

Syllabi for screening tests and interviews

B. Chemistry

Physical Chemistry

- **Basic Mathematical Concepts:** Functions; maxima and minima; integrals; ordinary differential equations; vectors and matrices; determinants; basics of statistics and probability theory.
- **Atomic and Molecular Structure:** Fundamental particles; Bohr's theory of hydrogen-like atom; wave-particle duality; uncertainty principle; Schrödinger's wave equation; quantum numbers; shapes of orbitals; Hund's rule and Pauli's exclusion principle; electronic configuration of simple homonuclear diatomic molecules.
- **Theory of Gases:** Kinetic theory of gases; Maxwell-Boltzmann distribution law; equipartition of energy.
- **Chemical Thermodynamics:** Reversible and irreversible processes; first law and its application to ideal and non-ideal gases; thermochemistry; second law; entropy and free energy; criteria for spontaneity.
- **Chemical and Phase Equilibria:** Law of mass action; K_p , K_c , K_x and K_n ; effect of temperature on K ; ionic equilibria in solutions; pH and buffer solutions; hydrolysis; solubility product; phase equilibria- phase rule and its application to one-component and two-component systems; colligative properties.
- **Electrochemistry:** Conductance and its applications; transport number; galvanic cells; EMF and free energy; concentration cells with and without transport; polarography.
- **Chemical Kinetics:** Reactions of various order; Arrhenius equation; collision theory; transition state theory; chain reactions - normal and branched; enzyme kinetics; photochemical processes; catalysis.
- **Colloids and Surfaces:** Colloidal state of matter. Properties of lyophilic and lyophobic colloidal solutions. Thermodynamics of colloidal solutions. Determination of molecular weight of macromolecules. Surface energetics and adsorption.

- **Spectroscopy:** Beer-Lambert law; fundamental concepts of rotational, vibrational, electronic and magnetic resonance spectroscopy.

Organic Chemistry

- **Aliphatic and Aromatic Hydrocarbons:** Preparation, properties and their reactions. Reaction Intermediates and Stereo-electronic Effects.
- **Mechanism of Organic Reactions:** Nucleophilic substitution reactions, electrophilic addition to carbon-carbon double bond, free radical addition to olefins, elimination reactions.
- **Aromatic Compound and their reactions:** Aromaticity and Antiaromaticity, Aromatic Electrophilic Substitution, Aromatic Nucleophilic Substitution: S_N^{Ar} and Benzyne Mechanism.
- **Alkyl Halides:** Preparation, properties and important reactions of alkyl halides.
- **Stereochemistry:** Classification of Stereo isomers-Geometrical isomers-conformational analyses. Configuration-Wedge formula and Fischer projection formula-Newmann projection formula. Optical isomerism and chirality.
- **Alcohols and Phenols-Synthesis:** 1^o, 2^o and 3^o alcohols. Glycerol-preparation, properties and uses. Phenols and derivatives- preparation and properties. Pinacol-Pinacolone, Fries and Claisen rearrangements.
- **Carbonyl Compounds:** Preparation of aldehydes and ketones-Rosenmund's reduction, Etard's reaction, Oppenauer oxidation, Houben-Hoesh synthesis. Oxidation, reduction, condensation and rearrangement reactions of aldehydes and ketones. Reactions of α,β -unsaturated carbonyl compounds.
- **Carboxylic acids and Derivatives:** Hydroxy acids and their properties. Dicarboxylic acids- Aromatic acids- Aromatic sulphonic acids- Saccharin and chloramine-T, sulphanilic acid, sulphanilamide, and Sulpha drugs.
- **Synthetic Reagents:** Active methylene group. Grignard reagent, Frankland reagent, Reformatsky reaction, Claisen Condensation.
- **Nitrogen Compounds:** Cyanides and Isocyanides -Aromatic nitro compounds- Benzidine rearrangement. Separation of 1^o, 2^o and 3^o amines. Quaternary ammonium salts. Aromatic amines, diazonium salts-diazomethane, diazoacetic ester-Ardnt-Eistert synthesis, Wolf rearrangement.
- Heterocyclic Compounds, Hoffmann's exhaustive methylation.

- **Carbohydrates:** Anomers, mutarotation. Reactions of aldoses and ketoses. Epimer and Epimerisation. Disaccharides.
- Overview of amino acids, proteins, nucleic acids, dyes and pigments, polymer Chemistry
- **Structure Determination:** Structure determination of small organic molecules using IR, UV and NMR.

Inorganic Chemistry

- **Fundamental concepts:** Organization of elements in the periodic table, Periodic trends of the properties of the elements. Acids and bases, Redox reactions and reduction potentials.
- **Chemical Bonding and Shapes of Compounds:** Types of bonding; VSEPR theory and shapes of molecules; hybridization; dipole moment; ionic solids; structure of NaCl, CsCl, diamond and graphite; lattice energy.
- **Main Group Elements (s and p blocks):** General concepts on group relationships and gradation in properties; structure of electron deficient compounds involving main group elements.
- **Transition Metals (d block):** Characteristics of 3d elements; oxide, hydroxide and salts of first row metals; coordination complexes: structure, isomerism, reaction mechanism and electronic spectra; VB, MO and Crystal Field theoretical approaches for structure, color and magnetic properties of metal complexes; organometallic compounds having ligands with back bonding capabilities such as metal carbonyls.
- **Bioinorganic Chemistry:** Essentials and trace elements of life; basic reactions in the biological systems and the role of metal ions, especially Fe^{2+} , Fe^{3+} , Cu^{2+} and Zn^{2+} ; structure and function of haemoglobin, myoglobin, and carbonic anhydrase.