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

Course Specification
(Bachelor)

Course Title:	Organic Reactions Mechanism
Course Code:	CHM 1422
Program:	Bachelor of Science in Chemistry
Department:	Chemistry
College:	Science
Institution:	Imam Mohammed Ibn Saud Islamic University
Version:	2024 V 1
Last Revision Date:	13 October 2024

Table of Contents

A. General information about the course:

-1. Course Identification

1. Credit hours: 2 (2, 0,0)					
2 (2 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 7/ Fourth year					
4. Course general Description:					
This course provides students with an Introduction for Organic Reactions Mechanism, which covers all aspects; kinetic and physical methods to determine organic reaction mechanism; classifications of reaction mechanism; Substitution; Addition; Elimination; Radical Addition Reaction and Rearrangement.					
5. Pre-requirements for this course (if any)**:**					
CHM 1321 Heterocyclic Chemistry					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					

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

- **Recall knowledge of core organic chemistry.**
- **Describe advanced organic chemistry topics including reaction mechanism, advanced synthetic procedures and strategy.**
- **Reproduce knowledge of quantitative understanding of reactions and proposing potential improvements to existing processes in organic chemistry.**
- **Recognize appropriate mechanism in organic synthesis.**
- **Define factors influencing the chemical reaction mechanism**

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	**30**	**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**	**30**
2.	**Laboratory/Studio**	**0**
3.	**Field**	**0**
4.	**Tutorial**	**0**
5.	**Others (specify)**	**0**
Total		30

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 recall knowledge of core organic chemistry.**	**K1; K3;**	• Lectures • Group Discussion • A Private study including home exam.	• Quizzes Assignments ▪ Discussions. ▪ Oral Discussion ▪ Participation.
1.2	**To describe advanced organic chemistry topics including reaction mechanism advanced synthetic procedures and strategy.**	**K1; K3**	• Lectures, • Group discussion	• Quizzes Assignments. • Oral Discussion marks
1.3	**To recognize appropriate mechanism and factors influence the organic synthesis.**	**K1; K3**	• Lectures, • Group discussion	• Midterms. • Assignments • Oral Discussions. • Quizzes.
2.0	**Skills**			
2.1	**To Evaluate knowledge and understanding of essential facts, concepts and principles of physical organic chemistry.**	**S1;S3**	• Lectures activity • Think and talk about the reactivity of Organic Compounds and functional groups.	• Questions in Lectures. • Short Quizzes and Exams. • Participation • Oral Discussion, • Home Exam.

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
2.2	To analyze problems and plan strategies for their solution, critically review different approaches to problems and demonstrate good research design.	S1;S3; S4	• Introduce some examples of Organic Reactions from Previous courses achieving Brainstorming.	• Questions in Lectures. • Participation through Oral Discussion • Short Quizzes and Exams.
2.3	To Summarize concepts of reaction mechanism leading to logic thinking, followed by evaluation gained information.	S1;S3; S4	• Lectures and Oral Discussions. • Brain storming Exercises	• Questions in Lectures. • Short Quizzes and Exams.
2.4	To demonstrate oral Communication to carry out Chemical Reactions Sequence orally and propose a reaction mechanism and writing of mini-Reports, with operating electronic mail and Network in communicating with others.	S1, S4	• Group Discussion and Assignments • Introduce several reports about examples of reaction mechanism in English, which will require reading, writing, and oral presentation. • Encourage students to use electronic mail to submit Home Exams and Assignments	• Oral Discussion, Quizzes, and Exams. • Giving marks for Oral Discussion in Lectures. • Marks given for Assignments
3.0	Values, autonomy, and responsibility			
3.1	To show responsibility for their own learning and motivate for team work	V1;V2	• Brain Storms Exercises • Group Discussion	• Oral Discussion. • Group Discussion • Assignments

C. Course Content

No	List of Topics	Contact Hours
1.	**An Overview of Organic Reactions**: Understanding Organic Reaction, kinds of organic reactions, How Organic Reactions occur: Mechanisms, Steps in Mechanisms, Types of Steps in Reaction Mechanisms, Energy diagram of any	4

