gaseous pollutants: Oxides of carbon, nitrogen and sulphur, hydrocarbons; their sources, harmful effects and prevention; Greenhouse effect and Global warming: Acid rain; Particulate pollutants: Smoke, dust, smog, fumes, mist; their sources, harmful effects and prevention. Stratospheric pollution- Formation and breakdown of ozone, depletion of the ozone layer - its mechanism and effects. Water Pollution - Major pollutants such as. pathogens, organic wastes and chemical pollutants; their harmful effects and prevention. Soil pollution - Major pollutants such as; Pesticides (insecticides. herbicides and fungicides), their harmful effects and prevention. Strategies to control environmental pollution.

SOME BASIC PRINCIPLES OF ORGANIC CHEMISTRY: Tetravalency of carbon: Shapes of simple molecules - hybridization (s and p): Classification of organic compounds based on functional groups: and those containing halogens, oxygen, nitrogen and sulphur; Homologous series: Isomerism - structural and stereoisomerism. Nomenclature (Trivial and IUPAC) Covalent bond fission - Homolytic and heterolytic: free radicals, carbocations and carbanions; stability of carbocations and free radicals, electrophiles and nucleophiles. Electronic displacement in a covalent bond - Inductive effect, electromeric effect, resonance and hyperconjugation. Common types of organic reactionsSubstitution, addition, elimination and rearrangement.

HYDROCARBONS: Classification, isomerism, IUPAC nomenclature, general methods of preparation, properties and reactions. Alkanes - Conformations: Sawhorse and Newman projections (of ethane): Mechanism of halogenation of alkanes. Alkenes - Geometrical isomerism: Mechanism of electrophilic addition: addition of hydrogen, halogens, water, hydrogen halides (Markownikoffs and peroxide effect): Ozonolysis and polymerization. Alkynes - Acidic character: Addition of hydrogen, halogens, water and hydrogen halides: Polymerization. Aromatic hydrocarbons - Nomenclature, benzene - structure and aromaticity: Mechanism of electrophilic substitution: halogenation, nitration. Friedel - Craft's alkylation and acylation, directive influence of the functional group in mono-substituted benzene.

POLYMERS: General introduction and classification of polymers, general methods of polymerization, - Addition and condensation, copolymerization. Natural and synthetic, rubber and vulcanization, some important polymers with emphasis on their monomers and uses – polythene, nylon, polyester and bakelite.

CHEMISTRY IN EVERYDAY LIFE: Chemicals in Medicines - Analgesics, tranquillizers, antiseptics, disinfectants, antimicrobials, anti-fertility drugs, antibiotics, antacids. Anti-histamines - their meaning and common examples. Chemicals in food - Preservatives, artificial sweetening agents - common examples.

Cleansing Agents - Soaps and detergents, cleansing action.

E. ENGLISH

Grammar Verbal Reasoning, Synonyms, Antonyms, Plurals, Sentence Completion.

M. Tech.(PLASTIC ENGINEERING / POLYMER NANOTECHNOLOGY)

Question Paper Pattern:

'Multiple Choice' type question

Total 100 Questions, Total marks: 100, Duration: 2 hours

A. Engineering Mathematics: 10 -15 Questions

B. Branch Subjects: 40-50 Questions

C. English: 5-10 Questions

E. Analytical and Logical Reasoning: 10-20 Questions

D. General Knowledge and Current Affairs: 10 -15 Questions

Syllabus:

A. ENGINEERING MATHEMATICS

Ordinary Differential Equations – Solution of first order , second order and higher order differential equations(separable equation, exact differential equation, homogeneous equation with constant co efficient, Euler Cauchy equations ,solution by undetermined coefficients and variation of parameters) Linear Algebra – Matrices ,Vectors, Determinants and linear system of equations ,Eigen value problems, symmetric, skew symmetric ,orthogonal matrices .Complex matrices ,Hermitian , Skew Hermitian and Unitary matrices, Similarity of matrices. Fourier series - Fourier series and expansion of functions of any period, odd and even functions, half range expansion. Laplace Transform – Use of Laplace transform for solving differential equations, Convolution and Integral equations. Complex Analysis – Analytic functions, Cauchy-Riemann equations, Laurent's series, singularities and zeros. Numerical Methods – Interpolation, numerical integration, solution of first order ordinary differential equations. Probability and Statistics- Probability distribution (discrete and continuous), sampling distribution, correlation and regression analysis.

B. BRANCH SUBJECTS

Polymer Science and Engineering: Natural Polymers, Synthetic polymers –homo polymers, co-polymers, cross linked polymers, polymerisation- Addition Polymerization, step growth polymerisation, Degree of polymerisation, polydispersity, molecular weight of polymers, molecular weight distribution.

