Course Specifications

Course Title:	Coordination Chemistry
Course Code:	4023564-3
Program:	Chemistry
Department:	Department of Chemistry
College:	Faculty of Applied Science
Institution:	Umm Al-Qura University

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A. Course Identification

1. Credit hours:
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: 6th level / 3rd year
4. Pre-requisites for this course (if any)**:** Chemistry of Transition Elements
5. Co-requisites for this course (if any)**:** None

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	√	100 %
2	**Blended**	---	---
3	**E-learning**	---	---
4	**Correspondence**	---	---
5	**Other**	---	---

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	**30**
2	**Laboratory/Studio**	**42**
3	**Tutorial**	**---**
4	**Others** (specify)	**---**
	Total	**72**
Other Learning Hours*		
1	**Study**	**51**
2	**Assignments**	**10**
3	**Library**	**3**
4	**Projects/Research Essays/Theses**	**3**
5	**Others**(specify)	**22**
	Total	**89**

***The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

B. Course Objectives and Learning Outcomes

1. Course Description

This course deals with the main subjects in coordination chemistry including importance, nomenclature, isomerism, geometry, preparation, electronic and IR spectra, and biological activity of the metal complexes as well as theories explaining bonding in coordination compounds.

2. Course Main Objective

By ending this course, students should be familiar with:

a. The importance, nomenclature, isomerism, geometry, preparation of the metal complexes.

b. The different theories explaining the bonding in coordination compounds.

c. The magnetic, biological, electronic and IR spectral properties of metal complexes.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge:**	
1.1	Describe the nature, types and importance of coordination compounds.	**K3**
1.2	Explain the preparation methods of coordination compounds.	**K4**
1.3	Write the nomenclature of coordination compounds using the laws of naming, and recognize their chemical and physical properties.	**K1**
1.4	Discuss the mode of bonding in metal complexes using bonding theories.	**K3**
1.5	Mention the important applications of metal complexes.	**K6**
2	**Skills :**	
2.1	Confirm the molecular formula of metal complexes.	**S1**
2.2	Estimate the type of metal complex.	**S2**
2.3	Apply the analytical calculations to determine the complex geometry.	**S7**
2.4	Design scientific methods and think to solve problems concerning the course.	**S2**
2.5	Work in teamwork to perform specific experimental tasks.	**S8**
2.6	Prepare transitional metal complexes and suggest the mechanics of formation of metallic compounds.	**S4**
3	**Competence:**	
3.1	Evaluate the different methods of preparation of inorganic compounds.	**C4**
3.2	Dispose the hazardous solution in right way.	
3.3	Bind coordination geometry to chemical properties such as magnetic properties and spectra of compounds.	**C3**

CLOs		Aligned PLOs
3.4	Handle chemicals safely, independently.	C2
3.5	Communicate results of work to classmate and participate in class or laboratory discussions.	C1

C. Course Content

No	List of Topics	Contact Hours
1	Introduction to the chemistry of coordination compounds - Werner theory of coordination compounds - Effective atomic number.	4
2	Ligands – nomenclature of metal complexes – symmetry in metal complexes.	2
3	Valence bond theory – coordination numbers and geometrical structures – inner and outer complexes.	4
4	Stability of metal complexes; factors affecting the stability of metal complexes – ionic and ionization potential – geometrical arrangement of ligands around the central metal ion - metal chelates.	4
5	Crystal field theory; ligand field in octahedral complexes – ligand field in tetrahedral complexes – ligand field in square planer complexes – Jahn-Teller effect (distortion from symmetrical arrangement) – crystal field stabilization energies.	4
6	Preparation of coordination compounds (complexes); direct reactions – oxidation and reduction reactions – thermal decomposition reactions.	4
7	Electronic spectrum of complexes - infrared spectra of the metal complexes.	4
8	Metal complexes of significant biological activities.	4
Total		**30**

No	**Practical Part:** List of Topics	Contact Hours
1	Introduction about coordination chemistry and safety rules in labs.	3
2	Preparation of $[Cu(en)_2](NO_3)_2$	3
3	Preparation of $[Co(NH_3)_5Cl]Cl_2$	3
4	Preparation of $K_3[Cr(C_2O_4)_3]$	3
5	Preparation of $[Ni(en)_3]Cl_2.2H_2O$	3
6	Preparation of $[Fe(acac)_3]$	3
7	Melting points of the metal complexes.	3

