



## Course Specification of Medicinal Chemistry III

I. Course Identification and General Information:						
1	Course Title	Medicinal Chemistry III				
2	Course Number & Code:	Ph5811				
3	Credit hours:	C.H				Total
		Th.	Pr.	Tr.	Seminar.	
		2	2			3
4	Study level/ semester at which this course is offered:	4 <sup>th</sup> level /2 <sup>nd</sup> semester				
5	Pre –requisite (if any):	Pharmaceutical analytical chemistry I&II and pharmaceutical organic chemistry I, II & III and Medicinal Chemistry I				
6	Co –requisite (if any):	Pharmacology IV				
7	Program (s) in which the course is offered:	Bachelor of pharmacy				
8	Language of teaching the course:	English				
9	The department in which the course is offered:	Department of Medicinal Chemistry, Pharmaceutical Organic and Analytical Chemistry				
10	Location of teaching the course:	Faculty of Pharmacy- Sana`a university				
11	Prepared by:	Associate Prof. Tawfeek Ahmed Alobaidy Associate Prof. Shada H. Yassin				
12	Date of approval:					

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## II. Course description:

The course is concerned with the fundamental knowledge about the synthesis, metabolism, physicochemical properties and their effect on drug profile. The practical part will be devoted to tutorials and studying on the qualitative and quantitative analysis and synthesis of some drugs in this course.

## III. Intended learning outcomes (ILOs) of the course:

**At the end of this course the students should be able to:**

1. Recognize the structural mechanism of action of studied classes of drugs
2. Outline the synthesis of some studied classes of drugs
3. Illustrate the SAR of each category in the course.
4. Discuss the metabolism and toxicity of studied classes of drugs.
5. Recognize the stereochemistry in drug structure and their effect on pharmacokinetic and pharmacodynamic profile of the drugs.
6. Identify the pharmacophores and toxicophores in the structure and their effect on pharmacokinetic and pharmacodynamic properties of the drugs.
7. Predict the metabophores in the drug structure that are responsible for metabolism in the biological system.
8. Design and evaluate qualitative and quantitative analysis of some drugs
9. Handle and dispose the chemical and pharmaceutical preparations safely and effectively.
10. Carry out synthesis some drugs.
11. Determine the quantitative analysis of some drugs.
12. Practice the qualitative analysis of some drugs.
13. Analyze the result of experimental tests that is practiced for some studied drugs
14. Communicate and cooperate effectively with his colleagues and other specialist to engage in teamwork planning and team processes.
15. Implement writing and presentation skills and demonstrate creativity and time management.

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16. Use technology and technology efficiently to perform the required tasks in field of medicinal chemistry.

#### IV. Intended learning outcomes (ILOs) of the course:

##### (A) Knowledge and Understanding:

Alignment Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs) in: Knowledge and Understanding.

Program Intended Learning Outcomes (Sub-

Course Intended Learning Outcomes (CILOs)

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PILOs) in: Knowledge and Understanding		in: Knowledge and Understanding	
After completing this program, students would be able to:		After participating in the course, students would be able to:	
A1-	Recognize the principles of physical, chemical, clinical, social, behavioral, health and pharmaceutical sciences.	a1-	Recognize the mechanism of action of studied classes of drugs
		a2-	Recognize the synthesis of some studied classes of drugs
A2-	Recognize the physicochemical properties, preparation, structure activity relationship (SAR), toxicity and the modern methods of analysis of various substances of chemical and natural products of therapeutic potential as well as the basic principle of drug discovery, design and development.	a3-	Illustrate the SAR of each category in the course.
		a4-	Discuss the metabolism and toxicity of studied classes of drugs.
A3-	Describe the general cellular, biochemical and physiological aspects of human body and recognize the pharmacokinetics, pharmacodynamics, disease pathophysiology, and pharmacogenetic of therapeutic agents to provide pharmaceutical care and facilitate management of patient's medication, rationalize drug use and overall health needs.	a5-	Recognize the stereochemistry in drug structure and their effect on pharmacokinetic and pharmacodynamic profile of the drugs.

### Teaching And Assessment Methods For Achieving Learning Outcomes:

#### Alignment Learning Outcomes of Knowledge and Understanding to Teaching and Assessment Methods:

Course Intended Learning Outcomes (CILOs) in Knowledge and Understanding After participating in the course, students would be able to:		Teaching strategies/methods to be used	Methods of assessment
a1-	Explain the mechanism of action of studied classes of drugs		Quizzes, Attendance, Participation, Short

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a2-	Recognize the synthesis of some studied classes of drugs	Lecture method , Computer based teaching and learning, group discussion and tutorial	answers, reports, homework, and Written exam.
a3-	Illustrate the SAR of each category in the course.		

a4-	Discuss the metabolism and toxicity of studied classes of drugs.		
a5-	Recognize the stereochemistry in drug structure and their effect on pharmacokinetic and pharmacodynamic profile of the drugs.		

