DEPARTMENT OF CHEMISTRY

SEMESTER IV

B Sc. (Hons) Chemistry

DISCIPLINE SPECIFIC CORE COURSE - 10(DSC-10): Coordination Chemistry and Reaction Mechanism

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 Reaction Mechanism (DSC-10: Inorganic Chemistry - IV)	04	03	--	01	Class 12th with Physics, Chemistry, Mathematics	--

Learning Objectives

The Objectives of this course are as follows:

- To familiarize the students with coordination compounds which find manifold applications in diverse areas.
- To acquaint the student with the concept of Inorganic reaction mechanism.

Learning Outcomes

By studying this course, the students will be able to:

- Explain the terms- ligand, denticity of ligands, chelate, coordination number and use standard rules to name coordination compounds.
- Discuss the various types of isomerism possible in such 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 Δ_o, Δ_t, pairing energy, CFSE, high spin and low spin complexes and how CFSE affects thermodynamic properties like lattice enthalpy and hydration enthalpy.
- Explain magnetic properties and colour of complexes on the basis of Crystal Field Theory.
- Explain the reaction mechanism of coordination compounds and differentiate between kinetic and thermodynamic stability.

SYLLABUS OF DSC-10

Unit-1: Coordination Chemistry **(Hours: 28)**

Werner's Coordination theory, simple problems based on this theory

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds (coordination numbers 4 and 6). Valence bond theory and its application to complexes of coordination numbers 4 and 6.

Crystal field theory, measurement of Δ_o. Calculation of CFSE in weak and strong fields, concept of pairing energies, factors affecting the magnitude of Δ_o. Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry: Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory (for octahedral σ-donor, π- acceptor and π- donor complexes).

Unit-2: Stability of complexes and Inorganic Reaction Mechanism: **(Hours: 17)**

Brief discussion of thermodynamic and kinetic stability, Factors affecting stability of complexes, such as chelate effect, macrocyclic effect, resonance effect etc., trends in step wise formation constant, interpretation of lability and inertness based on VBT and CFT.

Introduction to inorganic reaction mechanisms, concept of reaction pathways, transition state, intermediate and activated complex. Substitution reactions in square planar complexes, factors affecting the rate of Substitution reactions in square planar complexes- such as charge effect, solvent effect and Trans- effect (Theories of trans-effect).

Practical component
Practical: **Credits: 01**
(Laboratory periods: 15 classes of 2 hours each)

(A) Argentometry

Estimation of Cl^-

(i) By Mohr's method

(ii) By Vohlard's method and

(iii) By Fajan's method

(B) Complexometric Titrations:

(i) Complexometric estimation of Mg^{2+}/ Zn^{2+} using EDTA

(ii) Estimation of total hardness of water samples

(iii) Estimation of Ca^{2+} in solution by substitution method

(iv) Estimation of Ca/Mg in drugs or biological samples**.**

(C) Properties of Complexes

Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetone, dimethyl glyoxime, glycine) by substitution method.

Essential/recommended readings

Theory:

1. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), **Shriver and Atkins Inorganic Chemistry**, 5th Edition, Oxford University Press.
2. Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), **Inorganic Chemistry**, Fifth Edition, Pearson.
3. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), **Inorganic Chemistry-Principles of Structure and Reactivity**, Pearson Education.
4. Pfennig, B. W. (2015), **Principles of Inorganic Chemistry,** John Wiley & Sons.
5. Cotton, F.A.; Wilkinson, G.(1999), **Advanced Inorganic Chemistry,** Wiley-VCH.
6. Sodhi G.S. (2018), **Principles of Inorganic Chemistry,** Viva Books India.

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.
4. Marr, G.; Rockett, B.W. (1972), **Practical Inorganic Chemistry**, Van Nostrand Reinhold.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.