

SEMESTER-VI

PAPER-15

Marks: 150

INORGANIC: ORGANOMETALLIC, BIO-INORGANIC CHEMISTRY

THEORY

Unit I: Theoretical Principles in Inorganic Qualitative Analysis (H₂S Scheme)

Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

Unit II: Organometallic Compounds

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands.

Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π -acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium.

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene.

Unit III: Bioinorganic Chemistry

Metal ions present in the biological system and classification on the basis of action (essential, non-essential, trace, toxic). Classification of metallobiomolecules (enzymes, transport and storage proteins and non proteins). Na – K pump, a brief idea of ionophores. Importance of Zn as a biocatalyst. Metalloenzymes involving Zn – carbonic anhydrase, and carboxypeptidase A. Structure of the active site and function of these enzymes in brief.

Importance of iron in the human system with reference to haemoglobin and myoglobin. Role of haemoglobin as an oxygen carrier, Perutz Mechanism for oxygenation of haemoglobin,

Cooperative Effect, Bohr Effect, comparison of oxygen saturation curves of haemoglobin and myoglobin. Storage and transport of iron in humans – Ferritin and Transferrin. Chelating agents in medicine: Use of chelating agents like EDTA, BAL and D- penicillamine in metal poisoning. Anticancer activity of Cisplatin.

Recommended Texts:

1. Vogel, A.I. *Qualitative Inorganic Analysis*, Longman, 1972
2. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, 7th Edition, Prentice Hall, 1996-03-07.
3. Cotton, F.A. G.; Wilkinson & Gaus, P.L. *Basic Inorganic Chemistry 3rd Ed.*; Wiley India,
4. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed.*, Harper Collins 1993, Pearson, 2006.
5. Sharpe, A.G. *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005
6. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry 3rd Ed.*, John Wiley and Sons, NY, 1994.
7. Greenwood, N.N. & Earnshaw, A. *Chemistry of the Elements, Elsevier 2nd Ed*, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
8. Lee, J.D. *Concise Inorganic Chemistry 5th Ed.*, John Wiley and sons 2008.
9. Powell, P. *Principles of Organometallic Chemistry*, Chapman and Hall, 1988.
10. Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.
11. Bertini, I.; Gray, H.B.; Lippard, S.J. & Valentine, J.S. *Bioinorganic Chemistry*, Viva Books Pvt. Ltd., 1998.
12. Lippard, S.J. & Berg, J.M. *Principles of Bioinorganic Chemistry*, Panima Publishing Corporation, 1997.
13. Hughes, M.N. *Inorganic Chemistry of Biological Processes*, John Wiley and Sons, London, 1981.

PRACTICAL

INORGANIC: QUALITATIVE SEMIMICRO ANALYSIS

Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

CO_3^{2-} , NO_2^- , S^{2-} , SO_3^{2-} , $\text{S}_2\text{O}_3^{2-}$, CH_3COO^- , F^- , Cl^- , Br^- , I^- , NO_3^- , BO_3^{3-} , $\text{C}_2\text{O}_4^{2-}$, PO_4^{3-} , NH_4^+ , K^+ , Pb^{2+} , Cu^{2+} , Cd^{2+} , Bi^{3+} , Sn^{2+} , Sb^{3+} , Fe^{3+} , Al^{3+} , Cr^{3+} , Zn^{2+} , Mn^{2+} , Co^{2+} , Ni^{2+} , Ba^{2+} , Sr^{2+} , Ca^{2+} , Mg^{2+}

Mixtures should preferably contain one interfering anion, **or** insoluble component (BaSO_4 , SrSO_4 , PbSO_4 , CaF_2 or Al_2O_3) **or** combination of anions e.g. CO_3^{2-} and SO_3^{2-} , NO_2^- and NO_3^- , Cl^- and Br^- , Cl^- and I^- , Br^- and I^- , NO_3^- and Br^- , NO_3^- and I^- .

Spot tests should be done whenever possible.

Recommended Text:

1. Svehla, Vogel, A.I. *Qualitative Inorganic Analysis*, Longman, 1972
2. G. *Vogel's Qualitative Inorganic Analysis*, 7th Edition, Prentice Hall, 1996-03-07.