



## Course Specifications

<b>Course Title:</b>	Heterocyclic Chemistry
<b>Course Code:</b>	CHEM333-3
<b>Program:</b>	Bachelor of Science in Chemistry
<b>Department:</b>	Chemistry
<b>College:</b>	Faculty of Science
<b>Institution:</b>	Jazan University (JU)

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## A. Course Identification

<b>1. Credit hours:</b> 3hrs	<b>Workload:</b> 192	<b>ECTS:</b> 6.9
<b>2. Course type</b>		
a. University <input type="checkbox"/>	College <input type="checkbox"/>	Department <input checked="" type="checkbox"/>
b. Required <input checked="" type="checkbox"/>	Elective <input type="checkbox"/>	Others <input type="checkbox"/>
<b>3. Level/year at which this course is offered:</b> Level 5/ year 3		
<b>4. Pre-requisites for this course (if any):</b>		
None		
<b>5. Co-requisites for this course (if any):</b>		
none		

### 6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	27	40%
2	Blended		
3	E-learning	3	10%
4	Distance learning		
5	Laboratory/Studio	30	50%
	<b>TOTAL</b>	60	

### 7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
1	Lecture	30
2	Laboratory/Studio	30
3	Tutorial	
4	Others (specify)	
	<b>Total</b>	60

## B. Course Objectives and Learning Outcomes

### 1. Course Description

Course Title	Course Number	Contact Hours (CH)		Credit unit (CU)	Year	Level	Pre-requisite
		Lec.	Prac.				
Heterocyclic Chemistry	CHEM333-3	2	2	3	3	5	None

#### Course objectives:

1. Identification and classification of heterocyclic organic compounds.
2. To identify the physical properties of heterocyclic organic compounds.
3. Study of the addition reactions, the electrophilic and nucleophilic substitution reactions on a five and six-membered ring with one and two heteroatoms.

#### Syllabus: A-Theoretical contents

Definition, classification and nomenclature of heterocyclic organic compounds - physical properties of heterocyclic compounds – Addition reactions, electrophilic and nucleophilic substitution reactions of five and six-membered rings with one or two heteroatoms- pyrrole, furan, thiophene, pyrazole, imidazole, oxazole, thiazole, isothiazole, azine, thiazine, pyridine, alkyl pyridine, pyridazine, pyrimidine and quinoline – Synthesis of five and six-membered rings with one or two heteroatoms - some poly-heterocyclic compounds - synthesis and reactions.

#### Syllabus: B-Practical contents

Selected experiments related to hetero-chemistry topics.

### 2. Course Main Objective

This course aims to provide students with basic knowledge of heterocyclic organic compounds, their physical and chemical properties and their most important chemical reactions.

### 3. Course Learning Outcomes

CLOs		Aligned PLOs
1	<b>Knowledge and Understanding</b> <i>Upon completion of this course, student will be able to</i>	
1.1	Demonstrate a broad knowledge and understanding in heterocyclic topic as Nomenclature of heterocyclic compounds, Five-Membered rings with one hetero atom, Fused benzene ring Five-Membered rings with one hetero atom, Five-Membered rings with two hetero atom, Six-Membered rings with one hetero atom, Fused benzene ring Six-Membered rings with one hetero atom, important of Biological activities of heterocyclic compounds (P)	K.1
1.2	Describe the aromatic character of some heterocyclic compounds and giving explanation to some of their synthetic methods. _____ (P)	K.2
2	<b>Skills :</b> <i>Upon completion of this course, student will be able to</i>	

CLOs		Aligned PLOs
2.1	Demonstrate the knowledge and skills to interpret products obtained from different reaction conditions regarding heterocyclic chemistry	S.1
2.2	Apply their experimental basics and skills to use laboratory equipment, modern instrumentation, and classical techniques for carrying out experiments as well as accurately record and analyze the results of such experiments. (P) (P)	S.2
2.3	Knows the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals. (I)	S.3
2.4	Use of communication and online technology to write articles on heterocyclic compounds or synthesis and reactions of heterocyclic compounds (I)	S.4
3	<b>Values:</b> <i>Upon completion of this course, student will be able to</i>	
3.1	Work as a group leader in cooperation with other colleagues (I)	V.1