Polymerisation techniques, Analysis and characterisation of polymers, melt flow index, Polymer processing: injection moulding, blow moulding, extrusion, compression moulding, polymer additives, polymer blends and alloys. Engineering plastics, commodity plastics, high performance plastics. Application of polymers.

Chemistry: Chemical bonding atomic structure, organic chemistry, name reaction, physical chemistry Chemical kinetics –Spectroscopy.

Material Science: Mechanical properties of material - Magnetic and Dielectric materials – Conductor and Semi conductor materials.

Applied Mechanics: Law of Mechanics – Lame's theorem – Forces, Moments and Couples – Displacement, velocity and Acceleration – Friction – Moment of Inertia.

M.Sc (Polymer Science)

Question Paper Pattern:

'Multiple Choice' type question

Total 100 Questions, Total marks: 100, Duration: 2 hours

A. Core Subjects: 60-70 Questions

B. English: 5-10 Questions

C. Mathematics: 5 -10 Questions

D. General Knowledge and Current Affairs: 10 -15 Questions

Syllabus:

A. CORE SUBJECTS

• Organic Chemistry • Name Reactions • Polymer Chemistry • Chemical Kinetics and Photochemistry • Functional Groups • Spectroscopy. • Hydrocarbons and their Halogen Derivatives. • Atomic Structure, Chemical Bonding, & Periodic Properties. • Bio-molecules. • Qualitative and Quantitative Analyses • Physical Chemistry and Analytical Chemistry

B. ENGLISH

• Grammar Verbal Reasoning • Synonyms • Antonyms • Plurals • Sentence Completion

C. MATHEMATICS

• Numerical Aptitude • Ratios and Proportion • Average and Percentages • Profit and loss

D. GENERAL KNOWLEDGE AND CURRENT AFFAIRS

Integrated M.Sc. (Material Science & Engineering)

Question Paper Pattern:

'Multiple Choice' type question

Total 100 Questions, Total marks: 100, Duration: 2 hours

A. Mathematics: 15 -30 Questions

B. Physics: 15-30 Questions

C. Chemistry: 15-30 Questions

D. English: 5-10 Questions

E. General Knowledge and Current Affairs: 10 -15 Questions

Syllabus:

A. MATHEMATICS

SETS, RELATIONS AND FUNCTIONS: Sets and their representation: Union, intersection and complement of sets and their algebraic properties; Power set; Relation, Type of relations, equivalence relations, functions; one-one, into and onto functions, the composition of functions.

COMPLEX NUMBERS AND QUADRATIC EQUATIONS: Complex numbers as ordered pairs of reals, Representation of complex numbers in the form a + ib and their representation in a plane, Argand diagram, algebra of complex number, modulus and argument (or amplitude) of a complex number, square root of a complex number, triangle inequality, Quadratic equations in real and complex number system and their solutions Relations between roots and coefficient, nature of roots, the formation of quadratic equations with given roots.

MATRICES AND DETERMINANTS: Matrices, algebra of matrices, type of matrices, determinants and

matrices of order two and three, properties of determinants, evaluation of determinants, area of triangles using determinants, Adjoint and evaluation of inverse of a square matrix using determinants and elementary transformations, Test of consistency and solution of simultaneous linear equations in two or three variables using determinants and matrices.

PERMUTATIONS AND COMBINATIONS: The fundamental principle of counting, permutation as an arrangement and combination as section, Meaning of P (n,r) and C (n,r), simple applications.

MATHEMATICAL INDUCTIONS: Principle of Mathematical Induction and its simple applications.

BINOMIAL THEOREM AND ITS SIMPLE APPLICATIONS: Binomial theorem for a positive integral index, general term and middle term, properties of Binomial coefficients and simple applications.

SEQUENCE AND SERIES: Arithmetic and Geometric progressions, insertion of arithmetic, geometricmeans between two given numbers, Relation between A.M and G.M sum up to n terms of special series;Sn, Sn2, Sn3. Arithmetico-Geometric progression.

LIMIT, CONTINUITY AND DIFFERENTIABILITY: Real – valued functions, algebra of functions, polynomials, rational, trigonometric, logarithmic and exponential functions, inverse function. Graphs of simple functions. Limits, continuity and differentiability. Differentiation of the sum, difference, product and quotient of two functions. Differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit functions; derivatives of order up to two, Rolle's and Lagrange's Mean value Theorems, Applications of derivatives: Rate of change of quantities, monotonic Increasing and decreasing functions, Maxima and minima of functions of one variable, tangents and normal.

INTEGRAL CALCULAS: Integral as an anti-derivative, Fundamental Integrals involving algebraic, trigonometric, exponential and logarithms functions. Integrations by substitution, by parts and by partial functions. Integration using trigonometric identities. Evaluation of simple integrals of the type ∫d/ 2+a2, ∫d/√ 2±a2, ∫d/a2−2, ∫d √a2− 2, ∫d/a2+b+c, ∫d/√a2+ b+c, ∫(p+q)d /a2+b+c,
∫(p+q)d√a2+b+c, ∫√a2 ± 2d, ∫√2− a2d Integral as limit of a sum. The fundamental theorem of calculus, properties of definite integrals. Evaluation of definite integrals, determining areas of the regions bounded by simple curves in standard form.

