BSC. (PHYSICAL SCIENCES)- CHEMISTRY COMPONENT
SEMESTER - V

DISCIPLINE SPECIFIC CORE COURSE CHEM-DSC -13: Chemistry- V: Coordination Chemistry and Organometallics

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Coordination Chemistry and Organometallics DSC-13: Chemistry- V	**04**	**02**	**-**	**02**	**Class 12th with Physics, Chemistry, Mathematics**	

Learning Objectives

The Learning Objectives of this course are as follows:

- To develop basic understanding of coordination chemistry and organometallics which are of immense importance to biological systems, qualitative quantitative analysis, catalysis, medicines, paints and pigments etc.
- The students learn nomenclature, isomerism and bonding in coordination compounds with special emphasis on important coordination compounds in the biological system.
- To understand 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 studying this course, students will be able to:

- Understand terms: ligand, denticity of ligands, chelate, coordination number.
- Systematically name coordination compounds.
- Discuss the 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.
- Explain the meaning of the terms $\Delta o.$, Δt, pairing energy, CFSE, high spin and low spin and how CFSE affects thermodynamic properties like lattice enthalpy and hydration enthalpy.

- Explain magnetic properties and colour of complexes on basis of Crystal Field Theory
- Apply 18-electron rule to rationalize the stability of metal carbonyls and related species.
- Learn how IR data can be used to understand extent of back bonding in metal carbonyls.

Syllabus

Unit 1: Introduction to Coordination compounds **(Hours: 6)**

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 numbers 4 and 6.

Unit 2: Bonding in Coordination Compounds **(Hours: 14)**

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 **(Hours: 10)**

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 Component **Credits:02**

(Laboratory periods:60)

1. Estimation of Mg^{2+} by direct complexometric titrations using EDTA.
2. Estimation of Zn^{2+} by direct complexometric titrations using EDTA.
3. Estimation of Ca^{2+} by direct complexometric titrations 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.

Teaching Plan 2024-2025
B.Sc. Physical Sciences (Semester V)
DSC-13: Coordination Chemistry and Organometallics

Teacher: **Prof. Arkaja Goswami**

Week	Topic
Week 1	Brief discussion with examples of types of ligands, denticity and concept of chelate.
Week 2	Denticity and concept of chelate. IUPAC system of nomenclature of coordination compounds (mononuclear and binuclear) involving Simple monodentate and bidentate ligands.
Week 3	IUPAC system of nomenclature of coordination compounds (mononuclear and binuclear) involving Simple monodentate and bidentate ligands.
Week 4	Valence Bond Theory (VBT): Salient features of theory, concept of inner and outer orbital complexes,
Week 5	Drawbacks of VBT.Crystal Field Theory.
Week 6	Splitting of d orbitals in octahedral symmetry. Crystal field effects for weak and strong fields.
Week 7	Crystal field stabilization energy (CFSE), concept of pairing energy, Factors affecting the magnitude of A, Spectrochemical series,
Week 8	Splitting of d orbitals in tetrahedral symmetry. Comparison of CFSE for octahedral and tetrahedral fields,
Week 9	tetragonal distortion of octahedral geometry, John-Teller distortion
Week 10	Definition and classification with appropriate examples based on nature of metal-carbon bond (ionic, sigma, pi and multicenter bonds)
Week 11	Structure and bonding of methyl lithium and Zeise's salt.
Week 12	Structure and bonding of ferrocene, mononuclear and Polynuclear carbonyls of 3d metals,
Week 13	18-electron rule as applied to carbonyls,
Week 14	acceptor behavior of carbon monoxide (MO diagram of CO to be discussed),
Week 15	Synergic effect and use of IR data to explain extent of back bonding.
Week 16	How and why molecular diagram of CO can be referred to for synergistic effect .to IR frequencies.
Week 17	Tests / Assignments