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### C. Course Content

No	List of Topics	Contact Hours
1	Introduction of heterocyclic compounds Nomenclature of heterocyclic compounds Nomenclature of one ring heterocyclic compounds with one heteroatoms (N,O,S)	2
2	Nomenclature of heterocyclic compounds: Nomenclature of one ring heterocyclic compounds with two or more heteroatoms (N,O,S). Nomenclature of fused ring heterocyclic compounds with one or more heteroatoms (N,O,S). examples:	4
3	Five-Membered rings with one hetero atom Pyrrole ( Azole ), Furan and Thiophene (Methods of preparation, Physical properties and structure, Chemical properties) Reactions : ( basicity ; acidity properties ) .	6
4	Fuse ring Five-Membered rings with one hetero atom Indole – benzofuran- benzothiophene (Methods of preparation, Physical properties and structure, Chemical properties.	4
5	Five-Membered rings with two hetero atom-atoms Pyrazole and Imidazole (Methods of preparation, Physical properties and structure , Chemical properties)	2
6	Six-Membered rings with one hetero atom Pyridine (Methods of preparation. Physical and chemical properties and structure Chemical properties. Derivative of pyridine (alkyl pyridine, amino pyridine) Six-Membered rings with two hetero atom Pyridazine, pyrimidine, pyrazine (Methods of preparation. Physical properties and Chemical properties	6

7	Fused Six-Membered rings with one hetero atom Quinoline and isoquinoline (Methods of preparation. Physical properties and <del>structure, Chemical</del> chemical properties.	4
8	Six membered rings with one oxygen atom (Pyran-Coumarin-4-Chromone) Six-membered rings with two different heteroatoms ( Morpholine-piperazine-phenoxazine) <del>And Biological activities</del>	2
<b>Total</b>		<b>30</b>

## D. Teaching and Assessment

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

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
<b>1.0</b>	<b>Knowledge and Understanding</b>		
1.1	<del>Demonstrate a broad, knowledge and understanding in heterocyclic topic as Nomenclature of heterocyclic compounds, Five-Membered rings with one hetero atom, Fused benzene ring Five-Membered rings with one hetero atom, Five-Membered rings with two hetero atom, Six-Membered rings with one hetero atom, Fused benzene ring Six-Membered rings with one hetero atom, important of Biological activities of heterocyclic compounds (P) Demonstrate abroad knowledge about the fundamentals and properties of main groups of transition elements in periodic table, coordination parameters, organometallic complexes...etc (P)</del>	Lecture Open discussion in class	MCQ Short answer Q <del>Fill-in the Blank</del> Final Exam.
1.2	<del>Describe the aromatic character of some heterocyclic compounds and giving explanation to some of their synthetic methods. (P) Describe the postulates of Werner theory, organometallic rules and coordination parameters. (P)</del>	Lecture Open discussion in class	MCQ Short answer Q Fill-in the Blank Final Exam.
<b>2.0</b>	<b>Skills</b>		
2.1	<del>Demonstrate the knowledge and skills to interpret products obtained from different reaction conditions regarding heterocyclic chemistry (P) Demonstrate the knowledge and skills to calculate the coordination number, CFSE, oxidation state of metal and magnetic moments (P)</del>	Lecture Open discussion in class Web-based work	MCQ Short answer Q Fill-in the Blank Final Exam.