## (B) Intellectual Skills:

Alignment Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs) in: **Intellectual skills**

Program Intended Learning Outcomes (Sub-PILOs) in Intellectual skills		Course Intended Learning Outcomes (CILOs) of Intellectual Skills	
After completing this program, students would be able to		After participating in the course, students would be able to:	
<b>B1-</b>	Consolidate the chemical, biochemical and physiological principles to construct the pharmacophores of the structure and their effect on the stability, pharmacokinetic and pharmacodynamic profiles of the drug.	<b>b1-</b>	Identify the pharmacophores and toxicophores in the structure and their effect on pharmacokinetic and pharmacodynamic properties of the drugs.
<b>B2-</b>	Categorize the synthetic and natural drugs according to their mechanism of action, systemic effect, therapeutic uses, contraindication and toxicity.	<b>b2-</b>	Predict the metabophores in the drug structure that are responsible for metabolism in the biological system.
		<b>b3-</b>	Design and evaluate qualitative and quantitative analysis of some drugs

## Teaching And Assessment Methods For Achieving Learning Outcomes:

Alignment Learning Outcomes of Intellectual Skills to Teaching Methods and Assessment Methods:

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<i>Course Intended Learning Outcomes (CILOs) in Intellectual Skills.</i>		<i>Teaching strategies/methods to be used.</i>	<i>Methods of assessment</i>
After participating in the course, students would be able to:			
<b>b1-</b>	Identify the pharmacophores and toxicophores in the structure and their effect on pharmacokinetic and pharmacodynamic properties of the drugs.	Lecture method, Computer based teaching and learning Group Discussion, Problem solving sessions and brainstorming	Quizzes, Attendance, Participation, Short answers, reports, homework, and Written exam.
<b>b2-</b>	Predict the metabophores in the drug structure that are responsible for metabolism in the biological system.		
<b>b3-</b>	Design and evaluate qualitative and quantitative analysis of some drugs		

<b>(C) Professional and Practical Skills.</b>			
Alignment Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs) in: Professional and Practical Skills			
Program Intended Learning Outcomes (Sub- PILOs) in Professional and Practical Skills		Course Intended Learning Outcomes (CILOs) in Professional and Practical Skills	
After completing this program, students would be able to:		After participating in the course, students would be able to:	
<b>C1-</b>	Operate different pharmaceutical equipments and instruments and use emerging technologies in design, synthesis, pre-formulation, formulation, packaging, storage and analysis of pharmaceutical products according to GLP, GSP and cGMP guidelines.	<b>c1-</b>	Handle and dispose the chemical and pharmaceutical preparations safely and effectively.
<b>C2-</b>		<b>c2-</b>	Carry out synthesis some drugs.

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	Handle and dispose chemicals and pharmaceutical preparations including radiopharmaceuticals safely and effectively.	c3-	Determine the quantitative analysis of some drugs
C5-	Conduct research studies and utilize the results in different pharmaceutical fields.	c4-	Practice the qualitative analysis of some drugs
		c5-	Analyze the result of experimental tests that is practiced for some studied drugs

### Teaching And Assessment Methods For Achieving Learning Outcomes:

Alignment Learning Outcomes of Professional and Practical Skills to Teaching and Assessment Methods:

Course Intended Learning Outcomes (CILOs) in Professional and Practical Skills		Teaching strategies/methods to be used	Methods of assessment
After participating in the course, students would be able to:			
c1-	Handle and dispose the chemical and pharmaceutical preparations safely and effectively.	Lecture method, Practical sessions, Problem solving sessions and brainstorming	Practical works, homework, practical exam and practical reports.
c2-	Carry out synthesis some drugs.		
c3-	Determine the quantitative analysis of some drugs		
c4-	Practice the qualitative analysis of some drugs		
c5-	Analyze the result of experimental tests that is practiced for some studied drugs		

### (D) General / Transferable Skills:

Alignment Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs) in: **General and Transferable skills**

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Program Intended Learning Outcomes (PILOs) in General / Transferable skills		Course Intended Learning Outcomes (CILOs) in General / Transferable skills	
After completing this program, students would be able to:		After participating in the course, students would be able to:	
D3-	Develop financial, market management, writing, presentation and time management skills as well as creativity, critical thinking, problem solving and decision making abilities.	d1-	Communicate and cooperate effectively with his colleagues and other specialist to engage in teamwork planning and team processes.
D5-	Apply information and communication technology and working effectively in a team.	d2-	Implement writing and presentation skills and demonstrate creativity and time management.
		d3-	Use technology and technology efficiently to perform the required tasks in field of medicinal chemistry.
<b>Teaching And Assessment Methods For Achieving Learning Outcomes:</b>			
Alignment Learning Outcomes of General and Transferable skills to Teaching and Assessment Methods.			

Course Intended Learning Outcomes (CILOs) in General and Transferable Skills		Teaching strategies/methods to be used.	Methods of assessment
After participating in the course, students would be able to:			
d1-	Communicate and cooperate effectively with his colleagues and other specialist to engage in teamwork planning and team processes.	Small group discussions, Tutorials and Practical sessions.	Homework, and reports.
d2-	Implement writing and presentation skills and demonstrate creativity and time management.		
d3-	Use technology and technology efficiently to perform the required tasks in field of medicinal chemistry.		

