

## ALLIED COURSE PAPER - II

### CHEMICAL BONDING

Marks: 150

Knowledge of Inorganic compounds is very important to most of the Scientists involved in different fields of Chemistry and in all other Sciences. This paper will help the student understand and rationalize the bonding in compounds, the basic shapes and structures of molecules in gaseous and solid state and even predict properties which may be of potential interest to their use as materials. Geology, Environmental Science, Molecular Biology, Material and Polymer Science, require knowledge of these Inorganic compounds (materials). This would prepare a strong and an essential base for them to integrate chemistry with their discipline at higher level.

### THEORY

#### Unit 1: The Covalent Bond and the structure of molecules

Valence Bond Approach , Concept of Resonance in various Organic and Inorganic compounds, hybridisation and structure, Equivalent and non-equivalent hybrid orbitals, Bent's rule and its applications ,VSEPR model for predicting shapes of molecules and ions containing lone pairs, sigma and pi bonds

#### Unit 2: Molecular Orbital Approach

LCAO method, symmetry and overlap for s-s ,s-p and p-p combinations, MO treatment of homonuclear diatomic molecules of 2<sup>nd</sup> period ( $B_2$ ,  $C_2$ ,  $N_2$ ,  $O_2$ ,  $F_2$ ) and heteronuclear di-atomic molecules ( $CO$ ,  $NO$ ) and their ions.

#### Unit 3: Bonding in Solid State

The close packing of atoms and ions in solids , size effects of atoms and ions, Fajan's rule (atomic and

ionic radius ratio in crystalline solids) and isomorphous substitutions.

Lattice energy (Born-Haber cycle) .

Stoichiometric and non-stoichiometric defects in Solids , Solid solutions and alloys.

Band theory ( conductors, semi-conductors and insulators).

#### Unit 4: Intermolecular forces:

van-der Waals forces, Hydrogen bonding and its applications, effect of these forces on melting point, boiling point and solubility.

**Suggested Texts:**

1. James E. Huheey, *"Inorganic Chemistry: Principles of structure and reactivity"*, Pearson Education, IV Edition 2006.
2. D. S. Shriver and P.A. Atkins, *"Inorganic Chemistry"*, Oxford University Press, V Edition 2009.
3. Alan G. Sharpe, *"Inorganic Chemistry"*, Pearson Education, III Edition 1981.
4. J. D. Lee, *Concise Inorganic Chemistry*, John Wiley & Sons, NY, V Edition 2008.
5. Grey L. Miessler and Donald A. Tarr, *"Inorganic Chemistry"*, Prentice Hall, IV Edition 2011.
6. B. Douglas, D. H. McDaniel and J. J. Alexander, *"Concepts and Models of Inorganic Chemistry"*, John Wiley and Sons, III Edition 1994.

**PRACTICAL****TITRIMETRIC ANALYSIS**

Preparations of standard solutions (concept of primary and secondary standards), Different units of concentration (molarity, molality, normality and formality)

**(A) Titrations involving acids-Bases:**

Principle of acid-base titrations, Principle behind selection of an appropriate indicator.

- i. Standardization of NaOH solution (standard solution of oxalic acid to be prepared)
- ii. Determination of concentration of carbonate and hydroxide present in a mixture.
- iii. Determination of concentration of carbonate and bicarbonate present in a mixture.
- iv. Determination of concentration of free alkali present in soaps/detergents/shampoos.

**(B) Titrations involving redox reactions:**

Concept of electrode potential, principle behind selection of an appropriate indicator.

- i. Standardization of  $\text{KMnO}_4$  solution (standard solution of Mohr's salt to be prepared).
- ii. Determination of concentration of Fe (II) in Mohr's salt and/or  $\text{K}_2\text{Cr}_2\text{O}_7$  using diphenylamine / N-phenylanthranilic acid as internal indicator (standard solution of  $\text{K}_2\text{Cr}_2\text{O}_7$  and /or Mohr's salt to be prepared).
- iii. Determination of iron content in ores / alloys using appropriate redox titration.

**Recommended Texts:**

1. *Vogel's Textbook of Quantitative Inorganic Analysis*, John Wiley & Sons, NY, V Edition 1989.
2. Harris, D.C. *Quantitative Chemical Analysis*, Freeman, W.H. & Co.Inc.NY, VII Edition, 2007.