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
2.2	<i>Apply their experimental basics and skills to use laboratory equipment, modern instrumentation, and classical techniques for carrying out experiments as well as accurately record and analyze the results of such experiments. (P)</i>		
2.23	<i>Knows the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals. (I)</i> <i>Apply their experimental basics and skills to use laboratory equipment, modern instrumentation, and classical techniques for carrying out experiments as well as accurately record and analyze the results of such experiments. (P)</i>	Lab work Group work Lab work Group work	MCQ Short answer Q Practical Exam MCQ Short answer Q Practical Exam
2.4	<i>Make effective use of communication, and online technology about transition elements topics in order to improve their basic knowledge in writing with a good verbal and clear scientific language. (I)</i>	ppt-Presentations Group discussion	Presentation
3.0	<b>Values</b>		
3.1	<i>Work as a group leader in cooperation with other colleagues (I)</i> <i>Work as a group leader in cooperator with other colleagues. (P)</i>	Open discussion Lab work Group discussion Research group	Oral exam Practical assignments Laboratory reports Web-based research

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## 2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Homework assignment	2	2
2	Lecture Quizzes.	4	0
3	Mid-term exam	8	15
4	Homework assignment	9	3
5	Lecture Quizzes	10	0
6	Presentation	11	0
7	Safety Quiz	12	0
	LAB Lab Sheet	14	10
	Final practical exam	15	20
	Final Exam	16	50
8	Total		100

\*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:

Student Academic Counseling:

Students are grouped into groups of (10-15) students. Each group is assigned to a member of staff who will act as Academic Counselor. Members of staff be available for academic counseling on daily basis for at 4h/day during office hours.

## F. Learning Resources and Facilities

### 1. Learning Resources

<b>Required Textbooks</b>	<ul style="list-style-type: none"> <li>• <u>Heterocyclic Chemistry, John A. Joule, Keith Mills.; 5th Edition, April 2010, ©2010, Wiley Black well, ISBN: 978-1-4051-3300-5, pages 718</u></li> <li>• <u>Practical Heterocyclic Chemistry, A. O. Fitton R. K. Smalley, 1st Edition, Academic Press, 1968.</u></li> </ul> <p><u>Heterocyclic Chemistry, John A. Joule, Keith Mills.; 5th Edition, June 2010, Wiley-Black well, ISBN: 978-1-405-13300-5, pages 718</u></p> <ul style="list-style-type: none"> <li>• <u>Practical Heterocyclic Chemistry, A. O. Fitton R. K. Smalley, 1st Edition, Academic Press, 1968.</u></li> </ul>
<b>Essential References Materials</b>	<ol style="list-style-type: none"> <li>1. Heterocyclic chemistry; Gilchrist, T. L. 3<sup>rd</sup> ed.; Addison Wesley Longman: Edinburgh Gate, 1997.</li> <li>2. Heterocyclic chemistry; Joule, J. A.; Mills, K.; 4<sup>th</sup> ed.; Blackwell Science: Oxford, 2000.</li> <li>3. Heterocyclic Chemistry, R. R. Gupta, M. Kumar, V. Gupta, Volume II: Five-Membered Heterocycles, Springer, ISBN 978-3-642-08460-7, 1999.</li> </ol>
<b>Electronic Materials</b>	<ul style="list-style-type: none"> <li>• <a href="https://b-ok.asia/book/829427/cae9f4">https://b-ok.asia/book/829427/cae9f4</a></li> <li>• <a href="https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(McMurry)/15%3A_Benzene_and_Aromaticity/15.06%3A_Aromatic_Heterocycles-_Pyridine_and_Pyrrole">https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(McMurry)/15%3A_Benzene_and_Aromaticity/15.06%3A_Aromatic_Heterocycles-_Pyridine_and_Pyrrole</a></li> </ul>
<b>Other Learning Materials</b>	Computer-based programs/ ChemDraw

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### 2. Facilities Required

Item	Resources
<b>Accommodation</b> (Classrooms, laboratories, demonstration rooms/labs, etc.)	Classrooms capacity (30) students  Lab capacity (15) students
<b>Technology Resources</b> (AV, data show, Smart Board, software, etc.)	Smart board, Data show, Black board, internet
<b>Other Resources</b> (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	<ul style="list-style-type: none"> <li>• Magnetic resonance spectroscopy (NMR spectroscopy)</li> <li>• Fourier Transformer Infra-red spectrophotometer (FT-IR)</li> <li>• Melting Point Apparatus</li> </ul>