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## V. Course Content:

### 1 – Course Topics/Items:

#### a – Theoretical Aspect

Order	Topic List / Units	CILOs (symbols)	Sub-topic List	Number of weeks	Contact hours
1.	Antibacterial agents	a1, a2, a3, a4, b1, b2, d1, d2, d3	<b>Sulfonamides;</b> - Classification, - Mechanism of action - SAR, - Synthesis, - Metabolism,	1	2
2.	Antibiotics I	a1, a2, a3, a4, a5 b1, b2, b3, d1, d2, d3	<b>Penicillins;</b> - Mechanism of action - SAR - Stereochemistry - Orally and injectable Penicillins - Long acting Penicillins - $\beta$ - Lactamase sensitive and resistant Penicillins - Broad spectrum Penicillins - Allergy to Penicillins	1	2
3.		a1, a2, a3, a4, a5	<b>A. Cephalosopins; -</b> Mechanism of action	1	2

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	<b>Antibiotics II</b>	b1,b2, d1,d2, d3	- SAR - Stereochemistry - 1st generation, - 2 <sup>nd</sup> generation, - 3 <sup>rd</sup> generation, - 4 <sup>th</sup> generation and - 5 <sup>th</sup> generation <b>B. Monolactam and carbapenam.</b>		
4.	<b>Antibiotics III</b>	a1, a3,a4, b1,b2, b3, d1,d2, d3	- Tetracyclines, and - Aminoglycosides	1	2
5.	<b>Antibiotics IV</b>	a1, a2,a3,a4, a5 b1,b2, b3d1,d2, d3	- Lincosamide, - Macrolide & - Chlormphenicol	1	2
6.	<b>Quinolones</b>	a1, a3,a4, a5 b1,b2, b3, d1,d2, d3	- 1st Generation <b>Quinolones</b> - 2 <sup>nd</sup> Generation <b>Quinolones</b> and - 3 <sup>rd</sup> Generation <b>Quinolones</b>	1	2
7.	<b>Mid Exam</b>	a1-5, b1-2		1	2
8.	<b>Anti Mycobacterial Agents</b>	a1, a2,a3,a4, a5 b1,b2, b3d1,d2, d3	- Anti T.B: 1 <sup>st</sup> line Anti T.B 2 <sup>nd</sup> line Anti T.B - Antileprosy	1	2
9.	<b>Anti-infective agents</b>	a1, a2,a3,a4, a5 b1,b2, d1,d2, d3	Alcohols, phenols, oxidizing agents, iodine, chlorine compound, cationic surfactants, medicinal dyes, mercury compound preservatives	1	2

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10.	Antifungal Agent	a1, a3,a4, a5 b1,b2, d1,d2, d3	<ul style="list-style-type: none"> <li>- Types of Fungi</li> <li>- Antibiotics,</li> <li>- Azoles,</li> <li>- Allylamines and morpholines</li> <li>- Antimetabolites,</li> <li>- Fatty acids and dyes</li> </ul>	2	4
11.	Antiviral agent	a1, a2,a3,a4, a5 b1,b2, d1,d2, d3	<ul style="list-style-type: none"> <li>- Types viruses,</li> <li>- DNA viral replication,</li> <li>- The building blocks of DNA nucleosides,</li> <li>- Agents interfere with viral nucleic acid replication</li> <li>- Anti-Retroviral [AntiHIV] Agents - Agents inhibit the uncoating process, Neuraminidase</li> <li>- Inhibitors, Non-Nucleoside Reverse Transcriptase [RT] Inhibitors. - HIV Protease Inhibitors</li> </ul>	2	4
12.	Anticancer I	a1, a2,a3,a4, a5 b1,b2, d1,d2, d3	<ul style="list-style-type: none"> <li>- Types of Neoplasm</li> <li>- Mechanism of Cancer formation - Chemotherapeutic Agents</li> <li>Alkylating agents.</li> <li>Anti-metabolites [ Specific S]</li> </ul>	1	2
13.	Anticancer II	a1, a2,a3,a4, a5 b1,b2, d1,d2, d3	<ul style="list-style-type: none"> <li>DNA intercalating agents.</li> <li>Antibiotics.</li> <li>Antimitotic agents [Specific M].</li> <li>Hormones.</li> <li>Miscellaneous compounds.</li> </ul>	1	2
14.	Antihistamines	a1, a3,a4, a5 b1,b2, d1,d2, d3	<ul style="list-style-type: none"> <li>- 1<sup>st</sup> generation, 2<sup>nd</sup> generation H<sub>1</sub>-antihistamines</li> <li>- H<sub>2</sub>- antihistamines</li> </ul>	2	4

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15.	Final Exam	a1-5, b1, b2	1	2
Number of Weeks /and Units Per Semester			16	32

b - Practical Aspect				
Order	Tasks/ Experiments	CILOs (symbols)	Number of Weeks	Contact Hours
1	Hydrolytic cleavage of Sulfacetamide	b3, c1,c2, c5, d1-3	1	2
2	Crystallization and Identification of Some Sulfa drugs	b3, c1, c2, c3, c5,	1	2