DIFFRENTIAL EQUATIONS: Ordinary differential equations, their order and degree, the formation of differential equations, solution of differential equation by the method of separation of variables,solution of a homogeneous and linear differential equation of the type dy/dx + p(x)y = q(x).

CO-ORDINATE GEOMETRY: Cartesian system of rectangular coordinates in a plane, distance formula, sections formula, locus and its equation, translation of axes, the slope of a line, parallel and perpendicular lines, intercepts of a line on the co-ordinate axis. Straight line Various forms of equations of a line, intersection of lines, angles between two lines, conditions for concurrence of three lines, the distance of a point form a line, equations of internal and external by sectors of angles between two lines coordinate of the centroid, orthocentre and circumcentre of a triangle, equation of the family of lines passing through the point of intersection of two lines. Circle, conic sections A standard form of equations of a circle, the general form of the equation of a circle, its radius and central, equation of a circle when the endpoints of a diameter are given, points of intersection of a line and a circle with the centre at the origin and condition for a lineto be tangent to a circle, equation of the tangent, sections of conics, equations of conic sections (parabola, ellipse and hyperbola) in standard forms, condition for Y = mx +c to be a tangent and point (s) of tangency.

THREE DIMENSIONAL GEOMETRY: Coordinates of a point in space, the distance between two points, section formula, directions ratios and direction cosines, the angle between two intersecting lines. Skew lines, the shortest distance between them and its equation. Equations of a line and a plane in different forms, the intersection of a line and a plane, coplanar lines.

VECTOR ALGEBRA: Vectors and scalars, the addition of vectors, components of a vector in two dimensions and three-dimensional space, scalar and vector products, scalar and vector triple product.

STATISTICS AND PROBABILITY: Measures of discretion; calculation of mean, median, mode of grouped and ungrouped data calculation of standard deviation, variance and mean deviation for grouped and ungrouped data. Probability: Probability of an event, addition and multiplication theorems of probability, Baye's theorem, probability distribution of a random variate, Bernoulli trials and binomial distribution.

TRIGONOMETRY: Trigonometrical identities and equations, trigonometrical functions, inverse trigonometrical functions and their properties, heights and distance.

MATHEMATICAL REASONING: Statement logical operations and, or, implies, implied by, if and only if, understanding of tautology, contradiction, converse and contrapositive.

B. PHYSICS

PHYSICS AND MEASUREMENT: Physics, technology and society, S I Units, fundamental and derived units, least count, accuracy and precision of measuring instruments, Errors in measurement, Dimensions of Physics quantities, dimensional analysis and its applications.

KINEMATICS: The frame of reference, motion in a straight line, Position- time graph, speed and velocity; Uniform and non-uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, velocity- time, position-time graph, relations for uniformly accelerated motion, Scalars and Vectors, Vector.

Addition and subtraction, zero vector, scalar and vector products, Unit Vector, Resolution of a Vector. Relative Velocity, Motion in a plane, Projectile Motion, Uniform Circular Motion.

LAWS OF MOTION: Force and inertia, Newton’s First law of motion; Momentum, Newton’s Second Law of motion, Impulses;Newton’s Third Law of motion. Law of conservation of linear momentum and its applications. Equilibrium of concurrent forces. Static and Kinetic friction, laws of friction, rolling friction. Dynamics of uniform circular motion: centripetal force and its applications.

WORK, ENERGY AND POWER: Work done by a content force and a variable force; kinetic and potential energies, work-energy theorem, power. The potential energy of spring conservation of mechanical energy, conservative and neoconservative forces; Elastic and inelastic collisions in one and two dimensions.

ROTATIONAL MOTION: Centre of the mass of a two-particle system, Centre of the mass of a rigid body; Basic concepts of rotational motion; a moment of a force; torque, angular momentum, conservation of angular momentum and its applications; the moment of inertia, the radius of gyration. Values of moments of inertia for simple geometrical objects, parallel and perpendicular axes theorems and their applications. Rigid body rotation equations of rotational motion.

GRAVITATION: The universal law of gravitation. Acceleration due to gravity and its variation withaltitude and depth. Kepler’s law of planetary motion. Gravitational potential energy; gravitational potential. Escape velocity, Orbital velocity of a satellite. Geo stationary satellites.

