هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

# Course Specification
## (Bachelor)

| | |
|---|---|
| Course Title: | ORGANOMETALLIC CHEMISTRY |
| Course Code: | CHM 1313 |
| Program: | Bachelor of Science in Chemistry |
| Department: | Chemistry |
| College: | Science |
| Institution: | Imam Mohammed Ibn Saud Islamic University |
| Version: | 2024 1 |
| Last Revision Date: | 13 October 2024 |

## Table of Contents

## A. General information about the course:

### -1. Course Identification

| | | | | | |
|---|---|---|---|---|---|
| **1. Credit hours: 3 (3,0, 0)** | | | | | |
| **3 (3 Lectures, 0 Tutorials, 0 Lab)** | | | | | |
| **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 provides students with an introduction 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, as well as transition metals. Organometallic reactions, catalysis, and their applications will be included.** | | | | | |
| **5. Pre-requirements for this course** (if any)**:** | | | | | |
| **Inorganic Chemistry (2) - CHM 1311** | | | | | |
| **6. Co-requisites for this course** (if any)**:** | | | | | |
| **None** | | | | | |
| **7. Course Main Objective(s):** | | | | | |

- **To improve the student's knowledge of the basic information about Organometallic Chemistry.**
- **To outline Organometallic Reactions and Catalysis,**
- **To recall the applications of organometallic compounds (catalytic processes, organic synthesis, therapeutics, biocides, qualitative and quantitative analysis, metallurgical operations, and polymers).**

### 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<br>• Traditional classroom<br>• 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 of effective atomic number and molecular orbital diagrams of organometallic compounds,** | **K1; K2** | • Three hours of weekly lectures.<br>• A Private study including home exam. | ▪ Quizzes Assignments<br>▪ Discussions.<br>▪ Participation. |
| **1.2** | **To outline the bonding and bridging modes for organic ligand structure** | **K1** | • Three hours of weekly lectures.<br>• Group discussion | • Quizzes<br>• Assignments.<br>• Oral Discussion |
| **1.3** | **To recognize synthetic methods of organometallic compounds with different applications in catalytic processes.** | **K1; K2** | • Three hours are weekly for lectures<br>• Think, talk, and review synthetic methods of organometallic compounds | • Participation,<br>• Quizzes and MCQs, |
| **2.0** | Skills | | | |
| **2.1** | **To evaluate Organometallic Compounds and the** | **S1; S2; S3** | • Lectures activity<br>• Think and talk about the reactivity of | • Questions in Lectures.<br>• Short Quizzes and |

| Code | Course Learning Outcomes | Code of PLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| | **relationship among organic ligands structure for Organometallic Chemistry applications** | | Organometallic Compounds<br>• Introduce some solved and unsolved examples of Organometallic Compounds Synthesis and Reactivity achieving | Exams.<br>• Participation through Classwork and Homework. |
| **2.2** | **To develop routes for Organometallic Compounds synthesis.** | **; S1; S2; S3** | • Encourage students to communicate their logic and chemical thinking and to work and discuss cooperatively with their peers to develop individual skills. | • Questions in Lectures.<br>• Short Quizzes and Exams. |
| **2.3** | **To analyze spectral data of organometallic compounds and to explain the reactivity of Organometallic Compounds as a catalyst.** | **S1; S2; S3** | • Lectures<br>• Group discussion | • Questions in Lectures.<br>• Short Quizzes and Exams.<br>• Oral Presentation |
| **2.4** | **To demonstrate oral and network communication and technical writing skills.** | **S2; S3** | • Oral participation<br>• Group discussions<br>• Encourage students to use electronic mail to submit homework and assignments. | • Oral tests and sheets Marks<br>• Assignments and homework marks |
| **3.0** | Values, autonomy, and responsibility | | | |
| **3.1** | **To show confident attitudes through single and teamwork and effective awareness to maintain scientific integrity during different assessments, projects, and mini reports** | **V1, V2** | • Group discussion, Assignments and homework | • Oral tests, sheets, Marks<br>• Assignments and homework marks |

## 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. | 7 |
| 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 | 6 |
| 3 | **The 18-electron rule**, Exceptions to 18-electron rule, Hapticity, Metallocenes | 4 |
| 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 Group 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) | 6 |
| 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. | 7 |
| 7 | **Applications of Organometallics**: Zieglear- Natta catalysis and Wilkinson catalysis, Organic synthesis, Therapeutics, Biocides, Qualitative analysis, Quantitative analysis, Metallurgical operations, Polymers. | 6 |
| 8 | **Revisions.** | 3 |
| Total | | 45 |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1. | **Quizzes, Attendance, Participation, Homework** | **All the semester** | **20 %** |

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 2. | Midterm Exam 1 | Around 6th 7th week | 20 % |
| 3. | Midterm Exam 2 | Around 11th 12th week | 20% |
| 4. | Final Exam | Around 16-17th 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 | ***Organometallic Chemistry***, G. S. Sodhi, 2009, Ane Books Pvt. Ltd. ISBN: 8180521982 |
| Supportive References | ***Inorganic Chemistry,*** Catherine E. Housecroft and Alan G. Sharpe, 2nd Ed. 2005, Publisher: Pearson Education Limited, ISBN 0130-39913-2. ***Inorganic Chemistry,*** Gary L. Miessler and Donald A. Tarr, 4th Ed. 2010, Prentice Hall ISBN 10:0136128661. ***The organometallic chemistry of the transition metals***, Robert H. Crabtree, 4th Ed, 2005, John Wiley & Sons, Inc., ,10 9 8 7 6 5 4 3 2 1. |
| Electronic Materials | • **Blackboard**<br>• **http://home.cc.umanitoba.ca/~budzelaa/CHEM4680/CHEM4680_lectures.html**<br>**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. Required Facilities and equipment

| Items | Resources |
|---|---|
| **facilities**<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | • **Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.** |

| Items | Resources |
|---|---|
| **Technology equipment** (projector, smart board, software) | **The rooms are equipped with data show, Smart Board, WI-FI access.** |
| **Other equipment** (depending on the nature of the specialty) | • **None** |

## 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. **Indirect:** Course report. |
| 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. **Indirect:** Second examiner checklist-Course report. |
| | **Program Leaders** | **Indirect:** Exams. |

**Assessors** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval

| | |
|---|---|
| **COUNCIL /COMMITTEE** | **COUNCIL OF DEPARTMENT OF CHEMISTRY** |
| **REFERENCE NO.** | **7 (NO. 2/3)** |
| **DATE** | **29/3/1446 - 2/10/2024** |