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		d1-3		
3	Synthesis of Diazonium salt of Sulfanilamide	b3, c1,c2, c5, d1-3	1	2
4	Quantitative estimation of Sulfamethoxazole and Trimethoprim in Tab	b3,c1, c3, c5, d1-3	1	2
5	Qualitative determination of <b>Penicillin</b>	b3, c1, c3, c5, d1-3	1	2
6	Mid-Exam	b3, c1,c2, c3, c5	1	2
7	Quantitative estimation of <b>Penicillin capsules</b> by spectrophotometric method	b3, c1 ,c3, c5, d1-3	1	2
8	Quantitative estimation of <b>Penicillin</b> by redox method	b3, c1, c3, c5, d1-3	1	2
9	Quantitative estimation of <b>Tetracycline cap.</b>	b3, c1, c3, c5,d1-3	1	2
10	<b>Spectrophotometric determination of Chloamphenicol eye ointment</b>	b3, c1, c4, c5,d1-3	1	2
11	Quantitative estimation of Nalidixic acid	b3, c1 ,c3, c5,d1-3	1	2
12	Quantitative estimation of INH	b3, c1 ,c3, c5,d1-3	1	2
13	Quantitative estimation of <b>Busulfan</b>	b3, c1 ,c3, c5,d1-3	1	2
14	<b>Identification of Chloroquine</b>	b3, c1, c4, c5,d1-3	1	2
15	<b>Assay of Chloroquine</b>	b3, c1, c3, c5, d1-3	1	2
16	Final Exam	b3, c1-5	1	2
<b>Number of Weeks /and Units Per Semester</b>			<b>16</b>	<b>32</b>

**I. a-Teaching strategies of the course:**

Lecture method, Group Discussion, Problem solving sessions and Computer based teaching and learning, tutorials, brainstorming and Practical sessions.

**b- Assessment Methods:**

Quizzes, Attendance, Participation, Short answers, reports, homework, and Written exam  
Practical works, practical exam and practical reports.

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VII. Assignments:				
No.	Assignments	Aligned CILOs (symbols)	Week Due	Mark
1	Homework Assignments	a1,a3, a5, b1-4, d1-3	Sporadic through the semester	10
2	Reports	c1-4, d1-3		

I- Schedule of Assessment Tasks for Students During the Semester:					
No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes (CILOs symbols)
1.	Attendance, reports and Participation	All Weeks	10	7%	a1-5, b2-3, d1-3
2.	Quizzes and Homework-assignments	Sporadic through the semester	10	7%	a1,a3, a5, b1-3, d1-3
3.	Attendance, Practical Reports	All Weeks	15	10%	c1-4
4.	Practical mid-semester exam	8 <sup>th</sup>	15	10%	b3,c1-3
5.	Theoretical mid-semester exam	7 <sup>th</sup>	30	20%	a1-5, b1-2
6.	Final Exam (theoretical)	16 <sup>th</sup>	50	33%	a1-5, b1-2
7.	Final Exam (practical)	16 <sup>th</sup>	20	13%	b3, c1-5
<b>Total</b>			<b>150</b>	<b>100%</b>	

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I. Students' Support:	
Office Hours/week	Other Procedures (if any)
Two contact hours per week	None

II. Learning Resources:	
1- Required Textbook(s) ( maximum two ).	
	<p>1- John M. Beale, Jr. and John H. Block, 2011, "Text book of Organic Medicinal and Pharmaceutical Chemistry" 12th Edition, Wilson and Gisvold, Lippincott Williams and Wilkins, A Wolters Kluwer Company, Philadelphia.</p> <p>2- Graham L. Patrick, 2013, "An Introduction to Medicinal Chemistry" 5<sup>th</sup> Edition, Oxford University Press Inc, New York.</p>
2- Recommended Books and Reference Materials.	
	<p>1- Thomas Nogrady, Donald F. Weaver, 2005, Medicinal Chemistry A Molecular and Biochemical Approach edition, Oxford University Press, Inc., New York.</p> <p>2- Donald J. Abraham, " BURGER'S Medicinal Chemistry and Drug Discovery" 6<sup>th</sup> edition, A John Wiley and Sons, Inc, Virginia. 3- Thomas L. Lemke, Victoria F. Roche, David A. Willaiams and S. William Zito, 2008, "Foye's Principles of Medicinal Chemistry" 6<sup>th</sup>, Edition,, Lippincott Williams &amp; Wilkins, a Wolters Kluwer business, Philadelphia.</p> <p>4- Povl Krogsgaard-Larsen, Tommy Liljefors and Ulf Madsen, 2002 , "Textbook of Drug Design and Discovery" Third edition , Taylor &amp; Francis, London.</p> <p>5- K.-H. Hellwich · C. D. Siebert, 2006, "Stereochemistry Workbook" Springer-Verlag Berlin Heidelberg, Berlin.</p> <p>6- Lectures Notes and Practical Manual.</p>
3- Electronic Materials and Web Sites etc.	

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- 1- <http://www.chemaxon/marvin>
- 2- <http://www.webmolecules.com>
- 3- <http://www.acdlabs.com>
- 4- PASS Prediction of Activity Spectra for Substance) (<http://www.ibmh.msk.su/PASS>).

### III. Facilities Required:

#### 1 - Accommodation:

- Well-equipped lecture halls with data show facilities, whiteboards, net connection, etc.
- Well-equipped laboratories with all required equipment and reagents.

#### 2 - Computing resources:

- Computer laboratory with internet facilities.

### IV. Course Improvement Processes:

#### 1- Strategies for obtaining student feedback on effectiveness of teaching

- Student-based assessment of the effectiveness of teaching using a questionnaire designed by the Quality Assurance Unit at the end of the semester.
- Meeting with students and faculty (once per semester).