PROPERTIES OF SOLIDS AND LIQUIDS: Elastic behaviour, Stress-strain relationship, Hooke's Law. Young's modulus, bulk modulus, modulus of rigidity. Pressure due to a fluid column; Pascal's law and its applications. Viscosity. Stokes' law. terminal velocity, streamline and turbulent flow. Reynolds number. Bernoulli's principle and its applications. Surface energy and surface tension, angle of contact, application of surface tension - drops, bubbles and capillary rise. Heat, temperature, thermal expansion; specific heat capacity, calorimetry; change of state, latent heat. Heat transfer-conduction, convection and radiation. Newton's law of cooling.

THERMODYNAMICS: Thermal equilibrium, zeroth law of thermodynamics, the concept of temperature. Heat, work and internal energy. The first law of thermodynamics. The second law of thermodynamics: reversible and irreversible processes. Carnot engine and its efficiency.

KINETIC THEORY OF GASES: Equation of state of a perfect gas, work done on compressing a gas,Kinetic theory of gases - assumptions, the concept of pressure. Kinetic energy and temperature: RMS speed of gas molecules: Degrees of freedom. Law of equipartition of energy, applications to specific heat capacities of gases; Mean free path. Avogadro's number.

OSCILLATIONS AND WAVES: Periodic motion - period, frequency, displacement as a function of time. Periodic functions. Simple harmonic motion (S.H.M.) and its equation; phase: oscillations of a spring - restoring force and force constant: energy in S.H.M. - Kinetic and potential energies; Simple pendulum - derivation of expression for its time period: Free, forced and damped oscillations, resonance. Wave motion. Longitudinal and transverse waves, speed of a wave. Displacement relation for a progressive wave. Principle of superposition of waves, a reflection of waves. Standing waves in strings and organ pipes, fundamental mode and harmonics. Beats. Doppler Effect in sound.

ELECTROSTATICS: Electric charges: Conservation of charge. Coulomb's law-forces between two point charges, forces between multiple charges: superposition principle and continuous charge distribution. Electric field: Electric field due to a point charge, Electric field lines. Electric dipole, Electric field due to a dipole. Torque on a dipole in a uniform electric field. Electric flux. Gauss's law and its applications to find field due to infinitely long uniformly charged straight wire, uniformly charged infiniteplane sheet and uniformly charged thin spherical shell. Electric potential and its calculation for a point charge, electric dipole and system of charges; Equipotential surfaces, Electrical potential energy of a system of two point charges in an electrostatic field. Conductors and insulators. Dielectrics and electric polarization, capacitor, the combination of capacitors in series and parallel, capacitance of a parallelplate capacitor with and without dielectric medium between the plates. Energy stored in a capacitor.

CURRENT ELECTRICITY: Electric current. Drift velocity. Ohm's law. Electrical resistance. Resistances of different materials. V-l characteristics of Ohmic and non-ohmic conductors. Electrical energy and power. Electrical resistivity. Colour code for resistors; Series and parallel combinations of resistors; Temperature dependence of resistance. Electric Cell and its Internal resistance, potential difference and emf of a cell, a combination of cells in series and parallel. Kirchhoff’s laws and their applications. Wheatstone bridge. Metre Bridge. Potentiometer - principle and its applications.

MAGNETIC EFFECTS OF CURRENT AND MAGNETISM: Biot - Savart law and its application to current carrying circular loop. Ampere's law and its applications to infinitely long current carryingstraight wire and solenoid. Force on a moving charge in uniform magnetic and electric fields. Cyclotron. Force on a current-carrying conductor in a uniform magnetic field. The force between two parallel current carrying conductors definition of ampere. Torque experienced by a current loop in a uniform magnetic field: Moving coil galvanometer, its current sensitivity and conversion to ammeter and voltmeter. Current loop as a magnetic dipole and its magnetic dipole moment. Bar magnet as anequivalent solenoid, magnetic field lines; Earth's magnetic field and magnetic elements. Para-, dia- and ferromagnetic substances. Magnetic susceptibility and permeability. Hysteresis. Electromagnets and permanent magnets.

ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENTS: Electromagnetic induction:Faraday's law. Induced emf and current: Lenz’s Law, Eddy currents. Self and mutual inductance. Alternating currents, peak and RMS value of alternating current/ voltage: reactance and impedance: LCR series circuit, resonance: Quality factor, power in AC circuits, wattless current. AC generator and transformer.

ELECTROMAGNETIC WAVES: Electromagnetic waves and their characteristics, Transverse nature of electromagnetic waves, Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet. X-rays. Gamma rays), Applications of e.m. waves.

OPTICS: Reflection and refraction of light at plane and spherical surfaces, mirror formula. Total internal reflection and its applications. Deviation and Dispersion of light by a; prism; Lens Formula. Magnification. Power of a Lens. Combination of thin lenses in contact. Microscope and Astronomical Telescope (reflecting and refracting) and their magnifying powers. Wave optics: wave front and Huygens'principle. Laws of

reflection and refraction using Huygens principle. Interference, Young's double-slit experiment and expression for fringe width, coherent sources and sustained interference of light. Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and astronomical telescopes. Polarization, plane-polarized light: Brewster's law, uses of plane-polarized light and Polaroid.