8	Solubility of the metal complexes.	**3**
9	Conductivity of the metal complexes.	**3**
10	Application of UV-Vis spectroscopy in determining different types of electronic transitions in some complexes.	**6**
11	Investigation of different function groups in some complexes using IR spectral measurement.	**6**
12	Final practical exam.	**3**
Total		**42**

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge**		
1.1	Describe the nature, types and importance of coordination compounds.	Scientific discussion and web based study	Mid-tern and final written exams.
1.2	Explain the preparation methods of coordination compounds.	Lecture and web based study.	Mid-tern and final written exams.
1.3	Write the nomenclature of coordination compounds using the laws of naming, and recognize their chemical and physical properties.	Lecture and scientific discussion	Mid-tern and final written exams.
1.4	Discuss the mode of bonding in metal complexes using bonding theories.	Lecture and web based study.	Mid-tern and final written exams.
1.5	Mention the important applications of metal complexes.	Lecture and library based study.	Mid-tern and final written exams.
2.0	**Skills**		
2.1	Confirm the molecular formula of metal complexes.	Scientific discussion and library based activities.	Final exam and measuring the response to the assignments.
2.2	Estimate the type of metal complex.	Lecture and web based study.	Periodic tests and assignments.

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.3	Apply the analytical calculations to determine the complex geometry.	Scientific discussion and library based activities.	Final exam and measuring the response to the assignments.
2.4	Design scientific methods and think to solve problems concerning the course.	Scientific discussion and library based activities.	Final exam and measuring the response to the assignments.
2.5	Work in teamwork to perform specific experimental tasks.	Practical experiments in groups and web-based studies in groups. .	Evaluate the results of collective works and duties as well as knowing the contribution of each individual in labs.
2.6	Prepare transitional metal complexes and suggest the mechanics of formation of metallic compounds.	Lecture, scientific discussion and practical experiments.	Practical and written exams.
3.0	**Competence**		
3.1	Evaluate the different methods of preparation of inorganic compounds.	Lecture and web-based studies.	Checking performance in written and practical exams.
3.2	Dispose the hazardous solution in right way.	Practical work and scientific discussion	Practical and written exams.
3.3	Bind coordination geometry to chemical properties such as magnetic properties and spectra of compounds.	Lecture and scientific discussions.	Periodic and final written exams.
3.4	Handle chemicals safely, independently.	Practical work and scientific discussion	Practical and written exams.
3.5	Communicate results of work to classmate and participate in class or laboratory discussions.	Practical works and periodic group duties.	Practical exams and group presentations.

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Homework or activities.	--	**10 %**

#	Assessment task*	Week Due	Percentage of Total Assessment Score
2	Midterm Exam.	8	20 %
3	Practical Exams.	14	30 %
4	Final Exam. (2 hours exam)	16	40 %

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

- Availability of Staff members to provide counseling and advice.
- Office hours: During the working hoursweekly.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	• P. L. Soni, Vandna Soni, Coordination Chemistry: Metal Complexes, CRC Press, 2013.
Essential References Materials	• Geoffrey A. Lawrance, Introduction to Coordination Chemistry, John Wiley & Sons, 2009. • William L. Jolly, Modern Inorganic Chemistry; (2^{nd} edition) McGraw-Hill, New York, 1991. • Kazuo Nakamoto, Infrared and Raman Spectra of Inorganic and Coordination Compounds, John Wiley &Sons, 2009
Electronic Materials	• http://www.chemweb.com • http://www.sciencedirect.com • http://www.rsc.org
Other Learning Materials	None

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Equipped lecture halls and laboratories equipped specializing in inorganic chemistry.
Technology Resources (AV, data show, Smart Board, software, etc.)	Roomequippedwithcomputers, data show andTV.
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	Noother requirements.

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment.	Program Leaders	Periodic reviewof final exams and the student's degrees in this course.
Extent of achievement of course learning outcomes.	Peer Reviewer	Checking selected exam papers, and student assignments.
Quality of learning resources	Students	Complete thequestionnaireevaluation of the coursein particular

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes,Quality oflearning resources, etc.)
Evaluators (Students,Faculty, Program Leaders,Peer Reviewer, Others (specify)
Assessment Methods(Direct, Indirect)

H. Specification Approval Data

Council / Committee	
Reference No.	
Date	

Received by: Dr. Ismail Althagafi **Department Head**

Signature: **Date: 20/12/2019**