#### 2- Other strategies for evaluation of teaching by the instructor or by the department.

- Assessment of the course syllabus and contents by the teachers using a questionnaire designed by the Quality Assurance Unit of the university at the end of the semester.
- Regular meeting and discussion of the course content between the Head of Department and the teaching staff of the course (for theory and practice).

#### 3- Processes for improvement of teaching.

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	<ul style="list-style-type: none"> <li>Revision of the course specification and its teaching strategies every three academic years after consideration of all issues raised by the teachers and/or students during regular meetings and discussions.</li> <li>Exploring any possible defects in the course that might be encountered by the teaching staff and their mitigation in subsequent improved versions of course specification.</li> </ul>
<b>4- Processes for verifying standards of students' achievement</b>	
	<ul style="list-style-type: none"> <li>Checking of a sample of students' work by an independent faculty member.</li> <li>Periodic exchange and check marking of a sample of students' assignments with a faculty member from another institution.</li> <li>Adoption of scoring rubrics to assess the students' achievement (both for ongoing or summative assessments).</li> <li>Regular follow-up of laboratory logbooks to assess the practical achievement of students.</li> </ul>
<b>5- Procedures for periodically reviewing of course effectiveness and planning for improvement</b>	
	<ul style="list-style-type: none"> <li>Student rating and feedback</li> <li>Peer rating and feedback</li> <li>Regular meeting of the Curriculum Committee of the faculty.</li> </ul>
<b>6- Course development plans</b>	
	<ul style="list-style-type: none"> <li>Conducting regular workshops for the staff for improving their course specification skills.</li> <li>Regular revision of course specification and syllabus items.</li> </ul>

#### VIII. Course Policies: (including plagiarism, academic honesty, attendance etc)

The University Regulations on academic misconduct will be strictly enforced. Please refer to -----

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1	<p><b>Class Attendance:</b></p> <ul style="list-style-type: none"> <li>Attendance of all lectures and practical sessions is required. Unexcused absence exceeding 25% of the lectures or practical sessions will disqualify the student from entering the final exam.</li> </ul>
2	<p><b>Tardy:</b></p> <p>- Roll will be called in the very beginning of each lecture and practical class. Retardation for more than three weeks without a reasonable excursion, the student involved shall not be allowed to attend the class any longer and consequently shall be considered to be absent.</p>
3	<p><b>Exam Attendance/Punctuality:</b></p> <ul style="list-style-type: none"> <li>Exam attendance is obligatory unless being excused by the department and faculty.</li> <li>Absence from assignments or exams will be dealt with according to the general policy of the university.</li> </ul>
4	<p><b>Assignments &amp; Projects:</b></p> <ul style="list-style-type: none"> <li>Assignments: Written and oral; Laboratory logbook signed by the responsible demonstrator. ■</li> <li>Projects: Not applicable.</li> </ul>
5	<p><b>Cheating:</b></p> <ul style="list-style-type: none"> <li>Punishment of cheating will be according to the general policy of the university in this respect.</li> </ul>
6	<p><b>Plagiarism:</b></p> <ul style="list-style-type: none"> <li>Plagiarism in written essays, reports, etc. is not accepted, and students who plagiarize the works of others will be punished according to the general policy of the university.</li> </ul>
7	<p><b>Other policies:</b></p> <ul style="list-style-type: none"> <li>General policies of the Students' Affairs of the University and the Quality Assurance Unit.</li> </ul>

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## Course Plan of Medicinal Chemistry III

### II- Information about Faculty Member Responsible for the Course:

Name of Faculty Member	Tawfeek A. Al-Obaidy Shada H. Yassin	Office Hours					
Location & Telephone No.		SAT	SUN	MON	TUE	WED	THU
E-mail	Tawfik_93@yahoo.com		4h				

### III- Course Identification and General Information:

1-	Course Title:	Medicinal Chemistry III				
2-	Course Number & Code:	Ph5811				
3-	Credit hours:	C.H				Total
		Th.	Seminar	Pr.	F. Tr.	
		2	-	2		3
4-	Study level/year at which this course is offered:	4 <sup>th</sup> level / 2 <sup>nd</sup> semester				

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5-	Pre –requisite (if any):	General Pharmaceutical chemistry, Pharmaceutical analytical chemistry I&II , Pharmaceutical organic chemistry I,II&III and Medicinal Chemistry I
6-	Co –requisite (if any):	Pharmacology IV
7-	Program (s) in which the course is offered	Bachelor of Pharmacy
8-	Language of teaching the course:	English
9-	System of Study:	Semesters
10-	Mode of delivery:	Regular
11-	Location of teaching the course:	Faculty of Pharmacy- Sana`a university

#### IV- Course description:

The course is concerned with the fundamental knowledge about the synthesis, metabolism, physicochemical properties and their effect on drug profile. The practical part will be devoted to tutorials and studying on the qualitative and quantitative analysis and synthesis of some drugs in this course.