DUAL NATURE OF MATTER AND RADIATION: Dual nature of radiation. Photoelectric effect. Hertz and Lenard's observations; Einstein's photoelectric equation: particle nature of light. Matter waves-wave nature of particle, de Broglie relation. DavissonGermer experiment.

ATOMS AND NUCLEI: Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, atomic masses, isotopes, isobars: isotones. Radioactivity- alpha. beta and gamma particles/rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number, nuclear fission and fusion.

ELECTRONIC DEVICES: Semiconductors; semiconductor diode: 1- V characteristics in forward and reverse bias; diode as a rectifier; I-V characteristics of LED. the photodiode, solar cell and Zener diode; Zener diode as a voltage regulator. Junction transistor, transistor action, characteristics of a transistor: transistor as an amplifier (common emitter configuration) and oscillator. Logic gates (OR. AND. NOT. NAND and NOR). Transistor as a switch.

COMMUNICATION SYSTEMS: Propagation of electromagnetic waves in the atmosphere; Sky and space wave propagation. Need for modulation. Amplitude and Frequency Modulation, Bandwidth ofsignals. the bandwidth of Transmission medium, Basic Elements of a Communication System (Block Diagram only).

C. CHEMISTRY

b) PHYSICAL CHEMISTRY

SOME BASIC CONCEPTS IN CHEMISTRY: Matter and its nature, Dalton's atomic theory: Concept of atom, molecule, element and compound: Physical quantities and their measurements in Chemistry, precision and accuracy, significant figures. S.I.Units, dimensional analysis: Laws of chemical combination;Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae: Chemical equations and stoichiometry.

STATES OF MATTER: Classification of matter into solid, liquid and gaseous states. Gaseous State: Measurable properties of gases: Gas laws - Boyle's law, Charle's law. Graham's law of diffusion. Avogadro's law, Dalton's law of partial pressure; Concept of Absolute scale of temperature; Ideal gas equation; Kinetic theory of gases (only postulates); Concept of average, root mean square and most probable velocities; Real gases, deviation from Ideal behaviour, compressibility factor and van der Waalsequation. Liquid State: Properties of liquids - vapour pressure, viscosity and surface tension and effect oftemperature on them (qualitative treatment only). Solid State: Classification of solids: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea); Bragg's Law and its applications: Unit cell and lattices, packing in solids (fcc, bcc and hcp lattices), voids, calculations involving unit cell parameters, an imperfection in solids; Electrical and magnetic properties.

ATOMIC STRUCTURE: Thomson and Rutherford atomic models and their limitations; Nature of electromagnetic radiation, photoelectric effect; Spectrum of the hydrogen atom. Bohr model of a hydrogen atom - its postulates, derivation of the relations for the energy of the electron and radii of the different orbits, limitations of Bohr's model; Dual nature of matter, de Broglie's relationship. Heisenberg uncertainty principle. Elementary ideas of quantum mechanics, quantum mechanics, the quantum mechanical model of the atom, its important features. Concept of atomic orbitals as one-electron wave functions: Variation of Ψ and $\Psi 2$ with r for 1s and 2s orbitals; various quantum numbers (principal, angular momentum and magnetic quantum numbers) and their significance; shapes of s, p and d - orbitals, electron spin and spin quantum number: Rules for filling electrons in orbitals – Aufbau principle. Pauli's

exclusion principle and Hund's rule, electronic configuration of elements, extra stability of half-filled and completely filled orbitals.

CHEMICAL BONDING AND MOLECULAR STRUCTURE: Kossel - Lewis approach to chemical bond formation, the concept of ionic and covalent bonds. Ionic Bonding: Formation of ionic bonds, factors affecting the formation of ionic bonds; calculation of lattice enthalpy. Covalent Bonding: Concept of electronegativity. Fajan's rule, dipole moment: Valence Shell Electron Pair Repulsion (VSEPR) theory and shapes of simple molecules. Quantum mechanical approach to covalent bonding: Valence bond theory - its important features, the concept of hybridization involving s, p and d orbitals; Resonance. Molecular Orbital Theory - Its important features. LCAOs, types of molecular orbitals (bonding, antibonding), sigma and pi-bonds, molecular orbital electronic configurations of homonuclear diatomic molecules, the concept of bond order, bond length and bond energy. Elementary idea of metallic bonding. Hydrogen bonding and its applications.