## G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and	Student	Liker-type Survey



Evaluation Areas/Issues	Evaluators	Evaluation Methods
Assessment		Indirect
Extent of achievement of course learning outcomes	Instructor and Course coordinator	Class room evaluation (direct and indirect)
Quality of learning resources	Program committee	Indirect
Exam quality assessment	Assessment committee	Indirect

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)

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

**Assessment Methods** (Direct, Indirect)

### H. Specification Approval Data

Council / Committee	Chemistry Department Council
Reference No.	42 / 35 /102 112
Date	17 /09 /1442 Corresponding to 28 / 04 /2021

Attachment:  
EXP. Table

No.	List of Topics	APPARATUS	CHEMICALS	Week	Contact Hours
1	Qualitative Analysis of Organic Compounds. Preliminary Tests - Physical Constants Analysis for elements present- Solubility tests	Flame distilled water - test tubes - Beaker- flask	Litmus paper Simple salts of organic compound such as (oxalic acid-benzoic acid-aniline HCl-Urea-Glucose 1-Naphthylamin 1-naphthole	1	2

2	Qualitative Analysis for Elements Lassaigne's Sodium Fusion Test - Heat Test. Heating with soda lime - Nitration - Sulphation Treatment with NaOH- Treatment with FeCl <sub>3</sub>	Flame distilled water - test tubes – Beaker-flask	Litmus paper Simple salts of organic compound such as (oxalic acid-benzoic acid-aniline HCl-Urea-Glucose 1-Naphthylamin 1-naphthole Reagents :- NaOH, FeCl <sub>3</sub> , conc. HNO <sub>3</sub> , conc. H <sub>2</sub> SO <sub>4</sub> , soda lime,	3	6
3	Review	Flame distilled water - test tubes – Beaker-flask	Litmus paper Simple salts of organic compound such as (oxalic acid-benzoic acid-aniline HCl-Urea- Glucose 1-Naphthylamin 1-naphthole Reagents :- NaOH, FeCl <sub>3</sub> , conc. HNO <sub>3</sub> , conc. H <sub>2</sub> SO <sub>4</sub> , soda lime,	1	2
4	Identification of organic compounds Combination of (H, C,O) [Carbohydrate, Carboxylic acid, phenols]	Flame distilled water - test tubes – Beaker-flask	Carbohydrate Molisch Test. Benedict's Test Barfoed's Test Bial's test Seliwanoff's Test Carboxylic acid Acidity test Nitration FeCl <sub>3</sub> test CaCl <sub>2</sub> test Phthalein test Phenols Phenol, resorcinol, cresol 1-naphthol	2	4
4	Combination of (H, C,O and metallic) [Salts of acid]	Flame distilled water - test tubes – Beaker-flask	Heat test Nitration FeCl <sub>3</sub> test CaCl <sub>2</sub> test Phthalein test	1	2
5	Combination of (H, C,O and N) [Amm. Salts, Amide, imides]	Flame distilled water - test tubes – Beaker-flask	Simple of amm. Salts Acidity test Nitration FeCl <sub>3</sub> test CaCl <sub>2</sub> test Phthalein test Urea, imide NaOH test CuSO <sub>4</sub>	2	4
6	Combination of (H, C,O, N,S)	Flame distilled water - test tubes – Beaker-flask	Aniline H <sub>2</sub> SO <sub>4</sub> Thiourea, Sulphaline acid	1	2
7	Combination of (H, C,O, N, X)	Flame distilled water - test tubes – Beaker-flask	Aniline HCl Chlorale	1	2
8	Review	Flame distilled	Carbohydrate	1	2

		water - test tubes – Beaker-flask	Carboxylic acid Salts of acids Amm. salts		
<b>9</b>	Synthesis of some organic compounds (If there is a plus time) Preparation of aspirin; 7-hydroxy-4-methylcoumarin	Flame distilled water - test tubes – Beaker-flask- melting point apparatus glass rod Büchner funnel, filter paper	Phenol Ethyl acetoacetate, ethanol- benzene Salicylic acid Acetic anhydride	<b>2</b>	<b>4</b>
<u>9</u>	<u>Final Exam.</u>			<u>15</u>	
	Total			<del>15</del> <b>15</b>	<b>30</b>