#### V- Intended learning outcomes (ILOs) of the course:

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**At the end of this course the students should be able to:**

1. Recognize the structural mechanism of action of studied classes of drugs
2. Outline the synthesis of some studied classes of drugs
3. Illustrate the SAR of each category in the course.
4. Discuss the metabolism and toxicity of studied classes of drugs.
5. Recognize the stereochemistry in drug structure and their effect on pharmacokinetic and pharmacodynamic profile of the drugs.
6. Identify the pharmacophores and toxicophores in the structure and their effect on pharmacokinetic and pharmacodynamic properties of the drugs.
7. Predict the metabophores in the drug structure that are responsible for metabolism in the biological system.
8. Design and evaluate qualitative and quantitative analysis of some drugs
9. Handle and dispose the chemical and pharmaceutical preparations safely and effectively.
10. Carry out synthesis some drugs.
11. Determine the quantitative analysis of some drugs.
12. Practice the qualitative analysis of some drugs.
13. Analyze the result of experimental tests that is practiced for some studied drugs
14. Communicate and cooperate effectively with his colleagues and other specialist to engage in teamwork planning and team processes.
15. Implement writing and presentation skills and demonstrate creativity and time management.
16. Use technology and technology efficiently to perform the required tasks in field of medicinal chemistry.

## VI- Course Content:

### 1 – Course Topics/Items:

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a – Theoretical Aspect					
Order	Topic List / Units	CILOs (symbols)	Sub-topic List	Week Due	Contact hours
1-	Antibacterial agents	a1, a2, a3, a4, b1, b2, d1, d2, d3	<b>Sulfonamides;</b> <ul style="list-style-type: none"> <li>- Classification,</li> <li>- Mechanism of action</li> <li>- SAR,</li> <li>- Synthesis,</li> <li>- Metabolism,</li> </ul>	1	2
2-	Antibiotics I	a1, a2, a3, a4, a5 b1, b2, d1, d2, d3	<b>Penicillins;</b> <ul style="list-style-type: none"> <li>- Mechanism of action</li> <li>- SAR</li> <li>- Stereochemistry</li> <li>- Orally and injectable Penicillins</li> <li>- Long acting Penicillins</li> <li>- <math>\beta</math>- Lactamase sensitive and resistant Penicillins</li> <li>- Broad spectrum Penicillins</li> <li>- Allergy to Penicillins</li> </ul>	2	2
3-	Antibiotics II	a1, a2, a3, a4, a5 b1, b2, d1, d2, d3	<b>C. Cephalosopins;</b> <ul style="list-style-type: none"> <li>- Mechanism of action</li> <li>- SAR</li> <li>- Stereochemistry</li> <li>- 1st generation,</li> <li>- 2<sup>nd</sup> generation,</li> <li>- 3<sup>rd</sup> generation,</li> <li>- 4<sup>th</sup> generation and</li> <li>- 5<sup>th</sup> generation</li> </ul> <b>D. Monolactam and carbapenam.</b>	3	2
4-	Antibiotics III	a1, a3, a4, b1, b2, d1, d2, d3	<ul style="list-style-type: none"> <li>- Tetracyclines, and</li> <li>- Aminoglycosides</li> </ul>	4	2

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5-	Antibiotics IV	a1,	- Lincosamide,	5	2
		a2,a3,a4, a5 b1,b2, d1,d2, d3	- Macrolide & - Chlormphenicol		
6-	Quinolones	a1, a3,a4, a5 b1,b2, d1,d2, d3	- 1st Generation <b>Quinolones</b> - 2 <sup>nd</sup> Generation <b>Quinolones</b> and - 3 <sup>rd</sup> Generation <b>Quinolones</b>	6	2
7-	Mid Exam	a1-5, b1-2		7	2
8-	Anti Mycobacterial Agents	a1, a2,a3,a4, a5 b1,b2, d1,d2, d3	- Anti T.B: 1 <sup>st</sup> line Anti T.B 2 <sup>nd</sup> line Anti T.B - Antileprosy	8	2
9-	Anti-infective agents	a1, a2,a3,a4, a5 b1,b2, d1,d2, d3	Alcohols, phenols, oxidizing agents, iodine, chlorine compound, cationic surfactants, medicinal dyes, mercury compound preservatives	9	2
10-	Antifungal Agent	a1, a3,a4, a5 b1,b2, d1,d2, d3	- Types of Fungi - Antibiotics, - Azoles, - Allylamines and morpholines - Antimetabolites, - Fatty acids and dyes	10	2

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11-	<b>Antiviral agent</b>	a1, a2,a3,a4, a5 b1,b2, d1,d2, d3	- Types viruses, - DNA viral replication, - The building blocks of DNA nucleosides, - Agents interfere with viral nucleic acid replication - Anti-Retroviral [AntiHIV] Agents - Agents inhibit the uncoating process, Neuraminidase - Inhibitors, Non-Nucleoside Reverse Transcriptase [RT] Inhibitors. - HIV Protease Inhibitors	11	2
12-	<b>Anticancer I</b>	a1, a2,a3,a4, a5	- Types of Neoplasm - Mechanism of Cancer formation	12	2
		b1,b2, d1,d2, d3	- Chemotherapeutic Agents Alkylating agents. Anti-metabolites [ Specific S]		
13-	<b>Anticancer II</b>	a1, a2,a3,a4, a5 b1,b2, d1,d2, d3	DNA intercalating agents. Antibiotics. Antimitotic agents [Specific M]. Hormones. Miscellaneous compounds.	13	2
14-	<b>Antihistamines</b>	a1, a3,a4, a5 b1,b2, d1,d2, d3	- 1 <sup>st</sup> generation, 2 <sup>nd</sup> generation H <sub>1</sub> - antihistamines - H <sub>2</sub> - antihistamines	14,15	4
15-	<b>Final Exam</b>	a1-5, b1, b2		16	2
<b>Number of Weeks /and Units Per Semester</b>				<b>16</b>	<b>32</b>

