

General Chemistry• **Atomic Structure**

Bohr's theory and its limitation, Debroglie equation, Heisenberg's principle of uncertainty, Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau principle.

-Planck's quantum theory- Wave- Particl duality.

-Schrodinger wave equation.

-Angular momentum, quantisation of electronic energies (qualitative treatment of hydrogen atom)

- Periodicity in properties of atoms: Atomic and Ionic radii, Ionisation potential, Electronaffinity, Electronegativity, Hydration energy, Lattice energy.
- Chemical bonding: Valence bond theory, Hybrdization, valence shell electron pair repulsion theory (VSEPR) M O theory- molecular orbital diagram of homo and heteronuclear diatomic molecules.
- General properties of s-and p block elements.
- Chemical effects of unclear transformation- Nuclear fissionand fusion. Radioactive isotopes and their applications.
- Electronic displacement- Inductive, Electromeric and Mesomeric effects, Resonance and its application to organic compounds. Conjugation and hyper-conjugation.
- Oxidation- Reduction, Oxidising and Reducing agents Balancing of redox reactions.
- Concepts of acids and bases- Bronsted -Lowry theory, Lewis concept of acids and bases. Hard and fast acid and bases.
- Polymers: Definition and classification of polymers, properties of polymers with special reference to polyethene, polyvinyl chloride.
- Pollutants and their influence of environment, Chemical toxicology.
- **Symmetrty and Group Theory:** Symmetry elements and symmetry operations, definition of group and sub-groups, paint symmetry groups assignment of point groups of molecules like  $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{PCl}_5$  and  $\text{XeF}_4$ .

## Inorganic Chemistry

- Chemistry of Transition elements- General Characteristics: variable oxidation states, colour, complex formation, magnetic and catalytic properties.
- Chemistry of lanthanides and actinides, lanthanide contraction. Oxidation states. Spectral and magnetic properties. Principle of separation and isolation.
- Coordination Chemistry- IUPAC system of nomenclature of complex compounds, Isomerism, valence bond theory and its limitation. Crystal field theory: d-orbital splitting in octahedral and tetrahedral complexes, weak and strong field octahedral complexes, spectrochemical series. Electronic spectra of d-block elements. Complexes, selection rules for electronic transitions. Spectroscopic ground states for  $d^1$  to  $d^9$  systems.
- Main Group Elements and their Chemistry- Oxyacids of nitrogen, phosphorus and sulphur, Interhalogens and pseudohalides, Noble gas compounds, boranes, carboranes borazines and phosphazines, silicates and silicones,
- Organometallic Chemistry- Synthesis, Structure and bonding of organometallic compounds, Homogeneous catalytic reaction  $\pi$ -acid metal complexes.
- **Bio-inorganic and Supramolecular Chemistry**

Essential and trace elements in biological processes, Haemoglobin and myoglobin, Biological role of alkali and alkaline earth metals with special reference to  $Ca^{2+}$ , Photosynthesis and Nitrogen fixation.

Supramolecular Chemistry: introduction and nomenclature of supramolecules, molecular recognition and carrier design.

## **Organic Chemistry**

Stereochemistry: Conformational analysis of cycloalkanes, elements of symmetry, chirality, molecules with more than one chiral centre. Optical purity. Enantiotropic and diastereotropic atoms, optical activity in the absence of chiral carbon.

Nucleophilic aromatic substitution: aromatic  $SN_1$ , and  $SN_2$ , mechanism, leaving group and attacking nucleophile, evidences of neighbouring group participation, classical versus non-classical carbonium ion-the present status. Addition to carbon-carbon multiple bond, electrophilic, free radical and

nucleophilic addition. Esterification and hydrolysis of esters: evidence for tetrahedral intermediate,  $BAC_2$  and  $AAC_2$  mechanism and elimination reaction: the  $E_1$ ,  $E_2$  and  $E_{CB}$  mechanisms, Hoffmann versus Saytzeff elimination, competition between elimination and substitution reaction.

**Heterocyclic Chemistry:** Heterocyclic compounds with five and six membered ring-Pyrazoles, imidazoles, Pyridine and quinoline, applications of heterocyclic compounds- caffeine, diazepam and phenothiazines.

**Pericyclic reactions:** Molecular orbital symmetry, frontier orbital of ethylene, Woodward-Hoffmann correlation diagrams, cycloaddition, unimolecular tautomerism Ene reaction.

**Photochemistry of aromatic compounds:** ring isomerisation and cyclisation reactions, Photochemistry of carbonyl compounds, intramolecular and intermolecular hydrogen abstraction. Norrish cleavage (Type I and II)

**Chemistry of natural products:** Terpenes and alkaloids vitamins and Hormones-introduction of fat soluble and water soluble vitamins, functions of vitamin A, D, E, K Vitamin B-complex and vitamin C. Introduction. Classification and characteristics of hormones with special reference to thyroid hormones (thyroxin)

**Molecules of life processes:** Sugar, DNA and RNA enzymes-definition, classification and applications.

## Physical Chemistry

### **Solid state Chemistry**

Crystalline State of solids, unit cell, Bravais lattices, Miller indices, Diffraction of X-rays by crystalline solids, Crystal defects and non-stoichiometry, Perfect and imperfect crystals, Frenkel and Schottky defects Properties of solids ionic conductivity and diffusion and ferroelectric properties. Electronic properties and band theory- band structure of metals. Semiconductors (extrinsic and intrinsic) n-p-junction, superconductors.

**Surface phenomenon:** Surface tension, adsorption on solids, electrical phenomena at interfaces including electrokinetic, micelle and reverse micelle.

**Chemical Equilibria: Le-Chatelier's principle and its application:**

Free energy and entropy of mixing. Partial molar quantities, Gibbs-Duhem equation, Phase diagram of one and two component system and phase rule.

### **Thermodynamics**

First law of thermodynamics, Heat capacities at constant volume and pressure and their relationship, Joule-Thomson coefficient, calculation of  $w, q, dU$  and  $dH$  for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. Hess's law of heat summation and its applications, Heat of reaction at constant pressure and at constant volume, enthalpy of neutralization, bond energy and its calculation from thermo-chemical data.

Second law of thermodynamics- definition, Carnot cycle and efficiency. Concept of entropy, changes in ideal gases and mixing of gases.

Third Law of thermodynamics- statement and concept of residual entropy, Gibbs ( $G$ ) and Helmholtz ( $A$ ) Functions, thermodynamical quantities, variation of  $G$  and  $A$  with  $P, V$  and  $T$ .

### **Spectroscopy**

Time-dependent states and spectroscopy, absorption and emission of radiations and selection rules, line shapes and widths.

Magnetic-resonance spectroscopy, principle and application, chemical shift and spin-spin coupling first order spectra of  $A_3, X, AX$  and  $AMX$  system. Electronic spectroscopy of diatomic molecules, rotational fine structures.

IR spectroscopy, symmetry properties and nuclear spin affect, Raman Effect, vibration of polyatomic molecules.

### **Electrochemistry**

Quantitative treatment of Debye-Hukel theory of ion-ion interaction and activity coefficient. Thermodynamics of double layer. Determination of association constant ( $k_a$ ) from conductance data, Application of measurement of electrochemical rate constant.