VITEEE – 2025
CHEMISTRY

1. Physical Chemistry

Atomic Structure - Bohr's atomic model-Sommerfeld's extension of atomic structure; Electronic configuration and Quantum numbers; Shapes of s, p, d, f orbitals - Pauli's exclusion principle - Hund's Rule of maximum multiplicity- Aufbau principle. Emission and absorption spectra, line and band spectra; Hydrogen spectrum – Lyman, Balmer, Paschen, Brackett and Pfund series; de Broglie's theory; Heisenberg's uncertainty principle – wave nature of electron – Schrodinger wave equation (No derivation). Eigen values and eigen functions. Chemical bonding and hybridization of atomic orbitals involving s, p and d orbitals.

Thermodynamics, Chemical Equilibrium and Chemical Kinetics - I and II Laws of thermodynamics – spontaneous and non-spontaneous processes, entropy, Gibb's free energy – Standard Gibbs free energy change (ΔG^0) and chemical equilibrium – significance of entropy. Rate of a chemical reaction, factors affecting rates of reaction: concentration, temperature, pressure and catalyst; Law of mass action – Le Chatelier's principle, applications of chemical equilibrium. Rate expression, order, and molecularity of reactions, zero order, first order and pseudo first order reaction – half-life period. Determination of rate constant and order of reaction. Temperature dependence of rate constant – Arrhenius equation, activation energy and its calculation; elementary concept of collision theory of bimolecular gaseous reactions.

Solutions - Colligative properties of dilute solutions; Different methods for expressing the concentration of solution - molality, molarity, mole fraction, percentage, the vapour pressure of solutions and Raoult's Law - Ideal and non-ideal solutions, vapour pressure - composition, plots for ideal and non-ideal solutions

2. Inorganic and Material Chemistry

The s-block elements – properties and chemical reactivity of alkali and alkaline earth metals

The p-block elements – Phosphorous compounds: PCl_3, PCl_5 – Oxides, Hydrogen halides, Inter-halogen compounds and Xenon fluoride compounds

General characteristics of d – block elements – Electronic Configuration – Oxidation states of first row transition elements and their colours. Occurrence and principles of extraction: Copper, Silver, Gold and Zinc. Preparation and properties of $CuSO_4$, $AgNO_3$ and $K_2Cr_2O_7$.

Lanthanides – Introduction, electronic configuration, general characteristics, oxidation state – lanthanide contraction, uses, brief comparison of Lanthanides and Actinides

Introduction to coordination chemistry - IUPAC nomenclature of mononuclear coordination compounds; Isomerism, Geometrical isomerism in 4-coordinate, 6-coordinate complexes. Theories on coordination compounds – Werner's theory (brief), Valence Bond theory. Uses of coordination compounds. Bioinorganic compounds (Haemoglobin and chlorophyll).

Solid-State Chemistry - Lattice – unit cell, systems, types of crystals, packing in solids; Ionic crystals – Imperfections in solids – point defects, X-Ray diffraction – Electrical Property, Amorphous solids (elementary ideas only)

Surface Chemistry - Adsorption- physisorption and chemisorption; Catalysis – homogeneous and heterogeneous catalysis

3. Analytical Chemistry

Electrochemistry - Redox reactions; Theory of electrical conductance; metallic and electrolytic conductance. Faraday's laws – theory of strong electrolytes – Specific resistance, specific conductance, equivalent and molar conductance – Variation of conductance with dilution – Kohlrausch's Law – Ionic product of water, pH, and pH– buffer solutions – use of pH values. Cells – Electrodes and electrode potentials – construction of cell, EMF values and standard electrode potentials, Nernst equation and its application to chemical cells. Relation between Gibbs energy change and EMF of a cell, dry cell, electrolytic cells and Galvanic cells; lead accumulator; Fuel cells, Corrosion, and its prevention.

Environmental Chemistry - Environmental pollution - Atmospheric, water and soil.

