School of Chemistry
Faculty of Science
University of the Punjab, Lahore
Course Outline

BS Chemistry Semester-VI					
Programme	**BS (Chemistry)**	**Course Code**	**Chem-316**	**Credit Hours**	**2**
Course Title	**Coordination Chemistry**		**Course Type**	**Major**	

Course Introduction

It will help the students to understand the basic chemistry of d block elements and their coordination compounds, along with their applications on industrial scale due to their advanced stability, chelating ability and catalytic nature. Here is a brief description of course outlines:

Structure & Bonding

Introduction of transition elements, complex/coordination compounds/double salts, Development of coordination compounds: Bloom strand theory, Werner Theory, VBT; Hybridization in coordination compounds with coordination number from 2 to 9. Important features of CFT, d-orbitals splitting for various common geometries, measurement of 10 Dq., factors effecting 10 Dq. CFSE, Applications of CFT in explaining color, spinels etc. MOT; MO diagrams for metal complexes of common geometry. Ligand Field Theory (LFT)

Synthesis and properties

Introduction. Preparative methods. Isomerism in coordination compounds (Conformational, Coordination, Ionization, Hydrate/Solvate, Ligand, Linkage, Fluxional, and Spin isomerism). Stereochemistry (geometric and optical isomerism in compounds with coordination numbers 4 and 6). The spectrochemical series and factors affecting high/low spin. Magnetism (Diamagnetism and Paramagnetism). Jahn-Teller effect. Thermodynamic vs. Kinetic stability, Stability constants. Analytical methods for studying complexes. Role of metal complexes in analytical chemistry, industry, and nature.

Learning Outcomes

On the completion of the course, the students will be able to:

1. Understand the basic chemistry of d block elements and their coordination compounds,
2. Comprehend applications on industrial scale due to their advanced stability, chelating ability and catalytic nature.
3. Learn about the structure and coloring properties of coordination compounds.

	Course Content	Assignments/Readings
Week 1	Unit 1: Introduction of transition elements, complex/coordination compounds/double salts	Reading from recommended books
Week 2	Development of coordination compounds: Bloom strand theory,	Reading from recommended books
Week 3	Werner Theory	Reading from recommended books

Week 4	VBT; Hybridization in coordination compounds with coordination number from 2 to 9.	Reading from recommended books
Week 5	Important features of CFT,	Reading from recommended books
		Reading from recommended books
Week 6	d-orbitals splitting for various common geometries, measurement of 10 Dq., factors effecting 10 Dq. CFSE,	Reading from recommended books
		Examples survey
Week 7	Applications of CFT in explaining color, spinels etc.	Reading from recommended books
		Examples survey
Week 8	MOT; MO diagrams for metal complexes of common geometry. Ligand Field Theory (LFT)	Reading from recommended books
		Examples survey
Week 9	Mid Term Assessment	
Week 10	Unit2: Introduction. Preparative methods.	Reading from recommended books
Week 11	Isomerism in coordination compounds (Conformational, Coordination, Ionization, Hydrate/Solvate, Ligand, Linkage, Fluxional, and Spin isomerism). Stereochemistry (geometric and optical isomerism in compounds with coordination numbers 4 and 6).	Reading from recommended books
		Reading from recommended books
Week 12	The spectrochemical series and factors affecting high/low spin.	Reading from recommended books
		Examples practice
Week 13	Magnetism (Diamagnetism and Paramagnetism).	Reading from recommended books
		calculation practice
Week 14	Jahn-Teller effect.	Reading from recommended books
		Examples survey
Week 15	Thermodynamic vs. Kinetic stability, Stability constants.	Reading from recommended books
		Examples practice
Week 16	Analytical methods for studying complexes. Role of metal complexes in analytical chemistry, industry, and nature.	Reading from recommended books

Textbooks and Reading Material

1. Rayner Canham, Geiof., (1995), "*Descriptive Inorganic Chemistry"* & Co.
2. Sharp, A.G.(1992), "*Inorganic Chemistry*", Longman, 3rd Edition.
3. Shriver, D.F., P.W. Atkins and C.H. Langford, (1996), "*Inorganic Chemistry*", Oxford, 2nd Edition.
4. Ullah, S., (2020) *"Inorganic Chemistry"*, Ilmi Kitab Khana, Lahore.
5. Rehman, R., and Bhatti, H.N., (2015) "*Advanced Inorganic Chemistry*", Volume I, Carvan Book House Lahore.
6. Huheey, J. E., Keiter, E. A., Keiter, R. L.,(1997), "*Inorganic Chemistry: Principles of Structure and Reactivity*", 4th ed., Prentice Hall.