### b - Practical Aspect

Order	Tasks/ Experiments	CILOs (symbols)	Week Due	Contact Hours
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1	Hydrolytic cleavage of Sulfacetamide	b3, c1,c2, c5, d1-3	1	2
2	Crystallization and Identification of Some Sulfa drugs	b3, c1, c2, c3, c5, d1-3	2	2
3	Synthesis of Diazonium salt of Sulfanilamide	b3, c1,c2, c5, d1-3	3	2
4	Quantitative estimation of Sulfamethoxazole and Trimethoprim in Tab	b3,c1, c3, c5, d1-3	4	2
5	Qualitative determination of <b>Penicillin</b>	b3, c1, c3, c5, d1-3	5	2
6	Mid-Exam	b3, c1,c2, c3, c5	6	2
7	Quantitative estimation of <b>Penicillin capsules</b> by spectrophotometric method	b3, c1 ,c3, c5, d1-3	7	2
8	Quantitative estimation of <b>Penicillin</b> by redox method	b3, c1, c3, c5, d1-3	8	2

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9	Quantitative estimation of <b>Tetracycline cap.</b>	b3, c1, c3, c5,d1-3	9	2
10	<b>Spectrophotometric determination of Chloamphenicol eye ointment</b>	b3, c1, c4, c5,d1-3	10	2
11	Quantitative estimation of Nalidixic acid	b3, c1 ,c3, c5,d1-3	11	2
12	Quantitative estimation of INH	b3, c1 ,c3, c5,d1-3	12	2
13	Quantitative estimation of <b>Busulfan</b>	b3, c1 ,c3, c5,d1-3	13	2
14	<b>Identification of Chloroquine</b>	b3, c1, c4, c5,d1-3	14	2
15	<b>Assay of Chloroquine</b>	b3, c1, c3, c5, d1-3	15	2
16	Final Exam	b3, c1-5	16	2
<b>Number of Weeks /and Units Per Semester</b>			<b>16</b>	<b>32</b>

**VII- a-Teaching strategies of the course:**

Lecture method, Group Discussion, Problem solving sessions and Computer based teaching and learning, tutorials, brainstorming and Practical sessions.

**b- Assessment Methods:**

Quizzes, Attendance, Participation, Short answers, reports, homework, and Written exam  
Practical works, practical exam and practical reports.

**VII. Assignments:**

No.	Assignments	Aligned CILOs (symbols)	Week Due	Mark
1	Homework Assignments	a1,a3, a5, b1-4, d1-3	Sporadic through the semester	<b>10</b>
2	Reports	c1-5, d1-3		

**VII- Schedule of Assessment Tasks for Students During the Semester:**

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No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes (CILOs symbols)
8.	Attendance, reports and Participation	All Weeks	10	7%	a1-5, b2-3, d1-3
9.	Quizzes and Homework-assignments	Sporadic through the semester	10	7%	a1,a3, a5, b1-3, d1-3
10.	Attendance, Practical Reports	All Weeks	15	10%	c1-4
11.	Practical mid-semester exam	8 <sup>th</sup>	15	10%	b3,c1-3
12.	Theoretical mid-semester exam	7 <sup>th</sup>	30	20%	a1-5, b1-2
13.	Final Exam (theoretical)	16 <sup>th</sup>	50	33%	a1-5, b1-2
14.	Final Exam (practical)	16 <sup>th</sup>	20	13%	b3, c1-5
<b>Total</b>			<b>150</b>	<b>100%</b>	

### VIII- Students' Support:

Office Hours/week	Other Procedures (if any)
Two contact hours per week	None

### IX- Learning Resources:

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### 1- Required Textbook(s) ( maximum two ).

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- 4- Graham L. Patrick, 2013, "An Introduction to Medicinal Chemistry" 5<sup>th</sup> Edition, Oxford University

