Course Specification of Drug discovery and Development

I. Course Identification and General Information:

1.	**Course Title**	Drug discovery and Development					
2.	**Course Number & Code:**	**Ph51014**					
3.	**Credit hours:**	**C.H**				**Total**	
		Th.	**Pr.**	**Tr.**	**Seminar.**		
		2				**2**	
4.	**Study level/ semester at which this course is offered:**	5th level /2nd semester					
5.	**Pre –requisite (if any):**	Medicinal Chemistry I,II, III & IV					
6.	**Co –requisite (if any):**	-					
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					
11.	**Prepared by:**	Associate Prof. Tawfeek Ahmed Alobaidy Associate Prof. Jalal Abdulallah Hamoud					
12.	**Date of approval:**						

II. Course description:

This course introduces students to the basic principle of drug discovery and development. It demonstrate properties of drug likeness and drugs. It also covers the fundamental knowledge about the drug design.

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

At the end of this course, the students will be able to:

1. Recognize the basic principles of drug discovery, design and development.
2. Illustrate the concepts of fragments, drug likeness and drugs properties and importance of combinatory and parallel synthesis in finding a drug likeness.
3. Discuss the basic concepts of drug targets.
4. Demonstrate the essential knowledge and understanding about the properties of drug likeness in designing new chemical entities of potential biological activities.
5. Explain the preclinical and clinical studies that proceed the getting drug to the market.
6. Determine the methods used to calculate the properties of drug molecules
7. Identify the 3D pharmacophore of drug and the binding sites
8. Diagram the schemes that describe the types drug designs
9. Apply the docking procedures for design of some enzyme inhibitors.
10. Practice the drug design using some computer program.
11. Work independently or collaboratively as a teamwork member to prepare seminars/ presentations or write reports to present some examples for drug design.
12. Use computer and technology efficiently to collect, analyze and interpret information to gain knowledge in field of drug discovery and design.

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- PILOs) in: Knowledge and Understanding		Course Intended Learning Outcomes (CILOs) 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 basic principles of drug discovery, design and development.

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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.	**a2-**	Illustrate the concepts of fragments, drug likeness and drugs properties and importance of combinatory and parallel synthesis in finding a drug likeness.
		a3-	Discuss the basic concepts of drug targets.
A3-	Understand the general cellular, biochemical and physiological aspects of human body and recognize thepharmacokinetics, pharmacodynamics, disease pathophysiology, and pharmacogenetic of therapeutic agents to provide pharmaceutical care and facilitate management of patient's medication, rationalize drug use andoverall health needs.	**a4-**	Demonstrate the essential knowledge and understanding about the properties of drug likeness in designing new chemical entities of potential biological activities.
		a5-	Explain the preclinical and clinical studies that proceed the getting drug to the market.

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-	Recognize the basic principles of drug discovery, design and development.	Lectures methods, group discussion, Computer based teaching and learning.	Quizzes, Attendance, Participation, reports, homework, and written exam.
a2-	Illustrate the concepts of fragments, drug likeness and drugs properties and importance of combinatory and parallel synthesis in finding a drug likeness.		
a3-	Discuss the basic concepts of drug targets.		
a4-	Demonstrate the essential knowledge and understanding about the properties of drug likeness in designing new chemical entities of potential biological activities.		
a5-	Explain the preclinical and clinical studies that proceed the getting drug to the market.		

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(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:**	
B1-	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.	**b1-**	Determine the methods used to calculate the properties of drug molecules.
		b2-	Identify the 3D pharmacophores of drugs and the binding sites.
		b3-	Diagram the schemes that describe the types drug designs.

Teaching And Assessment Methods For Achieving Learning Outcomes:

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

*Course Intended Learning Outcomes (*CILOs*) in* Intellectual Skills. After participating in the course, students would be able to:		Teaching strategies/methods to be used.	*Methods of assessment*
b1-	Determine the methods used to calculate the properties of drug molecules	Lectures methods, Group Discussion, Problem solving sessions, brainstorming and Computer based teaching and learning	Oral Exam, Quizzes, Attendance, Participation, Short answers, homework, and Written exam.
b2-	Identify the 3D pharmacophore of drug and the binding sites		
b3-	Diagram the schemes that describe the types drug designs.		

(C) Professional and Practical Skills.

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:**	
C1-	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.	**c1-**	Apply the docking procedures for design of some enzyme inhibitors.
C5-	Conduct research studies and utilize the results in different pharmaceutical fields.	**c2-**	Practice the drug design using some computer program.

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 **After participating in the course, students would be able to:**		**Teaching strategies/methods to be used**	**Methods of assessment**
c1-	Apply the docking procedures for design of some enzyme inhibitors.	Lectures methods, group discussion and Computer based teaching and learning	Practical work on computer and homework.
c2-	Practice the drug design using some computer program.		

(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:**	
D1-	Practice independent learning needed for continuous professional development	**d1-**	Work independently or collaboratively as a teamwork member to prepare seminars/ presentations or write reports to present some examples for drug design.
D5-	Apply information and communication technology and working effectively in a team	**d2-**	Use computer and technology efficiently to collect, analyze and interpret information to gain knowledge in field of drug discovery and design.