Teaching Learning Strategies

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
1. Quiz/Tests
2. Presentations

Assignments: Types and Number with Calendar

1. Bonding in metal complexes of coordination number 5 to 9.
2. Isomerism, color, magnetism and stability in metal complexes / Applications of coordination compounds in industry.

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

BS Chemistry Semester-VI					
Programme	**BS (Chemistry)**	**Course Code**	**Chem-317**	**Credit Hours**	**1**
Course Title	**Inorganic Chemistry Lab**		**Course Type**	**Major**	

Course Introduction

This will help the students to synthesize and analyze metal complexes in industrial and commercial samples. Here is a brief description of course outlines:

Complexometry

Estimation of Mg^{+2} with EDTA (Direct titration in basic condition). Estimation of Ca^{2+} with EDTA (Direct titration in basic condition). Estimation of Mg^{+2} and Ca^{2+} with EDTA (Mixture analysis). Estimation of Zn^{2+} with EDTA (Direct titration in basic condition). Estimation of Cd^{2+} with EDTA (Direct titration in basic condition). Estimation of Ni^{+2} with EDTA (Indirect titration). Estimation of Al^{3+} with EDTA (Indirect titration). Determination of Pb^{2+} with EDTA (Direct titration in acidic condition). Determination of Co^{2+} with EDTA (Direct titration in acidic condition).

Synthesis of metal complexes

Tris(ethylenediamine) nickel (II) Chloride 2-hydrate. Sodium Cobaltinitrite. Pot. trioxalato aluminate(III). Hexaaqua Chromium (III) Chloride. Ammonium Sulphate Copper Sulphate Pentahydrate.

Learning Outcomes

On the completion of the course, the students will be able to understand:

1. differences between simple salts and complexes.
2. Preparatory methods for metal complexes on laboratory scale.
3. Estimation of metal ions concentration in different aqueous samples.

	Course Content	Assignments/Readings
Week 1	Estimation of Mg^{2+} with EDTA (Direct titration in basic condition).	Sample solution preparation
		Titration practice
Week 2	Estimation of Ca^{2+} with EDTA (Direct titration in basic condition).	Sample solution preparation
		Titration practice
Week 3	Estimation of Mg^{2+} and Ca^{2+} with EDTA (Mixture analysis).	Sample solution preparation
		Titration practice
Week 4	Estimation of Zn^{2+} with EDTA (Direct titration in basic condition).	Sample solution preparation
		Titration practice
Week 5	Estimation of Cd^{2+} with EDTA (Direct titration in basic condition).	Sample solution preparation
		Titration practice
Week 6	Estimation of Ni^{2+} with EDTA (Indirect titration).	Sample solution preparation
		Titration practice
Week 7	Estimation of Al^{3+} with EDTA (Indirect titration).	Sample solution preparation
		Titration practice
Week 8	Determination of Pb^{2+} with EDTA (Direct titration in acidic condition).	Sample solution preparation
		Titration practice

Week 9	Mid term assessment	
Week 10	Determination of Co^{2+} with EDTA (Direct titration in acidic condition).	Sample solution preparation
		Titration practice
Week 11	Preparation of Tris(ethylenediamine) nickle (II) Chloride 2-hydrate.	Sample solution preparation
		Titration practice
Week 12	Preparation of Sodium Cobaltinitrite	Sample solution preparation
		Titration practice
Week 13	Preparation of Pot. trioxalatoaluminate(III)	Sample solution preparation
		Titration practice
Week 14	Preparation of Hexaaquachromium(III) chloride.	Sample solution preparation
		Titration practice
Week 15	Preparation of Ammonium Sulphate Copper Sulphate Pentahydrate.	Sample solution preparation
		Titration practice
Week 16	Revision of all complexometric titrations and synthesis	Sample solution preparation
		Titration practice

Textbooks and Reading Material

1. Bassett, J., Denny, P. C., Jeffery, G. H., Mendham, J., (2009), "*Vogel's textbook of Quantitative Inorganic Analysis", 6th ed.*, Pearson Education, copyrights.
2. Pass, G., Sutcliffe, H., (1974), *Practical Inorganic Chemistry: Preparation Reactions and Instrumental Methods, 2nd ed.*, Chapman and Hall.
3. Rehman, R., and Bhatti, H.N., (2017), "*Advanced Experimental Inorganic Chemistry*" Carvan Book House Lahore.
4. Mendham, John., (2006), *"Vogel's textbook of quantitative chemical analysis"*. Pearson Education India.
5. Derek Woollins,J., (2010), "*Inorganic Experiments"*, 3rd revised edition, John Wiley & Sons.

Teaching Learning Strategies

1. Lecturing
2. Written Assignments
3. Lab work

Assignments: Types and Number with Calendar

1. Synthesis of metal complexes
2. Complexometry and its application

Assessment			
Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
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