

DISCIPLINE SPECIFIC COURSE (DSC) - 02
COURSE : INORGANIC CHEMISTRY

Total Credits: 04
Lectures: 30 Hours, Tutorial: 0, Practical: 60 Hours

Objectives:

The course introduces the students to basics of coordination chemistry and organometallics which are of immense importance to biological systems. Nomenclature, isomerism, bonding in coordination compounds has been dealt with in sufficient detail along with special emphasis on important coordination compounds in the biological system. In organometallic chemistry, the students are introduced to classification of organometallic compounds, the concept of hapticity and the 18-electron rule governing the stability of a wide variety of organometallic species with special emphasis on metal carbonyls.

Learning Outcomes:

- By the end of the course, the students will be able to:
- Understand term like; ligand, chelate, coordination number. Systematic naming of coordination compounds.
- Learn various types of isomerism possible in Octahedral and Tetrahedral coordination compounds.
- Use Valence Bond Theory to predict the structure and magnetic behaviour of metal complexes and understand the terms inner and outer orbital complexes.
- Understand meaning of the terms Δ_o , Δ_t , pairing energy, CFSE, high spin and low spin and how CFSE affects thermodynamic properties like lattice enthalpy and hydration enthalpy.
- Analyse IR data to understand the extent of back bonding in metal carbonyls.

Theory:

Unit 1. Introduction to Coordination compounds: 6 Hours

Brief discussion with examples of types of ligands, denticity and concept of chelate. IUPAC system of nomenclature of coordination compounds (mononuclear and binuclear) involving simple monodentate and bidentate ligands. Structural and stereoisomerism in complexes with coordination number 4 and 6.

Unit 2. Bonding in Coordination compounds: 14 Hours

Valence Bond Theory (VBT): Salient features of theory, concept of inner and outer orbital complexes, Drawbacks of VBT.

Crystal Field Theory: Splitting of d orbitals in octahedral symmetry. Crystal field effects for weak and strong fields, Crystal field stabilization energy (CFSE), concept of pairing energy,

Factors affecting the magnitude of Δ , Spectrochemical series, Splitting of d orbitals in tetrahedral symmetry, Comparison of CFSE for octahedral and tetrahedral fields, tetragonal distortion of octahedral geometry, Jahn-Teller distortion.

Unit 3. Organometallic chemistry: 10 Hours

Definition and classification with appropriate examples based on nature of metal-carbon bond (ionic, sigma, pi and multicentre bonds), Structure and bonding of methyl lithium and Zeise's salt, Structure and bonding of ferrocene, mononuclear and polynuclear carbonyls of 3d metals, 18-electron rule as applied to carbonyls, π -acceptor behaviour of carbon monoxide (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Practical: 60 Hours

1. Estimation of Mg^{2+} by direct complexometric titration using EDTA.
2. Estimation of Zn^{2+} by direct complexometric titration using EDTA.
3. Estimation of Ca^{2+} by direct complexometric titration using EDTA.
4. Estimation of total hardness of a given sample of water by complexometric titration.
5. Determination of the composition of the Fe^{3+} -salicylic acid complex/ Fe^{2+} -1, 10 phenanthroline complex in solution by Job's method.
6. Determination of the composition of the Fe^{3+} -salicylic acid complex/ Fe^{2+} -1,10-phenanthroline complex in solution by mole ratio method.
7. Preparation of the following inorganic compounds:
 - a) Tetraamminecopper (II) sulphate
 - b) Potassium trioxalatoferrate (III) trihydrate
 - c) Chrome alum
 - d) Cuprous chloride
 - e) Manganese (III) phosphate ($MnPO_4 \cdot H_2O$)
 - f) Potash alum
 - g) Acetylacetonate complex of Cu^{2+} and Fe^{3+}

Suggested Readings:

Theory:

1. Huheey, J.E., Keiter, E.A., Keiter, R. L., & Medhi, O.K. (2009). Inorganic Chemistry- Principles of Structure and Reactivity. Pearson Education.
2. Shriver, D. D., Atkins, P., & Langford, C.H. (1994). Inorganic Chemistry (2nd Ed.). Oxford University Press.
3. Atkins, P.W., Overton, T.L., Rourke, J.P., Weller, M.T., & Armstrong, F.A. (2010), Inorganic Chemistry (5th Ed.). W. H. Freeman and Company.
4. Cotton, F.A. Wilkinson, & G. Gaus, P.L. Basic Inorganic Chemistry (3rd Ed.). Wiley India.
5. Douglas, B.E., McDaniel, D.H., & Alexander, J.J. (1994). Concepts and Models of Inorganic Chemistry. John Wiley & Sons.

6. Greenwood, N.N.; Earnshaw, A. (1997). Chemistry of the Elements (2nd Ed.). Elsevier.
7. Sahoo, et al. Inorganic Chemistry. PHI Learning Private Limited.

Practical:

1. Jeffery, G.H., Bassett, J., Mendham, J., & Denney, R.C. (1989). Vogel's Textbook of Quantitative Chemical Analysis. John Wiley and Sons.
2. Marr, G., & Rockett, B.W. (1972). Practical Inorganic Chemistry. Van Nostrand Reinhold.

Keywords:

Crystal field theory, Dq, CFSE, Nomenclature, Valence bond theory, Crystal field theory, Magnetic properties, 18 electron rule, metal carbonyls, hapticity.

Teaching Learning Process:

- Conventional chalk and board teaching.
- Class interactions and discussions.
- Power point presentation on important topics.

Assessment Methods:

- Presentations by Individual Student/ Group of Students.
- Class Tests at Periodic Intervals.
- Written assignment(s).
- End semester University Theory Examination.