SYLLABUS

JEE MAIN

Section A : PHYSICAL CHEMISTRY

UNIT I 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.

UNIT II 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, van der Waals' equation, liquefaction of gases, critical constants.

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, imperfection in solids; electrical, magnetic and dielectric properties.

UNIT III Atomic Structure

Discovery of sub-atomic particles (electron, proton and neutron); Thomson and Rutherford atomic models and their limitations; Nature of electromagnetic radiation, photoelectric effect; spectrum of hydrogen atom, Bohr model of hydrogen atom - its postulates, derivation of the relations for 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 mechanical model of atom, its important features,
ψ and ψ^2, concept of atomic orbitals as one electron wave functions; Variation of ψ and ψ^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.

UNIT IV Chemical Bonding and Molecular Structure

Kossel Lewis approach to chemical bond formation, 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, 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, concept of bond order, bond length and bond energy.

Elementary idea of metallic bonding. Hydrogen bonding and its applications.

UNIT V Chemical Thermodynamics

Fundamentals of thermodynamics System and surroundings, extensive and intensive properties, state functions, types of processes.

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.

Second law of thermodynamics Spontaneity of processes; ΔS of the universe and ΔG of the system as criteria for spontaneity, ΔG° (Standard Gibb's energy change) and equilibrium constant.

UNIT VI Solutions

Different methods for expressing concentration of solution - molality, molarity, mole fraction, percentage (by volume and mass both), 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 - relative lowering of vapour pressure, depression of freezing point, 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.

UNIT VII Equilibrium

Meaning of equilibrium, 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.

Equilibria involving chemical processes Law of chemical equilibrium, equilibrium constants (K and K) and their significance, significance of ΔG and ΔG° in chemical equilibria, factors affecting equilibrium concentration, pressure, temperature, 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, solubility of sparingly soluble salts and solubility products, buffer solutions.

UNIT VIII Redox Reactions and Electrochemistry

Electronic concepts of oxidation and reduction, redox reactions, oxidation number, rules for assigning oxidation number, balancing of redox reactions.

Eectrolytic and metallic conduction, conductance in electrolytic solutions, specific and 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; Corrosion and its prevention.

UNIT IX 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, effect of temperature on rate of reactions - Arrhenius theory, activation energy and its calculation, collision theory of bimolecular gaseous reactions (no derivation).

UNIT X 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; multi molecular, macromole-cular and associated colloids (micelles), preparation and properties of colloids Tyndall effect, Brownian movement, electrophoresis, dialysis, coagulation and flocculation; Emulsions and their characteristics.

Section B : INORGANIC CHEMISTRY

UNIT XI Classification of Elements and Periodicity in Properties

Periodic Law and Present 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.

UNIT XII 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.

UNIT XIII 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.

UNIT XIV *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, sodium chloride, sodium hydroxide and sodium hydrogen carbonate; Industrial uses of lime, limestone, Plaster of Paris and cement; Biological significance of Na, K, Mg and Ca.

UNIT XV *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 and uses of borax, boric acid, diborane, boron trifluoride, aluminium chloride and alums.

Group 14 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 dioxygen and ozone; Allotropic forms of sulphur; Preparation, properties, structures and uses of sulphur dioxide, sulphuric acid (including its industrial preparation); Structures of oxoacids of sulphur.

Group 17 Preparation, properties and uses of chlorine and 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.

UNIT XVI *d*–and *f*–Block Elements

Transition Elements General introduction, electronic configuration, 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, chemical reactivity and lanthanoid contraction. Actinoids - Electronic configuration and oxidation states.

UNIT XVII Coordination Compounds

Introduction to coordination compounds, Werner's theory; ligands, coordination number, denticity, chelation; IUPAC nomenclature of mononuclear coordination compounds, isomerism; Bonding Valence bond approach and basic ideas of Crystal field theory, colour and magnetic properties; importance of coordination compounds (in qualitative analysis, extraction of metals and in biological systems).

