Course Specification

(Bachelor)

Course Title:	ORGANOMETALLIC CHEMISTRY
Course Code:	CHM 1316
Program:	Bachelor of Science in Chemical Laboratories
Department:	Chemistry
College:	Science
Institution:	Imam Mohammad ibn Saud Islamic University
Version:	2024-1
Last Revision Date:	15 September 2024

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A. General information about the course:

1. Course Identification:

1. Credit hours: 3 (3Lectures, 0 Lab, 0 Tutorials)				
3 (3 Lectures, 0 Lab, 0 Tutorials)				
2. Course type				
A.	☐University	☐College	☐Department	☐Track
B.	☐ Required		☒ Elective	
3. Level/year at which this course is offered: (Level 6/year 3)				
4. Course General Description:				
This course introduces students to Organometallic Chemistry, including definitions, historical developments, Coordination theories, and the 18-electron rule. It will cover the Organometallics of Group 1 and Group 2 and transition metals. Organometallic reactions, catalysis, and their applications will also be included.				
5. Pre-requirements for this course (if any)**:**				
Industrial Inorganic Chemistry, CHM 1314				
6. Pre-requirements for this course (if any)**:**				
None				
7. Course Main Objective(s):				

At the end of this course, the student will be able to:

- ✓ **Use the basic principles of descriptive chemistry and molecular orbital theory to describe organometallic compounds' chemical bonding and structure.**
- ✓ **Describe and explain catalytic processes using an organometallic compound as a catalyst.**
- ✓ **Recall the applications of organometallic compounds.**
- ✓ **Explain and predict the chemical behavior and reactivity of organometallic compounds**

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**45**	**100%**
2	E-learning	**0**	**0**
3	Hybrid • Traditional classroom • E-learning	**0**	**0**
4	Distance learning	**0**	**0**

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	**45**
2.	**Laboratory/Studio**	**0**
3.	**Field**	**0**
4.	**Tutorial**	**0**
5.	**Others (specify)……**	**0**
	Total	45

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

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	To describe the basic concepts of organometallic chemistry and its nomenclature and to recall the concept of adequate atomic number and molecular orbital diagrams of organometallic compounds,	K1, K2	▪ Three hours of weekly lectures. ▪ A Private study, including a Homework	Direct: ✓exams, quizzes ✓Homework ✓Participation
1.2	To outline the bonding and bridging modes for organic ligand structure	K1, K4	▪ Three hours of weekly interactive lectures. ▪ Self-study	Direct: ✓exams, quizzes ✓Oral Discussion ✓Homework ✓Participation
1.3	To recognize synthetic methods of organometallic compounds with different applications in catalytic processes.	K4	▪ Three hours of weekly lectures ▪ Think, talk, and list the organometallic applications in catalytic processes	Direct: ✓exams, quizzes ✓Oral Discussion ✓Mini reports ✓Participation

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
1.4	To define safety principles, list emergency responses, and outline the routes of exposure to hazards and the minimization, controlling, and laboratory management.	K3	▪ Three hours of weekly interactive lectures. ▪ Self-study ▪ Group Discussions	Direct: ✓exams, quizzes ✓Oral Discussion marks ✓Mini reports ✓Participation
2.0	Skills			
2.1	To evaluate Organometallic Compounds and the relationship among organic ligands structure for Organometallic Chemistry applications	S1	• Introduce some Organometallic Compounds to discuss and predict their structures • Brainstorming Exercises	Direct: ✓ exams, quizzes ✓ Oral Discussion marks ✓ Questions in Lectures. ✓ Participation
2.2	To develop routes for Organometallic compound synthesis.	S1, S2	• Interactive lectures • Brainstorming • Group Discussions	Direct: ✓ Questions in Lectures. ✓ Mini reports ✓ Participation ✓ Oral Discussion.
2.3	To analyze organometallic compounds' spectral data and explain the reactivity of Organometallic Compounds as a catalyst.	S3	• Brainstorming • Group Discussions	Direct: ✓ Questions in Lectures ✓ Short Quizzes and Exams. ✓ Participation ✓ Oral Discussion.
2.4	To demonstrate oral and network communication and technical writing skills.	S3, S4	✓ Group Discussions	Direct: ✓Reports ✓Discussion marks
3.0	Values, autonomy, and responsibility			
3.1	To show confident attitudes through single and teamwork	V1, V2	• Group discussion, assignments,	Direct: ✓Oral tests, ✓Assignments

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	and effective awareness to maintain scientific integrity during different assessments, projects, and mini-reports.			✓Mini projects

