DISCIPLINE SPECIFIC ELECTIVE COURSE – 24 PS (DSE-24 PS)

Coordination Chemistry, Reaction Mechanism and Spectral properties

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, Reaction Mechanism and Spectral properties (DSE-24 PS)	**04**	**02**	**--**	**02**	Class12th with Physics, Chemistry, Mathemat-ics	**--**

Course Objectives

The Learning Objectives of this course are as follows:

- Solve problems from the basic and advanced concepts of transition metal chemistry
- Apply different bonding theories to explain the interaction between transition metals and ligands and predict the shape, stability, and optical and magnetic properties of complexes
- Design the most possible products and choose appropriate reaction condition to obtain the desired products in coordination compounds
- Appraise some natural phenomenon where reactions of coordination compounds are happening inside the human body and in plants enabling them to improve individual and societal health as well as environment.

Learning Outcomes

By the end of this course, students will be able to:

- Understand the advance theories to explain bonding in complexes.
- Attain knowledge of reaction mechanism of complexes.
- Understand the spectroscopic techniques to study structure and bonding in complexes.
- Develop skills in the scientific method of planning, developing, conducting, reviewing and reporting experiments.
- Understand concepts of industrial catalysis which will help them to explore new innovative areas of research.

Theory:

Unit 1: Ligand Field/ Molecular Orbital Theory (MOT) of Coordination Compounds (10 Hours)

Limitations of CFT, Crystal field to ligand field, σ and π bonding and energy diagrams of octahedral, tetrahedral, square planar complexes, effect of ligand group orbitals on Δ, effect of charge of metal on Δ, spectrochemical series comparison from different theories.

Unit 2: Reaction Mechanism (10 Hours)

Reaction mechanisms of metal complexes, Nucleophilic substitution reactions in octahedra complexes and their mechanisms, hydrolysis reactions, water exchange reactions, trans effect and its application, electron transfer reactions, inner sphere and outer sphere mechanisms, mixed valence complexes, redox reactions of metal complexes in excited states, role of spin-orbit coupling, life-times of excited states in these complexes.

Unit 3: Electronic Transitions and Selection Rules (5 Hours)

Spin and Laporte selection rules of transitions, charge transfer transitions, LMCT and MLCT transitions, Intervalence charge transfer and inter ligand π-π^* charge transfer.

Unit 4: Spectral Properties (5 Hours)

Nephelauxetic series, Orgel and Tanabe-Sugano diagrams, spin cross over, Jahn-Teller Distortions and Spectra,

Practicals: Credits: 02

(Laboratory periods:15 classes of 4 hours each)

1. Estimation of Ca^{2+} in solution by (substitution method) using Erio-chrome black-T as indicator.
2. Estimation of Ca^{2+} /Mg^{2+} in drugs/ Milk/ Biological samples by Back titration.
3. Complexometric estimation of Zn^{2+} using Xylenol orange as indicator.
4. Complexometric estimation of Al^{3+} using Erio-chrome black-T as indicator.
5. Complexometric estimation of mixture of Zn^{2+} and Mg^{2+} in a sample solution using Xylenol orange and Eriochrome black-T as indicator
6. Complexometric estimation of mixture of Al^{3+} and Mg^{2+} in a sample solution using masking agent.
7. Estimation of $BaSO_4$ by EDTA back titration using Eriochrome black-T as indicator.
8. Measurement of 10 Dq by spectrophotometric method.
9. Verification of Spectrochemical series.
10. Preparation of acetylacetonato complex of Cu^{2+} and Fe^{3+}. Determine λ_{max} of the complex.
11. Synthesis of ammine complex of Ni^{2+} and its ligand exchange reaction such as acetylacetone, DMG, glycine by substitution method.

Essential/recommended 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. Cotton, F.A.; Wilkinson, G. (1999), **Advanced Inorganic Chemistry,** Wiley-

VCR.
3. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), **Inorganic Chemistry,** 5th Edition, Pearson.
4. B.E. Douglas, D.H. McDaniel and J.J. Alexander, **Concepts and Models of Inorganic Chemistry**, JohnWiley,1993, 3rd ed.

Practicals:

1. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. {1989}, **Vogel's Textbook of Quantitative Chemical Analysis,** John Wiley and Sons,
2. Harris, D. C.; Lucy, C. A.{2016}, **Quantitative Chemical Analysis,** 9th Edition, Freeman and Company.
3. Day, R. A.; Underwood, A. L. {2012}, **Quantitative Analysis,** Sixth Edition, PHI Learning Private Limited.

Assessment Methods: All examination and assessments methods shall be in line with the University of Delhi guidelines issued from time to time.