CHEMICAL THERMODYNAMICS: Fundamentals of thermodynamics: System and surroundings, extensive and intensive properties, state functions, types of processes. The first law of thermodynamics
- Concept of work, heat internal energy and enthalpy, heat capacity, molar heat capacity; Hess's law of constant heat summation; Enthalpies of bond dissociation, combustion, formation, atomization, sublimation, phase transition, hydration, ionization and solution. The second law of thermodynamics - Spontaneity of processes; ΔS of the universe and ΔG of the system as criteria for spontaneity. ΔG° (Standard Gibbs energy change) and equilibrium constant.

SOLUTIONS: Different methods for expressing the concentration of solution - molality, molarity, mole fraction, percentage (by volume and mass both), the vapour pressure of solutions and Raoult's Law
- Ideal and non-ideal solutions, vapour pressure - composition, plots for ideal and non-ideal solutions; Colligative properties of dilute solutions - a relative lowering of vapour pressure, depression of freezing point, the elevation of boiling point and osmotic pressure; Determination of molecular mass using colligative properties; Abnormal value of molar mass, van't Hoff factor and its significance.

EQUILIBRIUM: Meaning of equilibrium, the concept of dynamic equilibrium. Equilibria involving physical processes: Solid-liquid, liquid - gas and solid-gas equilibria, Henry's law. General characteristics of equilibrium involving physical processes. Equilibrium involving chemical processes: Law of chemical equilibrium, equilibrium constants (Kp and Kc) and their significance, the significance of ΔG and ΔG° in chemical equilibrium, factors affecting equilibrium concentration, pressure, temperature, the effect of catalyst; Le Chatelier's principle. Ionic equilibrium: Weak and strong electrolytes, ionization of electrolytes, various concepts of acids and bases (Arrhenius. Bronsted - Lowry and Lewis) and their ionization, acid-base equilibria (including multistage ionization) and ionization constants, ionization of water. pH scale, common ion effect, hydrolysis of salts and pH of their solutions, the solubility of sparingly soluble salts and solubility products, buffer solutions.

REDOX REACTIONS AND ELECTROCHEMISTRY: Electronic concepts of oxidation and reduction, redox reactions, oxidation number, rules for assigning oxidation number, balancing of redox reactions. Electrolytic and metallic conduction, conductance in electrolytic solutions, molar conductivities and their variation with concentration: Kohlrausch's law and its applications. Electrochemical cells - Electrolytic and Galvanic cells, different types of electrodes, electrode potentials including standard electrode potential, half - cell and cell reactions, emf of a Galvanic cell and its measurement: Nernst equation and its applications; Relationship between cell potential and Gibbs' energy change: Dry cell and lead accumulator; Fuel cells.

CHEMICAL KINETICS: Rate of a chemical reaction, factors affecting the rate of reactions: concentration, temperature, pressure and catalyst; elementary and complex reactions, order and molecularity of reactions, rate law, rate constant and its units, differential and integral forms of zero and first-order reactions, their characteristics and half-lives, the effect of temperature on the rate of reactions, Arrhenius

theory, activation energy and its calculation, collision theory of bimolecular gaseous reactions (no derivation).

SURFACE CHEMISTRY: Adsorption- Physisorption and chemisorption and their characteristics, factors affecting adsorption of gases on solids - Freundlich and Langmuir adsorption isotherms, adsorption from solutions. Catalysis - Homogeneous and heterogeneous, activity and selectivity of solid catalysts, enzyme catalysis and its mechanism. Colloidal state- distinction among true solutions, colloids and suspensions, classification of colloids - lyophilic. lyophobic; multimolecular. macromolecular and associated colloids (micelles), preparation and properties of colloids - Tyndall effect. Brownian movement, electrophoresis, dialysis, coagulation and flocculation: Emulsions and their characteristics.

b) INORGANIC CHEMISTRY

CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES: Modem periodic law andpresent form of the periodic table, s, p. d and f block elements, periodic trends in properties of elementsatomic and ionic radii, ionization enthalpy, electron gain enthalpy, valence, oxidation states and chemical reactivity.

GENERAL PRINCIPLES AND PROCESSES OF ISOLATION OF METALS: Modes of occurrence ofelements in nature, minerals, ores; Steps involved in the extraction of metals - concentration, reduction (chemical and electrolytic methods) and refining with special reference to the extraction of Al. Cu, Zn,and Fe; Thermodynamic and electrochemical principles involved in the extraction of metals.

HYDROGEN: Position of hydrogen in periodic table, isotopes, preparation, properties and uses of hydrogen; Physical and chemical properties of water and heavy water; Structure, preparation, reactions and uses of hydrogen peroxide; Classification of hydrides - ionic, covalent and interstitial; Hydrogen as a fuel.

S -BLOCK ELEMENTS (ALKALI AND ALKALINE EARTH METALS): Group -1 and 2 Elements General introduction, electronic configuration and general trends in physical and chemical properties of elements, anomalous properties of the first element of each group, diagonal relationships. Preparation and properties of some important compounds - sodium carbonate and sodium hydroxide and sodium hydrogen carbonate; Industrial uses of lime, limestone. Plaster of Paris and cement: Biological significance of Na, K. Mg and Ca.