	Reaction, Kinetics of the Reaction, Hybridization, Conjugation, Aromaticity, Inductive Effect, Mesomeric Effect, Tautumerization, Acid-bases and pKa	
2.	**General Principles for Writing Reaction Mechanisms:** Balancing Equations, Using Arrows to Show Moving Electrons, Mechanisms in Acidic and Basic Media, Electron-Rich Species: Bases or Nucleophiles? Trimolecular Steps, Stability of Intermediates, Driving Forces for Reactions, Structural Relationships between Starting Materials and Products	4
3.	**Reactions of Nucleophiles and bases:** Nucleophilic Substitution, Eliminations at Saturated Carbon, Nucleophilic Addition to Carbonyl Compounds, Base-Promoted Rearrangements, 5. Additional Mechanisms in Basic Media 1,2-(β-) Elimination, E1 Mechanism, E1Cb Mechanism, E2 Mechanism (Stereoselectivity in E2, Orientation in E2 Saytzev v. Hoffmann), Elimination v. Substitution, Effect of activating groups, Other 1,2-Elimination, 1,2-(α-) Elimination, Pyrolytic Syn Elimination.	7
4.	**Electrophilic Aromatic Substitution**:Electrophilic Attack on Benzene (π,σ complexes), Nitration, Halogenations, Sulphonation, Friedle- Crafts Reactions (Alkylation, Acylation), Diazo Coupling, Electrophilic Attack on C_6H_5Y (Y= $+NR_3$, CCl_3, NO_2, CHO, COOH etc., Y= OCOR, NHCOR, OR, OH, NH_2, NR_2, Partial Rate Factors and Selectivity, *O*,*P* Ratios, Electrophilic Substitution of Other Aromatic.	3
5.	**Reactions Involving Acids and Other Electrophiles:** 1. Stability of Carbocations, 2. Formation of Carbocations, 3.The Fate of Carbocations, 4. Rearrangement of Carbocations, 5.Electrophilic Addition, 6. Acid-Catalyzed Reactions of Carbonyl Compounds, 7. Electrophilic Aromatic Substitution, 8 . Carbenes, Electrophilic Heteroatoms	4
6.	**Radical Addition Reactions, Radical and Radicals Reaction and its application in biology:** 1 . Introduction, 2. Formation of Radicals, 3. Radical Chain Processes, 4. Radical Inhibitors, 5. Determining the Thermodynamic Feasibility of Radical Reactions, 6. Addition of Radicals, 7. Fragmentation Reactions, 8. Rearrangement of Radicals, 9. The SRN 1 Reaction, 10. The Birch Reduction, 11. A RadicalMechanism for the Rearrangement of Some Anions	3
7.	**Radical Addition Reactions, Radical and Radicals Reaction and its application in biology**: Production of Radicals, Reaction of Radicals, Homolytic Bond Dissociation, Reaction of Alkanes with Halogen, Chlorination of Methane, Radicals in Biology, Superoxide SOD and Antioxidant, Drugs based on Radicals.	3
8.	**Rearrangement and Fragmentation Reaction:** Cationic Rearrangement, Anionic Rearrangement, Radical Rearrangement, Factors Influence these Rearrangements.	2
	Total	**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1	6th/ 7th week	20 %
2.	Midterm 2	11th/ 12th week	20 %
3.	Quizzes, Home Works, class participation, and mini projects	During the semester	20 %
5.	Final Exam	16-17thweek	40 %
6.	Total	All weeks	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	• **Writing Reaction Mechanisms in Organic Chemistry,** Solomon, P. and Millar, A. • **A Guidebook to Mechanism in Organic Chemistry**, Peter Sykes, Pearson; 6 edition 6th Ed., 1996 | ISBN-10: 0582446953
Supportive References	• **The art of writing reasonable org reaction mech**, Robert B. Grossman. Springer • **Arrow-Pushing in Organic Chemistry: An Easy Approach to Understanding Reaction**, John Wiley & Sons, Inc., 2011, ISBN10: 978-1-118-21045-1 • **MARCH'S Advanced Organic Chemistry**, Reactions, Mechanisms, and Structure, Michael B. Smith, Jerry March, John Wiley & Sons, Inc., 7th Ed., 2007. ISBN: 978-0-470-46259-1 • **Organic Chemistry**, John E. McMurry, Mary Finch (Cengage Group), 8ed (2012), ISBN-10: 0495118370 | ISBN-13: 978-0495118374. • **Organic Chemistry**. Paula YurkanisBruice, 2nd Ed, PRENTICE HALL, Upper saddle River New Jersey 07458), 1998, ISBN-10: 0321803221
Electronic Materials	https://www.organic-chemistry.org/ https://rmg.mit.edu/
Other Learning Materials	Blackboard

2. Required Facilities and equipment

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

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