

**(a) Inorganic Chemistry**

1. **Periodic table:** Periodic classification of elements, long form of periodic table, trends within a group or period, periodicity in properties, Slater's rule.

2.

**Chemical bonding:** Types of bonding. VSEPR theory and shapes of molecules. Hybridization, dipole moment. Ionic solids - lattice energy. Structure of diamond and graphite.

3. **Main group elements (s and p blocks):** Properties; structure of electron deficient compounds of main group elements and application of main group elements.

4. **Transition metals (d block):** Characteristics of d-block elements. Coordination compounds of first row transition elements, bonding in coordination compounds – VBT and CFT of tetrahedral and octahedral complexes. Application of CFT to spectral and magnetic properties. Electronic spectra of coordination compounds.

5. **Organometallic compounds:** Organometallic compounds of Li, Be, Mg, B and Al. Concept of hapticity, 18 electron rule. Carbonyl compounds of first row of transition metals.

6. **Non aqueous solvents:** General characteristics, reactions with reference to ammonia and liquid sulphur dioxide.

7. **Acids and Bases:** Lewis and HSAB concepts

8. **Nuclear Chemistry:** Radioactivity, nuclear reactions, applications of isotopes.

**(b) Organic Chemistry**

1. **Nomenclature of Organic compounds.**

2. **Mechanism of Organic reactions:** Electronic effects in Organic molecules – Inductive effect, polarizability effect, resonance, hyperconjugation. Formal charge, generation, structure and general reactions of reactive intermediates: Carbocation, carbanion, carbon radical.

**3. Stereochemistry:** Types of isomerism. Projection formulae, chirality, assigning stereochemical descriptors to chiral centres and geometric isomers. Optical isomerism in compounds containing one and two asymmetric centers. Conformations of cyclohexanes.

**4. Aromaticity and Huckel's rule:** Mono and bicyclic carbocyclic aromatic hydrocarbons and their electrophilic substitution reactions.

**5. Synthetic chemistry:** Methods of preparation and characteristic reactions of alkanes, alkenes, alkynes (including their cyclic analogues)  
Functional group interconversions. Grignard reagents.

**6. Mechanism (with stereochemistry):** Aliphatic nucleophilic substitution, elimination, enolate reactions, Claisen condensation, esterification and ester hydrolysis, Cannizzaro reaction, benzoin condensation, Perkin reaction, Claisen rearrangement, Beckmann rearrangement, Wagner-Meerwein rearrangement.

**7. Carbohydrates:** Classification, nomenclature. Open and cyclic formulae. Chemistry of glucose.

**8. Amino acids and peptides:** Structure, stereochemistry, and characteristic reactions of amino acids. Structure of peptides.

### (c) Physical chemistry

**1. Atomic structure:** Fundamental particles. Bohr's theory of hydrogen atom; Wave-particle duality; Uncertainty principles, Schrodinger equation, Quantum numbers, shapes of orbitals; Hund's rule and Pauli's exclusion principle.

**2. Theory of gases:** Kinetic theory of gases. Real and ideal gases, critical phenomenon.

**3. Chemical thermodynamics:** Reversible and irreversible processes. First law and its application to ideal and nonideal gases. Thermochemistry. Second law. Entropy and free energy, Criteria for spontaneity.

**4. 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.

5. **Electrochemistry:** Conductance and its applications; Transport number; Galvanic cells; EMF and Free energy. Liquid junction potential and concentration cells. Application of emf measurement for determination of  $K$ ,  $\Delta G$ ,  $\Delta H$ ,  $\Delta S$ . Stability of complexes.

6. **Chemical kinetics:** Reactions of various order, Arrhenius equation, Collision theory; Theory of absolute reaction rate; Chain reactions - Normal and branched chain reactions; Enzyme kinetics; Photophysical and photochemical processes; Catalysis.

**(d) Analytical Chemistry**

Classification of analytical methods. Performance characteristics of analytical methods. Errors and their types. Acid-base titrations and acid-base indicators, Redox titrations, Conductometric and Potentiometric titrations