UNIT XVIII 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; Green house 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 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.

Section C : ORGANIC CHEMISTRY

UNIT XIX Purification & Characterisation of Organic Compounds

Purification Crystallisation, 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 in organic quantitative analysis.

UNIT XX 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: —C=C—,—C=C— 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 reactions Substitution, addition, elimination and rearrangement.

UNIT XXI 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 (Markownikoff's and peroxide effect); Ozonolysis, oxidation, and polymerization.

Alkenes 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 functional group in mono-substituted benzene.

UNIT XXII 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 XXIII 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, NH_3 and its derivatives), Grignard reagent; oxidation; reduction (Wolff Kishner and Clemmensen); acidity of α - hydrogen, aldol condensation, Cannizzaro reaction, Haloform reaction; Chemical tests to distinguish between aldehydes and Ketones.

Carboxylic Acids Acidic strength & factors affecting it.

UNIT XXIV 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.

UNIT XXV 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.

UNIT XXVI Biomolecules

General introduction and importance of biomolecules.

Carbohydrates Classification aldoses and ketoses; monosaccharides (glucose and fructose), constituent monosaccharides of oligosacchorides (sucrose, lactose, maltose) and polysaccharides (starch, cellulose, glycogen).

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.

UNIT XXVII Chemistry in Everyday Life

Chemicals in medicines Analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamins - their meaning and common examples.

Chemicals in food Preservatives, artificial sweetening agents - common examples.

Cleansing agents Soaps and detergents, cleansing action.

Unit XXVIII Principles Related to Practical Chemistry

- Detection of extra elements (N, S, halogens) in organic compounds; Detection of the following functional groups: hydroxyl (alcoholic and phenolic), carbonyl (aldehyde and ketone), carboxyl and amino groups in organic compounds.

  Chemistry involved in the preparation of the following
- Inorganic compounds Mohr's salt, potash alum.
- Organic compounds Acetanilide, *p*-nitroacetan ilide, aniline yellow, iodoform.
- Chemistry involved in the titrimetric excercises - Acids bases and the use of indicators, oxali acid vs $KMnO_4$, Mohr's salt vs $KMnO_4$.
- Chemical principles involved in the qualitative salt analysis
- 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_2, NO_3, 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 reaction of iodide ion with hydrogen peroxide at room temperature.

JEE ADVANCED

PHYSICAL CHEMISTRY

General Topics Concept of atoms and molecules, Dalton's atomic theory, Mole concept, Chemical formulae, Balanced chemical equations, Calculations (based on mole concept) involving common oxidation-reduction, neutralisation, and displacement reactions, Concentration in terms of mole fraction, molarity, molality and normality.

Gaseous and Liquid States Absolute scale of temperature, ideal gas equation, Deviation from ideality, van der Waals' equation, Kinetic theory of gases, average, root mean square and most probable velocities and their relation with temperature, Law of partial pressures, Vapour pressure, Diffusion of gases.

Atomic Structure and Chemical Bonding Bohr model, spectrum of hydrogen atom, quantum numbers, Wave-particle duality, de-Broglie hypothesis, Uncertainty principle, Qualitative quantum mechanical picture of hydrogen atom, shapes of s, p and d orbitals, Electronic configurations of elements (up to atomic number 36), Aufbau principle, Pauli's exclusion principle and Hund's rule, Orbital overlap and covalent bond; Hybridisation involving s, p and d orbitals only, Orbital energy diagrams for homonuclear diatomic species, Hydrogen bond, Polarity in molecules, dipole moment (qualitative aspects only), VSEPR model and shapes of molecules (linear, angular, triangular, square planar, pyramidal, square pyramidal, trigonal bipyramidal, tetrahedral and octahedral).

Energetics First law of thermodynamics, Internal energy, work and heat, pressure-volume work, Enthalpy, Hess's law, Heat of reaction, fusion and vaporization, Second law of thermodynamics, Entropy, Free energy, Criterion of spontaneity.