C. Course Content:

No	List of Topics	Contact Hours
1.	Introduction: Definition of organometallic compounds, Organic ligands and nomenclature, Historical developments, types of organometallic compounds, preparation of organometallic compounds, Grignard Reagents, Properties of organometallic compounds.	9
2.	Coordination Theories: Valence Bond Theory, Limitations of Valence Bond Theory, Ligand Field Theory, ligand field splitting, Octahedral Fields, Tetrahedral, Tetragonal, and Square Planar Fields, tetragonal distortion, Factors Affecting Δ, Ligand Field Stabilization Energy, Jahn-Teller Distortion, Limitations of Crystal Field Theory, Molecular Orbital Theory	3
3.	The 18-electron rule, Exceptions to 18-electron rule, Hapticity, Metallocenes	6
4.	Bonding between Metal atoms and Organic π Systems, Linear systems, π-Ethylene complexes, π-Allyl complexes, other linear π systems, cyclic π Systems, cyclopentadienyl (Cp) complexes, Ferrocene, (η5 -C5H5)2Fe, complexes containing cyclopentadienyl and CO ligands.	6
5.	Organometallics of Groups 1 and 2: preparations, reactions, and applications, Organoelement Compounds of the Carbon Group (Group 14) (preparations, reactions, and applications), Organometallics of Group 12 (preparations, reactions, and applications)	9
6.	Organometallic Reactions and Catalysis: Reactions involving gain or loss of ligands, Ligand dissociation and substitution, Oxidative addition, Reductive elimination, Nucleophilic displacement, Reactions involving modification of ligands, Insertion, Carbonyl insertion (alkyl migration, Hydride elimination, Abstraction, Cyclometallations, Nucleophilic Displacement, Catalytic Deuteration, Hydroformylation, Monsanto Acetic Acid Process, Wacker (Smidt) Process, Hydrogenation (Wilkinson's catalyst), Olefin Metathesis.	6
7.	Applications of Organometallics: Ziegler- Natta catalysis and Wilkinson catalysis, Organic synthesis, Therapeutics, Biocides, Qualitative analysis, Quantitative analysis, Metallurgical operations, Polymers.	3

8.	Revisions.	3
Total		45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1	Week 6th -7th	20 %
2.	Midterm 2	Week 11th -12th	20 %
3.	Quizzes, homework, class participation	During semester	20 %
4.	Final Exam	Around 16th week	40 %
5.	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	▪ G. S. Sodhi **Organometallic Chemistry**, , 2009, Ane Books Pvt. Ltd. ISBN: 8180521982
Supportive References	• Catherine E. Housecroft and Alan G. Sharpe, **Inorganic Chemistry**, 2nd Ed. 2005, Publisher: Pearson Education Limited, ISBN 0130-39913-2. • Gary L. Miessler and Donald A. Tarr**, Inorganic Chemistry**, 4th Ed. 2010, Prentice Hall ISBN 10:0136128661**.** • Robert H. Crabtree**, The organometallic chemistry of the transition metals**, 4th Ed, 2005, John Wiley & Sons, Inc., ,10 9 8 7 6 5 4 3 2 1.
Electronic Materials	• **Blackboard** • **http://home.cc.umanitoba.ca/~budzelaa/CHEM4680/CHEM4680_lectures.html** • **http://chem-faculty.lsu.edu/stanley/webpub/4571-chap5-hydrides.pdf**
Other Learning Materials	• **Comprehensive Inorganic Chemistry.** Sulekh Chandra, New Age International Limited Publishers, New Delhi, 2004 Descriptive inorganic chemistry, Rayner-Canham, Geoff., Publisher: W.H. Freeman, New York, 2006

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Each classroom should have a whiteboard and a projector, with a maximum of 20 students.**
Technology equipment (projector, smart board, software)	• **The rooms and laboratories are equipped with data show, Smart Board, and WI-FI access.**
Other equipment (depending on the nature of the specialty)	**---**

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students**	• **Direct:** Questionnaire.
	Course Responsible	• **Direct:** Course e-Portfolio. • **Indirect:** Second examiner checklist- Course report.
	Peer Reviewer	• **Direct**: Questionnaire. • **Indirect:** External assessor report.
Effectiveness of Students assessment	**Program Leaders**	• **Direct:** Course e-Portfolio.
Quality of learning resources	**Students**	• **Indirect:** Second examiner checklist- Course report.
	Faculty (Academic Advisory)	• **Direct:** course Entrance/Exit. • Indirect: Observations - Accreditation review.
	Program Leaders	• **Direct:** Course e-Portfolio. • **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
The extent to which CLOs have been achieved	**Course Responsible**	• Direct: Exams - Course e-Portfolio.

Assessment Areas/Issues	Assessor	Assessment Methods
		• Indirect: Second examiner checklist- Course report.
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	COUNCIL OF DEPARTMENT OF CHEMISTRY
REFERENCE NO.	3 (NO. 1/3)
DATE	5/3/1446- 8/09/2024