Course Specification
(Bachelor)

Course Title:	Heterocyclic Chemistry
Course Code:	CHM 1321
Program:	Bachelor of Science in Chemistry
Department:	Chemistry
College:	Science
Institution:	Imam Mohammed Ibn Saud Islamic University
Version:	2024 V2
Last Revision Date:	1 November 2024

Table of Contents

A. General information about the course: 3

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods 4

C. Course Content 6

D. Students Assessment Activities 7

E. Learning Resources and Facilities 7

F. Assessment of Course Quality 9

G. Specification Approval 10

A. General information about the course:

-1. Course Identification

1. Credit hours: 2 (2, 0, 0)					
2 Lectures					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered:					
Level 6/ Third year					
4. Course general Description:					
This course provides students with an introduction to heterocyclic chemistry, methods, reactivity and application of heterocyclic compounds in industry and medicinal chemistry. Topics covered in the course include a Heterocyclic structure and Nomenclature, Heterocycles with three members with one heteroatom, Structure of Five-membered Rings with One Heteroatom, Structure of Five-membered Rings with Two or More Heteroatoms, Structure of Six-membered Rings with One Heteroatom, Heterocycles with Six members with Two or More Heteroatoms, biologically important heterocycles.					
5. Pre-requirements for this course (if any)**:**					
CHM 1221 Organic Chemistry (2)					
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:

- know the basis of heterocyclic chemistry and its importance in terms of structure and nomncleature, and to recognize the relationship between the molecular structure and properties of heterocyclic compounds.
- Explore different synthetic methods for heterocyclic compounds including their reaction mechanism.
- Understand key reactions like cyclization and functional group transformations.
- Study electrophilic and nucleophilic reactions in heterocycles, and to Analyze reaction mechanisms specific to different heterocyclic systems.

- Understand the role of heterocyclic compounds in pharmaceuticals (e.g., antibiotics, antivirals)
- Study natural heterocycles found in biomolecules like nucleotides and alkaloids.
- Discuss heterocyclic compounds application in materials such as dyes, polymers, and organic semiconductors.
- Explore their role in developing new functional materials.

2. Teaching mode (mark all that apply)

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

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	32
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)**	0
Total		87

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 recognize the structures of important classes of Heterocyclic Aromatic Compounds and to memorize the	K1; K3;	▪ Four hours are weekly containing lectures and Group Discussion A Private study including home exam.	▪ Quizzes Assignments ▪ Discussions. ▪ Participation. ▪ Lab reports

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	Synthetic methods of Organic Compounds			
1.2	To define sequences of Heterocyclic Compounds Synthesis in different reaction conditions.	K1; K3;	Four hours are weekly containing lectures, and group discussion	▪ Quizzes Assignments. • Oral Discussion marks
1.3	To state electron deficient or electron rich in Heterocyclic Compounds in terms of reactivity and to write the appropriate the reaction mechanism used for synthesis	K1; K3	▪ Four hours are weekly for lectures, and group discussion ▪ Think and talk about reactivity of heterocyclic compounds	• Midterms. • Assignments • Oral Discussions. • Quizzes.
1.4	To recognize the structures of important classes of Heterocyclic Aromatic Compounds and to memorize the Synthetic methods of Organic Compounds	K1; K3;	▪ Four hours are weekly containing lectures and Group Discussion ▪ A Private study including home exam.	▪ Quizzes Assignments ▪ Discussions. ▪ Participation.
2.0	**Skills**			
2.1	To explain the reactivity of Heterocyclic Compounds towards a series of reagents	S1; S3	▪ Lectures activity Think and talk about the reactivity of heterocyclic Compounds	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Participation ▪ Oral Discussion, ▪ Home Exam.
2.2	To summarize Heterocyclic Compounds synthesis providing by appropriate reaction mechanism.	S1; S3	Encourage students to communicate their logic chemical thinking, and to work and discuss cooperatively with their peers to develop individual skills.	• Questions in Lectures. • Participation through Oral Discussion • Short Quizzes and Exams.
2.3	To evaluate the reactivity of	S1; S3	▪ Lectures and Oral Discussions.	▪ Questions in Lectures.