Chemical Equilibrium Law of mass action, Equilibrium constant, Le-Chatelier's principle (effect of concentration, temperature and pressure), Significance of DG and DGo in chemical equilibrium, Solubility product, common ion effect, pH and buffer solutions, Acids and bases (Bronsted and Lewis concepts), Hydrolysis of salts.

Electrochemistry Electrochemical cells and cell reactions, Standard electrode potentials, Nernst equation and its relation to DG, Electrochemical series, emf of galvanic cells, Faraday's laws of electrolysis, Electrolytic conductance, specific, equivalent and molar conductivity, Kohlrausch's law, Concentration cells.

Chemical Kinetics Rates of chemical reactions, Order of reactions, Rate constant, First order reactions, Temperature dependence of rate constant (Arrhenius equation).

Solid State Classification of solids, crystalline state, seven crystal systems (cell parameters a, b, c), close packed structure of solids (cubic), packing in fcc, bcc and hcp lattices, Nearest neighbours, ionic radii, simple ionic compounds, point defects.

Solutions Raoult's law, Molecular weight determination from lowering of vapour pressure, elevation of boiling point and depression of freezing point.

Surface Chemistry Elementary concepts of adsorption (excluding adsorption isotherms), Colloids, types, methods of preparation and general properties, Elementary ideas of emulsions, surfactants and micelles (only definitions and examples).

Nuclear Chemistry Radioactivity, isotopes and isobars, Properties of rays, Kinetics of radioactive decay (decay series excluded), carbon dating, Stability of nuclei with respect to proton-neutron ratio, Brief discussion on fission and fusion reactions.

INORGANIC CHEMISTRY

Isolation/Preparation and Properties of the following Non-metals Boron, silicon, nitrogen, phosphorus, oxygen, sulphur and halogens, Properties of allotropes of carbon (only diamond and graphite), phosphorus and sulphur.

Preparation and Properties of the following Compounds Oxides, peroxides, hydroxides, carbonates, bicarbonates, chlorides and sulphates of sodium, potassium, magnesium and calcium, Boron, diborane, boric acid and borax, Aluminium, alumina, aluminium chloride and alums, Carbon, oxides and oxyacid (carbonic acid), Silicon, silicones, silicates and silicon carbide, Nitrogen, oxides, oxyacids and ammonia, Phosphorus, oxides, oxyacids (phosphorus acid, phosphoric acid) and phosphine, Oxygen, ozone and hydrogen peroxide, Sulphur, hydrogen sulphide, oxides, sulphurous acid, sulphuric acid and sodium thiosulphate, Halogens, hydrohalic acids, oxides and oxyacids of chlorine, bleaching powder, Xenon fluorides.

Transition Elements (3d series) Definition, general characteristics, oxidation states and their stabilities, colour (excluding the details of electronic transitions) and

calculation of spin-only magnetic moment; Coordination compounds: nomenclature of mononuclear coordination compounds, cis-trans and ionisation isomerisms, hybridization and geometries of mononuclear coordination compounds (linear, tetrahedral, square planar and octahedral).

Preparation and Properties of the following Compounds Oxides and chlorides of tin and lead, Oxides, chlorides and sulphates of Fe^{2+}, Cu^{2+} and Zn^{2+}, Potassium permanganate, potassium dichromate, silver oxide, silver nitrate, silver thiosulphate.

Ores and Minerals Commonly occurring ores and minerals of iron, copper, tin, lead, magnesium, aluminium, zinc and silver.

Extractive Metallurgy Chemical principles and reactions only (industrial details excluded), Carbon reduction method (iron and tin), Self reduction method (copper and lead), Electrolytic reduction method (magnesium and aluminium), Cyanide process (silver and gold).

Principles of Qualitative Analysis Groups I to V (only Ag^{+}, Hg^{2+}, Cu^{2+}, Pb^{2+}, Bi^{3+}, Fe^{3+}, Cr^{3+}, Al^{3+}, Ca^{2+}, Ba^{2+}, Zn^{2+}, Mn^{2+} and Mg^{2+}), Nitrate, halides (excluding fluoride), sulphate and sulphide.

