

## GE- I (Theory)

### SEMESTER- I / II

(Credits: Theory-04, Practicals-02)

End Sem- 60marks

Mid Sem- 15 marks

Theory: 60 Lectures

Time- 3hrs

### SECTION A: INORGANIC CHEMISTRY-1

(30 Periods)

#### Unit-I

##### Atomic Structure

- (a) Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atomic spectra.
- (b) What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of  $\psi$  and  $\psi^2$ , Schrödinger equation for hydrogen atom. Significance of quantum numbers, Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms).
- (c) Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals; Anomalous electronic configurations.
- (d) Periodic Properties: Atomic radii and ionic radii, ionization energy, electron affinity, electronegativity, trends in periodic table and application in predicting and explaining the chemical behavior.

(16 Lectures)

#### Unit-II

##### Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO<sup>+</sup>. Comparison of VB and MO approaches.

(18 Lectures)

### Section B: Organic Chemistry-1

#### Unit- III

(30 Periods)

##### Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values.  
(8 Lectures)

#### Unit- IV Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). D and L; cis - trans nomenclature; CIP Rules: R/ S (for up to 2 chiral carbon atoms) and E / Z Nomenclature (for up to two C=C systems).

(10 Lectures)

#### Unit- V Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

**Alkanes:** (Up to 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

**Alkenes:** (Up to 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk.  $\text{KMnO}_4$ ) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.

**Alkynes:** (Up to 5 Carbons) Preparation: Acetylene from  $\text{CaC}_2$  and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline  $\text{KMnO}_4$ , ozonolysis and oxidation with hot alk.  $\text{KMnO}_4$ .

(12 Lectures)

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#### Reference Books:

- J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S.
  - F. A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
  - Douglas, McDaniel and Alexander: Concepts and Models in Inorganic Chemistry, John Wiley.
  - James E. Huheey, Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.
  - T. W. Graham Solomon: Organic Chemistry, John Wiley and Sons.
  - Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
  - E. L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill. • I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
  - R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
  - Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand
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## GE- I, LAB:

### **Inorganic Chemistry** (Expt. -15, Viva- 6 & Lab. Record- 4)

Time – 3hrs

Full mark- 25

#### **Qualitative Analysis**

Cation analysis, separation and identification of ions from groups I to V. (Phosphate separation may be included). Anion analysis including interfering acid radicals ( $\text{CO}_3^{2-}$  and  $\text{SO}_3^{2-}$ ,  $\text{Cl}^-$  and  $\text{Br}^-$ ,  $\text{Cl}^-$  and  $\text{I}^-$ ,  $\text{Br}^-$  and  $\text{I}^-$ ,  $\text{NO}_3^-$  and  $\text{Br}^-$ ,  $\text{NO}_3^-$  and  $\text{I}^-$ ,  $\text{NO}_3^-$  and  $\text{NO}_2^-$ ). Mixture containing not more than four radicals be given in the examination.

#### **Volumetric Analysis**

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with  $\text{KMnO}_4$ .
3. Estimation of water of crystallization in Mohr's salt by titrating with  $\text{KMnO}_4$ .
4. Estimation of Fe (II) ions by titrating it with  $\text{K}_2\text{Cr}_2\text{O}_7$  using internal indicator.
5. Estimation of Cu (II) ions iodometrically using  $\text{Na}_2\text{S}_2\text{O}_3$ .

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#### **Reference Books:**

- Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
  - Vogel's Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
  - Practical Organic Chemistry, F. G. Mann. & B. C. Saunders, Orient Longman, 1960.
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