



Course Specification

(Bachelor)

Course Title: **Coordination Chemistry**

Course Code: **CEM352**

Program: **Chemistry**

Department: **CHEMISTRY**

College: **Science**

Institution: **Majmaah university**

Version: **TP-153**

Last Revision Date: **8 December 2024**



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A. General information about the course:

1. Course Identification

1. Credit hours: (3)

2. Course type

A. University College Department Track Others
 B. Required Elective

3. Level/year at which this course is offered: (Level 5/ year 3)

4. Course General Description:

This course covers the fundamental concepts and theories of coordination chemistry, including the structure, bonding, properties, and applications of coordination compounds. Students will learn about the various types of ligands, coordination numbers, and geometries, as well as the electronic, magnetic, and spectral properties of coordination complexes.

The practical part introduces the synthesis of d-block complexes, demonstrate Techniques for studying the properties of coordination complexes.

5. Pre-requirements for this course (if any):

CHM251

6. Co-requisites for this course (if any):

None

7. Course Main Objective(s):

- Understand the basic principles and theories of coordination chemistry.
- Identify and describe the types of ligands and their coordination modes.
- Explain the electronic structure and bonding in coordination complexes.
- Analyze the spectroscopic, magnetic, and stability properties of coordination compounds.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom		
2	E-learning		



No	Mode of Instruction	Contact Hours	Percentage
3	Hybrid	15	50%
	<ul style="list-style-type: none"> Traditional classroom E-learning 	15	50%
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	45
2.	Laboratory/Studio	30
3.	Field	
4.	Tutorial	
5.	Others (specify)	
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	Demonstrate knowledge and understanding of essential principles relating to Transition Metal Complexes	K1	Formal lectures, Effective Learning Collaborative Learning.	Standardized exam Laboratory examination Class exercises Evaluation of research and presentation
1.2	Describe the d-Orbital and Geometry of Coordination Compounds	K2		
2.0	Skills			
2.1	Demonstrate laboratory skills, proper safety	S1	Lectures Laboratories	Evaluation of research -Practical tests





Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	procedures, and regulatory compliance in laboratory settings.			
2.2	Communicate effectively orally and written using appropriate presentation formats for different issues with recipients of different types	S2	Formal lectures, Effective Learning Collaborative Learning Team-based learning	Standardized exam Laboratory examination - Class exercises - Evaluation of research and presentation
3.0	Values, autonomy, and responsibility			
3.1	Demonstrate the ability to work independently and with groups	V2	Collaborative Learning Team-based learning	Laboratory examination - Class exercises - Evaluation of research and presentation
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction to coordination chemistry; Historical background and significance of coordination chemistry. - Basic definitions: central metal atom/ion, ligands.	2
2.	Formation of Transition Metals Complexes; <ul style="list-style-type: none"> • Stability of Complexes • Hard/Soft Acid/Base (HSAB) Theory • Chelate and Macrocyclic effect • Charge effect. 	8
3.	Fundamental of Coordination Compounds;	8





	<ul style="list-style-type: none"> Coordination numbers and common geometries (octahedral, tetrahedral, square planar). <ul style="list-style-type: none"> Common ligands and their properties. Nomenclature of coordination compounds. 	
4.	Isomerism in Coordination compounds; -Structural isomerism - Geometrical isomerism .	4
5.	Bonding in co-ordination complexes (Theories of Coordination compound): 1. Valence Bond Theory (VBT) -Basic principles of Valence Bond Theory. - Hybridization of atomic orbitals (sp ³ , dsp ² , d ² sp ³). - Explanation of geometry and bonding in coordination compounds using VBT. - Limitations of VBT.	4
6.	2. Crystal Field theory (CFT) <ul style="list-style-type: none"> Bonding models for d-blocks complexes. d-Orbital Occupancy for Complexes 3. Crystal Field stabilization energies (CFSE) <ul style="list-style-type: none"> Energetic lattice enthalpies Structural- Ionic radial Jahn Teller effect 	4
7.	4. Ligand Field Theory (LFT) - Extension of CFT with molecular orbital considerations. - Covalent character in metal-ligand bonding. - Molecular orbital diagrams for octahedral, tetrahedral, and square planar complexes. - Spectrochemical series. 5.Molecular Orbital Theory (MOT): Molecular Orbitals approach to Bonding in Transition Metals Complexes.	7
8.	Activity of co-ordination complexes in solution; Irving-William series, hydration, hydrolysis of complexes; oxidation states in aqueous solution, substitution reactions and their mechanism and the effect of the other group.	4
9.	Importance and applications of coordination chemistry; <ul style="list-style-type: none"> Biochemical processes Industrial applications Environmental applications. 	4
Total		45
Practical part :		
1	Synthesis of Tetraammine copper(II) sulfate monohydrate and Determination of structural Formula.	6
2	Synthesis of nitro-and[nitritopentammine cobalt (III)] Chloride and Determination of structural Formula.	6
3	Synthesis of Trans-dichlorobis(ethylenediamine) Cobalt (III) Chloride	6
4	Synthesis of tris(acetylacetonato) iron(III).	6
5	Synthesis of potassium tris(oxalato)chromium(III) trihydrate and Determination of structural Formula.	6





Total

30

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, exercises, Quiz , Essays, laboratory reports, Presentation ,project	During the semester	10%
2.	Mid term 1	8 th week	10%
3.	Mid term 2	11 th week	10%
4.	Electronic exam	12 th week	10%
5.	Lab exam	End of semester	20%
6.	Final exam	End of semester	40%
Total			100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Inorganic Chemistry (4th Edition) by Housecroft, Catherine, Sharpe, Alan G. 2012. Inorganic Chemistry: Principles of Structure and Reactivity" by James E. Huheey, Ellen A. Keiter, and Richard L. Keiter
Supportive References	Coordination Chemistry: Basics and Current Trends 1st ed. 2023 Edition, by Birgit Weber.
Electronic Materials	Relevant Website
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Class room, laboratory
Technology equipment (projector, smart board, software)	The electronic platform, data show, Smart Board



Items	Resources
<p>Other equipment (depending on the nature of the specialty)</p>	<p>Virtual laboratories Research laboratory Library.</p>

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching		
Effectiveness of Students assessment		
Quality of learning resources		
The extent to which CLOs have been achieved		
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify))

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	