Code	Course Learning Outcomes	Code of PLOs aligned with program	Teaching Strategies	Assessment Methods
	Heterocyclic Compounds according to heteroatoms and functional groups attached.		▪ Brain storming Exercises	▪ Short Quizzes and Exams.
2.4	To Demonstrate Oral Communication, and writing of mini-Reports, using electronic mail and Networks in communicating with others.	S2; S3; S4	▪ Group Discussion and Assignments ▪ Introduce several reports on Synthesis and Reactivity of Heterocyclic Compounds for 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 illustrate contribution in teamwork and raise Knowledge during various evaluations, initiatives.	V1;V2	▪ Brain Storms Exercises ▪ Group Discussion	▪ Oral Discussion. ▪ Group Discussion and Assignments

C. Course Content

No	List of Topics	Contact Hours
1.	**Structure and Nomenclatur of Heterocycles:** Introduction, structures, names, standard numbering of the more common heteroaromatic systems and some common non - aromatic heterocycles, Relationship of Heterocyclic and Carbocyclic Aromatic Compounds, Systematic Nomenclature, The Relation between Benzene Ring and the Heterocyclic Rings, Aromaticity Rules, Nomenclature of Heterocyclic Compounds of Five and Six Member-ring with Two Heteroatom's, Fused with Benzene Ring, Fused Heterocyclic Ring Systems,	**6**

2.	**Heterocycles with three members with one heteroatom:** Different Methods for the Preparation of Oxirane, Formation of Aziridines using Haloamines, Methylene Insertion Reactions. Some Examples of Nucleophilic and Electrophilic Ring Openings.	4
3	**Structure of Five-membered Rings with One Heteroatom:** Reactivity of Five-membered Rings with One Heteroatom, Electrophilic attack, Nucleophilic attack, Nucleophilic Attack at Nitrogen Heteroatom, Nucleophilic Attack at Hydrogen Attached to Ring Carbon or Ring Nitrogen, Benzo derivatives of Five-membered Heterocycles with One Heteroatom.	4
4	**Structure of Five-membered Rings with Two or More Heteroatoms:** Azoles with Heteroatoms in the 1,2-positions, Azoles with Heteroatoms in the 1,3-positions, Reactivity of Five-membered Rings with Two or More Heteroatoms	4
5	**Structure of Six-membered Rings with One Heteroatom and two hereroatmos:** Structure and Reactivity of Six-membered Rings with One Heteroatom (Pyran, Thiopyran, Pyridine), Structure and Reactivity of Aromatic Six-Membered Systems with two or More Heteroatoms, Synthesis them, and examples of their reactions. and mechanisms. Electrophilic attack, Nucleophilic attack, Nucleophilic Attack at Nitrogen Heteroatom, Nucleophilic Attack at Hydrogen Attached to Ring Carbon or Ring Nitrogen, Benzo derivatives of Six-membered heterocycles with one heteroatom.	8
6	**Biologically important heterocycles:** Pyrimidines, and Purines, structure, synthesis, Nucleic acids and enzymes, the Biological Processes	4
7	**Revisions.**	2
8		
Total		32

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 %

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
4.	Final Exam	17thweek	40 %
5.	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	• ***Heterocyclic Chemistry***, Joule, John A., Mills. K., Wiley-Blackwell, 5th Ed. (2010), ISBN: 978-1-4051-3300-5. • ***Handbook of Heterocyclic Chemistry,*** Katritzky, A. R.; Pozharskii, A. F.; 2nd Ed. (2000); Pergamon: Oxford. ISBN: 978-0-08-095843-9
Supportive References	• ***Heterocyclic Chemistry*** Gilchrist, T. L.; Addison Wesley Longman: Edinburgh Gate, 3rd Ed. (1997), ISBN-10: 0582278430 • **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 • ***Vogel's' Textbook of Practical Organic Chemistry,*** Vogel, A.I., Tatchell, A.R. , Furnis, B.S , Smith, P.W.G , Longman Group UK Limited, (5th Ed.), 1989 ISBN 978-0-582-46236-6
Electronic Materials	• https://lms.imamu.edu.sa/ • **https://www.chemicalsfinder.com/** • **https://www.cas.org/solutions/cas-scifinder-discovery-platform/cas-scifinder**
Other Learning Materials	

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.** • **In each laboratory, a list of safety and precautions are provided.** • **In each lab has proper ventilation, and well equipped with instruments.** • **In each lab, containers for solid waste, liquid waste, and crushed glasses.**

Items	Resources
	• **Each lab has a small pharmacy for first aid in case of an accident** • **In each lab, the rules, conditions, and safety mechanism as well list of Risk, Safety precautions according to Merck Catalogue are hanging in the labs**
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)	•

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 DEPARTEMENT OF CHEMISTRY
REFERENCE NO.	**7 (NO. 2/3) ???**
DATE	**29/3/1446 - 2/10/2024 ????**