P- BLOCK ELEMENTS: Group -13 to Group 18 Elements General Introduction: Electronic configuration and general trends in physical and chemical properties of elements across the periods and down the groups; unique behaviour of the first element in each group. Group wise study of the p - block elements Group - 13 Preparation, properties and uses of boron and aluminium; Structure, properties anduses of borax, boric acid, diborane, boron trifluoride, aluminium chloride and alums. Group -14 The tendency for catenation; Structure, properties and uses of Allotropes and oxides of carbon, silicon tetrachloride, silicates, zeolites and silicones. Group -15 Properties and uses of nitrogen and phosphorus; Allotrophic forms of phosphorus; Preparation, properties, structure and uses of ammonia, nitric acid, phosphine and phosphorus halides, (PCl_3. PCl_5); Structures of oxides and oxoacids of nitrogen and phosphorus. Group -16 Preparation, properties, structures and uses of ozone: Allotropic forms of sulphur; Preparation, properties, structures and uses of sulphuric acid (including its industrial preparation); Structures of oxoacids of sulphur. Group-17 Preparation, properties and uses of hydrochloric acid; Trends in the acidic nature of hydrogen halides; Structures of Interhalogen compounds and oxides and oxoacids of halogens. Group-18 Occurrence and uses of noble gases; Structures of fluorides and oxides of xenon.

d - and f- BLOCK ELEMENTS: Transition Elements General introduction, electronicconfiguration, occurrence and characteristics, general trends in properties of the first-row transition elements - physical properties, ionization enthalpy, oxidation states, atomic radii, colour, catalytic behaviour, magnetic properties, complex formation, interstitial compounds, alloy formation; Preparation, properties and uses

of $K_2Cr_2O_7$, and $KMnO_4$. Inner Transition Elements Lanthanoids - Electronic configuration, oxidation states and lanthanoid contraction.Actinoids - Electronic configuration and oxidation states.

CO-ORDINATION COMPOUNDS: Introduction to co-ordination compounds. Werner's theory; ligands, co-ordination number, denticity. chelation; IUPAC nomenclature of mononuclear co--ordinationcompounds, isomerism; Bonding-Valence bond approach and basic ideas of Crystal field theory, colour and magnetic properties; Importance of co- ordination compounds (in qualitative analysis, extraction of metals and in biological systems).

ENVIRONMENTAL CHEMISTRY: Environmental pollution - Atmospheric, water and soil. Atmospheric pollution - Tropospheric and Stratospheric Tropospheric pollutants - Gaseous pollutants: Oxides of carbon, nitrogen and sulphur, hydrocarbons; their sources, harmful effects and prevention; Greenhouse effect and Global warming: Acid rain; Particulate pollutants: Smoke, dust, smog, fumes, mist; their sources, harmful effects and prevention. Stratospheric pollution- Formation and breakdown of ozone, depletion of the ozone layer - its mechanism and effects. Water Pollution - Major pollutants such as. pathogens, organic wastes and chemical pollutants; their harmful effects and prevention. Soil pollution - Major pollutants such as; Pesticides (insecticides. herbicides and fungicides), their harmful effects and prevention. Strategies to control environmental pollution.

C) ORGANIC CHEMISTRY

PURIFICATION AND CHARACTERISATION OF ORGANIC COMPOUNDS: Purification -Crystallization, sublimation, distillation, differential extraction and chromatography - principles and their applications. Qualitative analysis - Detection of nitrogen, sulphur, phosphorus and halogens. Quantitative analysis (basic principles only) - Estimation of carbon, hydrogen, nitrogen, halogens, sulphur, phosphorus. Calculations of empirical formulae and molecular formulae: Numerical problems inorganic quantitative analysis.

SOME BASIC PRINCIPLES OF ORGANIC CHEMISTRY: Tetravalency of carbon: Shapes of simple molecules - hybridization (s and p): Classification of organic compounds based on functional groups: and those containing halogens, oxygen, nitrogen and sulphur; Homologous series: Isomerism - structural and stereoisomerism. Nomenclature (Trivial and IUPAC) Covalent bond fission - Homolytic and heterolytic: free radicals, carbocations and carbanions; stability of carbocations and free radicals, electrophiles and nucleophiles. Electronic displacement in a covalent bond - Inductive effect, electromeric effect, resonance and hyperconjugation. Common types of organic reactionsSubstitution, addition, elimination and rearrangement.