ORGANIC CHEMISTRY

Concepts Hybridisation of carbon, Sigma and pi-bonds, Shapes of simple organic molecules, Structural and geometrical isomerism, Optical isomerism of compounds containing up to two asymmetric centres, (R,S and E,Z nomenclature excluded), IUPAC nomenclature of simple organic compounds (only hydrocarbons, mono-functional and bi-functional compounds), Conformations of ethane and butane (Newman projections), Resonance and hyperconjugation, Keto-enol tautomerism, Determination of empirical and molecular formulae of simple compounds (only combustion method), Hydrogen bonds, definition and their effects on physical properties of alcohols and carboxylic acids, Inductive and resonance effects on acidity and basicity of organic acids and bases, Polarity and inductive effects in alkyl halides, Reactive intermediates produced during homolytic and heterolytic bond cleavage, Formation, structure and stability of carbocations, carbanions and free radicals.

Preparation, Properties and Reactions of Alkanes Homologous series, physical properties of alkanes (melting points, boiling points and density), Combustion and halogenation of alkanes, Preparation of alkanes by Wurtz reaction and decarboxylation reactions.

Preparation, Properties and Reactions of Alkenes and Alkynes Physical properties of alkenes and alkynes (boiling points, density and dipole moments), Acidity of alkynes, Acid catalysed hydration of alkenes and alkynes (excluding the stereochemistry of addition and elimination), Reactions of alkenes with $KMnO_4$ and ozone, Reduction of alkenes and alkynes, Preparation of alkenes and alkynes by elimination reactions, Electrophilic addition reactions of alkenes with X_2, HX, HOX and H_2O (X=halogen), Addition reactions of alkynes, Metal acetylides.

Reactions of Benzene Structure and aromaticity, Electrophilic substitution reactions, halogenation, nitration, sulphonation, Friedel-Crafts alkylation and acylation Effect of o-, m- and p-directing groups in monosubstituted benzenes.

Phenols Acidity, electrophilic substitution reactions (halogenation, nitration and sulphonation), Reimer-Tiemann reaction, Kolbe reaction.

Characteristic Reactions of the following (including those mentioned above) Alkyl halides, rearrangement reactions of alkyl carbocation, Grignard reactions, nucleophilic substitution reactions, Alcohols, esterification, dehydration and oxidation, reaction with sodium, phosphorus halides, $ZnCl_2$/concentrated HCl, conversion of alcohols into aldehydes and ketones, Ethers, Preparation by Williamson's Synthesis, Aldehydes and Ketones, oxidation, reduction, oxime and hydrazone formation, aldol condensation, Perkin reaction, Cannizzaro reaction, haloform reaction and nucleophilic addition reactions (Grignard addition), Carboxylic acids, formation of esters, acid chlorides and amides, ester hydrolysis. Amines, basicity of substituted anilines and aliphatic amines, preparation from nitro compounds, reaction with nitrous acid, azo coupling reaction of diazonium salts of aromatic amines, Sandmeyer and related reactions of diazonium salts, carbylamine reaction, Haloarenes, nucleophilic aromatic substitution in haloarenes and substituted haloarenes (excluding Benzyne mechanism and Cine substitution).

Carbohydrates Classification, mono and disaccharides (glucose and sucrose), Oxidation, reduction, glycoside formation and hydrolysis of sucrose.

Amino Acids and Peptides General structure (only primary structure for peptides) and physical properties.

Properties and Uses of Some Important Polymers Natural rubber, cellulose, nylon, teflon and PVC.

Practical Organic Chemistry Detection of elements (N, S, halogens), Detection and identification of the following functional groups, hydroxyl (alcoholic and phenolic), carbonyl (aldehyde and ketone), carboxyl, amino and nitro, Chemical methods of separation of mono-functional organic compounds from binary mixtures.