4. Basic Principles of Organic Chemistry

Carbon – tetravalency, hybridization; Classification of organic compounds – functional groups; Homologous series; Nomenclature (IUPAC); Homolytic and heterolytic bond cleavage; carbocations, carbanions and free radicals; electrophiles and nucleophiles; Inductive effect, electromeric effect, resonance and hyperconjugation.

Common organic reactions **-** Substitution, addition, elimination and rearrangement

Isomerism in Organic Compounds: Definition, Classification – structural isomerism, stereo isomerism – geometrical and optical isomerism. Optical activity - chirality – compounds containing chiral centres – R, S notation, D, L notation.

Detection of the functional groups in organic compounds: Hydroxyl (alcoholic and phenolic), carbonyl (aldehyde and ketones) carboxyl and amino groups.

5. Properties and Chemistry of Functionalized Organic Compounds

Alcohols and Ethers - Nomenclature of alcohols – Classification of alcohols - distinction between 1°, 2° and 3° alcohols – General methods of preparation of primary alcohols, properties. Methods of preparation of dihydric alcohols: Glycol – Properties – Uses. Methods of preparation of trihydric alcohols - Properties – Uses. Aromatic alcohols – preparation and properties of phenols and benzyl alcohol; Ethers – Nomenclature of ethers – general methods of preparation of aliphatic ethers - Properties – Uses. Aromatic ethers – Preparation of Anisole – Uses

Carbonyl Compounds - Nomenclature of carbonyl compounds – Comparison of aldehydes and ketones. General methods of preparation of aldehydes – Properties – Uses. Aromatic aldehydes – Preparation of benzaldehyde – Properties and Uses. Ketones – general methods of preparation of aliphatic ketones (acetone) – Properties – Uses. Aromatic ketones – preparation of acetophenone – Properties – Uses, preparation of benzophenone – Properties. Name reactions; Clemmensen reduction, Wolff – Kishner reduction, Cannizzaro reaction, Claisen Schmidt reaction, Benzoin Condensation, Aldol Condensation. Preparation and applications of Grignard reagents.

Carboxylic Acids and their derivatives - Nomenclature – Preparation of aliphatic monocarboxylic acids – formic acid – Properties – Uses. Monohydroxy mono carboxylic acids; Lactic acid – Synthesis of lactic acid. Aliphatic dicarboxylic acids; Preparation of oxalic and succinic acids. Aromatic acids: Benzoic and Salicylic acids – Properties – Uses. Derivatives of carboxylic acids; acetyl chloride (CH_3COCl) – Preparation – Properties – Uses. Preparation of acetamide, Properties – acetic anhydride – Preparation, Properties. Preparation of esters – methyl acetate – Properties

6. Organic Nitrogen Compounds

Organic Nitrogen Compounds - Aliphatic nitro compounds – Preparation of aliphatic nitroalkanes – Properties – Uses. Aromatic nitro compounds – Preparation – Properties – Uses. Distinction between aliphatic and aromatic nitro compounds. Amines; aliphatic amines – General methods of preparation – Properties – Distinction between 1°, 2° and 3° amines. Aromatic amines – Synthesis of benzylamine – Properties, Aniline – Preparation – Properties – Uses. Differences between aliphatic and aromatic amines. Aliphatic nitriles – Preparation – properties – Uses. Diazonium salts – Preparation of benzene diazonium chloride – Properties.

7. Biomolecules and Polymers

Carbohydrates – Distinction between sugars and non-sugars, structural formulae of glucose, fructose, and sucrose, with their linkages, invert sugar – definition, examples of oligo and polysaccharides

Amino acids and Proteins – Classification of amino acids with examples, Peptides - properties of peptide bond; Proteins - primary, secondary, tertiary and quaternary structure (qualitative idea only), denaturation of proteins, enzymes

Lipids - Definition, classification with examples, difference between fats, oils, and waxes.

Nucleic acids – Chemical constitution of DNA and RNA

Polymers - Classification – Natural and synthetic, methods of polymerization (addition and condensation), copolymerization. Some important polymers: natural and synthetic like polythene, nylon, polyesters, Bakelite, rubber. Biodegradable and non-biodegradable polymers.

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