HYDROCARBONS: Classification, isomerism, IUPAC nomenclature, general methods of preparation, properties and reactions. Alkanes - Conformations: Sawhorse and Newman projections (of ethane): Mechanism of halogenation of alkanes. Alkenes - Geometrical isomerism: Mechanism of electrophilic addition: addition of hydrogen, halogens, water, hydrogen halides (Markownikoffs and peroxide effect): Ozonolysis and polymerization. Alkynes - Acidic character: Addition of hydrogen, halogens, water and hydrogen halides: Polymerization. Aromatic hydrocarbons - Nomenclature, benzene - structure and aromaticity: Mechanism of electrophilic substitution: halogenation, nitration. Friedel - Craft's alkylation and acylation, directive influence of the functional group in mono-substituted benzene.

ORGANIC COMPOUNDS CONTAINING HALOGENS: General methods of preparation, properties and reactions; Nature of C-X bond; Mechanisms of substitution reactions. Uses; Environmental effects of chloroform, iodoform freons and DDT.

UNIT 23: ORGANIC COMPOUNDS CONTAINING OXYGEN: General methods of preparation, properties, reactions and uses. ALCOHOLS, PHENOLS AND ETHERS Alcohols: Identification of primary, secondary and tertiary alcohols: mechanism of dehydration. Phenols: Acidic nature, electrophilic substitution reactions: halogenation. nitration and sulphonation. Reimer - Tiemann reaction. Ethers: Structure.Aldehyde and

Ketones: Nature of carbonyl group; Nucleophilic addition to >C=O group, relative reactivities of aldehydes and ketones; Important reactions such as - Nucleophilic addition reactions (addition of HCN. NH3, and its derivatives), Grignard reagent; oxidation: reduction (Wolf Kishner and Clemmensen); the acidity of α-hydrogen. aldol condensation, Cannizzaro reaction. Haloform reaction, Chemical tests to distinguish between aldehydes and Ketones. Carboxylic Acids Acidic strength and factors affecting it,

ORGANIC COMPOUNDS CONTAINING NITROGEN: General methods of preparation. Properties, reactions and uses. Amines: Nomenclature, classification structure, basic character and identification of primary, secondary and tertiary amines and their basic character. Diazonium Salts: Importance in synthetic organic chemistry.

POLYMERS: General introduction and classification of polymers, general methods of polymerization, - Addition and condensation, copolymerization. Natural and synthetic, rubber and vulcanization, some important polymers with emphasis on their monomers and uses – polythene, nylon, polyester and bakelite.

BIOMOLECULES: General introduction and importance of biomolecules. CARBOHYDRATES - Classification; aldoses and ketoses: monosaccharides (glucose and fructose) and constituent monosaccharides of oligosaccharides (sucrose, lactose and maltose). PROTEINS - Elementary Idea of α-amino acids, peptide bond, polypeptides. Proteins: primary, secondary, tertiary and quaternary structure (qualitative idea only), denaturation of proteins, enzymes. VITAMINS – Classification and functions. NUCLEIC ACIDS – Chemical constitution of DNA and RNA. Biological functions of nucleic acids.

CHEMISTRY IN EVERYDAY LIFE: Chemicals in Medicines - Analgesics, tranquillizers, antiseptics, disinfectants, antimicrobials, anti-fertility drugs, antibiotics, antacids. Anti-histamines - their meaning and common examples. Chemicals in food - Preservatives, artificial sweetening agents - common examples. Cleansing Agents - Soaps and detergents, cleansing action.

PRINCIPLES RELATED TO PRACTICAL CHEMISTRY: Detection of extra elements (Nitrogen, Sulphur, halogens) in organic compounds; Detection of the following functional groups; hydroxyl (alcoholic and phenolic), carbonyl (aldehyde and ketones) carboxyl and amino groups in organic compounds. • The chemistry involved in the preparation of the following: Inorganic compounds; Mohr's salt, potash alum. Organic compounds: Acetanilide, p-nitro acetanilide, aniline yellow, iodoform. • The chemistry involved in the titrimetric exercises – Acids, bases and the use of indicators, oxalic-acid vs $KMnO_4$, Mohr's salt vs $KMnO_4$ • Chemical principles involved in the qualitative salt analysts: Cations – Pb^{2+}, Cu^{2+}, Al^{3+}, Fe^{3+}, Zn^{2+}, Ni^{2+} , Ca^{2+}, Ba^{2+}, Mg^{2+}, NH^{4+} Anions- CO_3^{2-}, S^{2-} ,SO_4^{2-}, NO^{3-} , NO^{2-}, Cl^- , Br^- ,I^- (Insoluble salts excluded).

Chemical principles involved in the following experiments: 1. Enthalpy of solution of $CuSO_4$ 2. Enthalpy of neutralization of strong acid and strong base 3. Preparation of lyophilic and lyophobic sols. 4. Kinetic study of the reaction of iodide ion with hydrogen peroxide at room temperature

D. ENGLISH

Grammar Verbal Reasoning, Synonyms, Antonyms, Plurals, Sentence Completion