ARSD College, University of Delhi

Model Course Handout/Lesson Plan

Course Name : B.Sc. (H) Chemistry						
Semester	**Course Code**	**Course Title**	**Lecture (L)**	**Tutorial (T)**	**Practical (P)**	**Credit (C)**
IV	32171401	Inorganic Chemistry III: Coordination Chemistry	4			4
Teacher/Instructor(s)		Dr. Naorem Premjit Singh				
Session		2021-22				

Course Objective:

The course introduces the students to coordination compounds which find manifold applications in diverse areas like qualitative and quantitative analysis, metallurgy, as catalysts in industrial processes as medicines, paints and pigments as well as in life. The student is also familiarized with the d and f block elements and gets an idea about horizontal similarity in a period in addition to vertical similarity in a group.

Course Learning Outcomes:

- Understand 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 and understand the types of isomerism possible in a metal complex.
- 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
- Understand the important properties of transition metals like variable oxidation states, colour, magneticand catalytic properties and use Latimer diagrams to predict and identify species which are reducing, oxidizing and tend to disproportionate and calculate skip step potentials
- Understand reaction mechanisms of coordination compounds and differentiate between kinetic and thermodynamic stability.

Lesson Plan:

Unit No.	Learning Objective	Lecture No.	Topics to be covered
1.	**Coordination Chemistry**	1-2	Werner's Coordination theory
		3-4	IUPAC nomenclature of coordination compounds
		5-7	Isomerism in coordination compounds with coordination numbers 4 and 6.
		8-9	Chelate effect and labile and inert complexes.
		10-13	Valence bond theory and its application to complexes of coordination numbers 4 and 6. Examples of inner and outer orbital complexes.
		14-15	Crystal field theory, measurement of Δo, factors affecting the magnitude of Δo.
		16-19	Calculation of CFSE in weak and strong fields, concept of pairing energies
		20-23	Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry.
		24-26	Qualitative aspect of Ligand field and MO Theory (for octahedral σ-donor, π- acceptor and π- donor complexes)
2.	**Transition Elements**	27-29	General group trends with special reference to electronic configuration, colour, variable valency, magnetic properties (no temperature dependence), catalytic properties, and ability to form complexes
		30-33	Latimer diagrams of Mn, Fe and Cu in acidic and basic media
		34	Brief discussion of differences between the first, second and third transition series.
		35-40	Some important compounds of Cr, Mn, Fe and Co and their roles as laboratory reagents; Potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite.
3.	**Lanthanoids and Actinoids**	41-44	Brief discussion of electronic configuration, oxidation states, colour, spectral and magnetic properties
		45-46	Lanthanoid contraction (causes and effects) separation of lanthanoids by ion exchange method
4.	**Inorganic Reaction Mechanism**	47	Introduction to inorganic reaction mechanisms
		48-49	Concept of reaction pathways, transition state, intermediate and activated complex
		50-53	Substitution reactions in square planar complexes
		54-57	Trans- effect, theories of trans-effect
		58-60	Thermodynamic and Kinetic stability (using VBT).

Evaluation Scheme:

No.	Component	Duration	Marks
1.	Internal Assessment • Quiz • Class Test • Attendance • Assignment		25
2.	End Semester Examination	3 hr	75

Details of the Course		
Unit	**Contents**	**Contact Hours**
1.	Coordination Chemistry: Recapitulation of Werner's Coordination theory, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. with coordination numbers 4 and 6. A brief idea about chelate effect and labile and inert complexes. Valence bond theory and its application to complexes of coordination numbers 4 and 6. Examples of inner and outer orbital complexes. Crystal field theory, measurement of Δo. Calculation of CFSE in weak and strong fields, concept of pairing energies, factors affecting the magnitude of Δo. 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).	26
2.	Transition Elements: General group trends with special reference to electronic configuration, colour, variable valency, magnetic properties (no temperature dependence), catalytic properties, and ability to form complexes. Latimer diagrams of Mn, Fe and Cu in acidic and basic media A brief discussion of differences between the first, second and third transition series. Some important compounds of Cr, Mn, Fe and Co and their roles as laboratory reagents; Potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite.	14
3.	Lanthanoids and Actinoids: A brief discussion of electronic configuration, oxidation states, colour, spectral and magnetic properties. Lanthanoid contraction (causes and effects) separation of lanthanoids by ion exchange method.	6
4.	Inorganic Reaction Mechanism: Introduction to inorganic reaction mechanisms. Concept of reaction pathways, transition state, intermediate and activated complex. Substitution reactions in square planar complexes, Trans- effect, theories of trans-effect. Thermodynamic and Kinetic stability (using VBT).	14
	Total	**60**
Suggested Books:		

Sl. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
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.	2010
	Miessler, G. L.; Fischer P.J.; Tarr, D. A. (2014), Inorganic Chemistry, 5th Edition, Pearson.	2014
	Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry- Principles of Structure and Reactivity, Pearson Education.	2009
	Pfennig, B. W. (2015), Principles of Inorganic Chemistry. John Wiley & Sons.	2015
	Cotton, F.A.; Wilkinson, G. (1999), Advanced Inorganic Chemistry Wiley-VCH.	1999
Mode of Evaluation:	Internal Assessment / End Semester Exam	