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	Press Inc, New York.
<b>2- Recommended Books and Reference Materials.</b>	
	<p>7- Thomas Nogrady, Donald F. Weaver, 2005, Medicinal Chemistry A Molecular and Biochemical Approach edition, Oxford University Press, Inc., New York.</p> <p>8- Donald J. Abraham, "BURGER'S Medicinal Chemistry and Drug Discovery" 6<sup>th</sup> edition, A John Wiley and Sons, Inc, Virginia.</p> <p>9- Thomas L. Lemke, Victoria F. Roche, David A. Willaiams and S. William Zito, 2008, "Foye's Principles of Medicinal Chemistry" 6<sup>th</sup>, Edition,, Lippincott Williams &amp; Wilkins, a Wolters Kluwer business, Philadelphia.</p> <p>10- Povl Krogsgaard-Larsen, Tommy Liljefors and Ulf Madsen, 2002 , "Textbook of Drug Design and Discovery" Third edition , Taylor &amp; Francis, London.</p> <p>11- K.-H. Hellwich · C. D. Siebert, 2006, "Stereochemistry Workbook" Springer-Verlag Berlin Heidelberg, Berlin.</p> <p>12- Lectures Notes and Practical Manual.</p>
<b>3- Electronic Materials and Web Sites etc.</b>	
	<p>16- <a href="http://www.chemaxon/marvin">http://www.chemaxon/marvin</a></p> <p>2- <a href="http://www.webmolecules.com">http://www.webmolecules.com</a></p> <p>3-<a href="http://www.acdlabs.com">http://www.acdlabs.com</a></p> <p>4-PASS Prediction of Activity Spectra for Substance) (<a href="http://www.ibmh.msk.su/PASS">http://www.ibmh.msk.su/PASS</a>).</p>
<b>X- Facilities Required:</b>	
<b>1 - Accommodation:</b>	<ul style="list-style-type: none"> <li>- Well-equipped lecture halls with data show facilities, whiteboards, net connection, etc.</li> <li>- Well-equipped laboratories with all required equipment and reagents.</li> </ul>
<b>3 - Computing resources:</b>	<ul style="list-style-type: none"> <li>- Computer laboratory with internet facilities.</li> </ul>
<b>XI- Course Improvement Processes:</b>	
<b>6- Strategies for obtaining student feedback on effectiveness of teaching</b>	
	<ul style="list-style-type: none"> <li>▪ Student-based assessment of the effectiveness of teaching using a questionnaire designed by the Quality Assurance Unit at the end of the semester.</li> </ul>

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	<ul style="list-style-type: none"> <li>Meeting with students and faculty (once per semester).</li> </ul>
<b>7- Other strategies for evaluation of teaching by the instructor or by the department.</b>	
	<ul style="list-style-type: none"> <li>Assessment of the course syllabus and contents by the teachers using a questionnaire designed by the Quality Assurance Unit of the university at the end of the semester.</li> <li>Regular meeting and discussion of the course content between the Head of Department and the teaching staff of the course (for theory and practice).</li> </ul>
<b>8- Processes for improvement of teaching.</b>	
	<ul style="list-style-type: none"> <li>Revision of the course specification and its teaching strategies every three academic years after consideration of all issues raised by the teachers and/or students during regular meetings and discussions.</li> <li>Exploring any possible defects in the course that might be encountered by the teaching staff and their mitigation in subsequent improved versions of course specification.</li> </ul>
<b>9- Processes for verifying standards of students' achievement</b>	
	<ul style="list-style-type: none"> <li>Checking of a sample of students' work by an independent faculty member.</li> <li>Periodic exchange and check marking of a sample of students' assignments with a faculty member from another institution.</li> <li>Adoption of scoring rubrics to assess the students' achievement (both for ongoing or summative assessments).</li> <li>Regular follow-up of laboratory logbooks to assess the practical achievement of students.</li> </ul>
<b>10- Procedures for periodically reviewing of course effectiveness and planning for improvement</b>	
	<ul style="list-style-type: none"> <li>Student rating and feedback</li> <li>Peer rating and feedback</li> <li>Regular meeting of the Curriculum Committee of the faculty.</li> </ul>
<b>6- Course development plans</b>	

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<ul style="list-style-type: none"> <li>▪ Conducting regular workshops for the staff for improving their course specification skills.</li> <li>▪ Regular revision of course specification and syllabus items.</li> </ul>
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IX. Course Policies: (including plagiarism, academic honesty, attendance etc)	
<b>The University Regulations on academic misconduct will be strictly enforced. Please refer to -----</b>	
<b>1</b>	<p><b>Class Attendance:</b></p> <ul style="list-style-type: none"> <li>▪ Attendance of all lectures and practical sessions is required. Unexcused absence exceeding 25% of the lectures or practical sessions will disqualify the student from entering the final exam.</li> </ul>
<b>2</b>	<p><b>Tardy:</b></p> <p>- Roll will be called in the very beginning of each lecture and practical class. Retardation for more than three weeks without a reasonable excursion, the student involved shall not be allowed to attend the class any longer and consequently shall be considered to be absent.</p>
<b>3</b>	<p><b>Exam Attendance/Punctuality:</b></p> <ul style="list-style-type: none"> <li>▪ Exam attendance is obligatory unless being excused by the department and faculty.</li> <li>▪ Absence from assignments or exams will be dealt with according to the general policy of the university.</li> </ul>
<b>4</b>	<p><b>Assignments &amp; Projects:</b></p> <ul style="list-style-type: none"> <li>▪ Assignments: Written and oral; Laboratory logbook signed by the responsible demonstrator. ▪</li> <li>Projects: Not applicable.</li> </ul>
<b>5</b>	<p><b>Cheating:</b></p> <ul style="list-style-type: none"> <li>▪ Punishment of cheating will be according to the general policy of the university in this respect.</li> </ul>
<b>6</b>	<p><b>Plagiarism:</b></p> <ul style="list-style-type: none"> <li>▪ Plagiarism in written essays, reports, etc. is not accepted, and students who plagiarize the works of others will be punished according to the general policy of the university.</li> </ul>



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**Other policies:**

- General policies of the Students' Affairs of the University and the Quality Assurance Unit.

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