Alignment Learning Outcomes of General and Transferable skills to Teaching and Assessment Methods.

Course Intended Learning Outcomes (CILOs) in General and Transferable Skills **After participating in the course, students would be able to:**		Teaching strategies/methods to be used.	Methods of assessment
d1-	Work independently or collaboratively as a teamwork member to prepare seminars/ presentations or write reports to present some examples for drug design.	Small group discussions and brainstorming	Homework and reports.
d2-	Use computer and technology efficiently to collect, analyze and interpret information to gain knowledge in field of drug discovery and design.		

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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	**Introduction to Drug discovery, design and development**	a1, d1,d2	-Terminology related to Drug discovery, design and development - Stages of drug discovery, primary goals and major activities.	1	2

2	**Integral Part of Drug Discovery: from fragments, lead, drug-like molecule to drug molecule**	a2, b1, d1, d2	**-Lead compound and drug-like molecule** Finding a fragment and lead compound, What is a drug-like molecule Lipinski's Rule Veber Rules **-Basic concepts about drug targets** **What is drug molecule** **Structural Integrity of a Drug Molecule:** Pharmaceutical, Pharmacokinetic and Pharmacodynamic Phases **-Structural fragments of a drug molecule:** pharmacophore, toxicophore, metabophore **-The properties of drug molecules:** 1. solubility and partition coefficient 2. Shape (steric, conforma onal, topological) proper es 3. Stereochemical proper es 4. Electronic properties **- Combinatorial and parallel synthesis in medicinal chemistry projects**	3	6

3	**Basic concepts of drug targets**	a3,d1, d2	- Protein as drug targets - Enzymes as drug targets - Receptors as drug targets - Nucleic acids as drug targets - Miscellaneous drug targets	2	4
4	**Mid Exam**	a1, a2, a3,b1		1	2

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5	**Drug discovery, design, and development**	a4, b1, b2, b3, c1,c2, d1, d2	**-Molecular and quantum mechanics** Molecular mechanics Quantum mechanics Energy minimization **-Molecular properties:** Partial charges, Molecular electrostatic potentials, Molecular orbitals , Spectroscopic transitions , The use of grids in measuring molecular properties **-Conformational analysis -Structure comparisons and overlays** **-Identifying the active conformation** X-ray crystallography Comparison of rigid and non-rigid ligands **-3D pharmacophore identification:** X-ray crystallography Structural comparison of active compounds Automatic identification of Pharmacophores **-Docking procedures** **-Types of Computer aided drug design** **1-**Structure-based drug design (direct design) strategy (SBDD) 2- Ligand –based drug design (indirect design) strategy (LBDD) **-Docking procedures** **-Examples for drug modelling** **A- Optimizing target interactions** - Drug optimization: strategies in drug design **B- Optimizing access to the target**	6	12
6	**Getting the drug to market**	a5, d1,d2	**Preclinical and clinical trials** Toxicity testing Drug metabolism studies Pharmacology, formulation, and stability tests Clinical trials	1	2

7	**Review**	a1,a2,a3,a4,a 5, b1, b2, b3, c1, c2		1	2
7	**Final Exam**	a1,a2,a3,a4,a5, b1, b2, b3, c1, c2		1	2
Number of Weeks /and Units Per Semester				**16**	**32**

VII- a-Teaching strategies of the course:
Lecture method, Group Discussion, Problem solving sessions and Computer based teaching and learning, Tutorials and brainstorming.
b- Assessment Methods:
Oral Exam, Quizzes, Attendance, Participation, Short answers, reports, homework, and Written exam.

VII. Assignments:

No.	Assignments	Aligned CILOs (symbols)	Week Due	Mark
1	Homework Assignments	a1-a4,b2,c1-2, d1-2	Sporadic through the semester	**5**
2	Reports	a1,a2, a5, b1, c1-2, d1-2		

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, Participation, reports and quizzes**	**All Weeks**	5	5%	a1-a4,b2,c1-2, d1-2
2	**Oral Tests and Homeworkassignments**	Sporadic through the semester	5	5%	a1,a2, a5, b1, c1-2, d1-2
3	**Theoretical mid-semester exam**	7th	20	20%	a1, a2, a3, b1
4	**Final Exam (theoretical)**	**16th**	70	70%	a1,a2,a3,a4,a5, b1, b2, b3, c1, c2
	Total		**100**	**100%**	

II. Students' Support:

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

III. Learning Resources:

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

1- Donald J. Abraham," BURGER'S Medicinal Chemistry and Drug Discovery" 6 th edition, A John Wiley and Sons, Inc, Virginia

2- 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.

2- Recommended Books and Reference Materials.

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1- Andrew Davis A, E Ward S, 2015, "The Handbook of Medicinal Chemistry Principles and Practice". 3rd edition, The Royal Society of Chemistry. Cambridge

2- Povl Krogsgaard-Larsen, Tommy Liljefors and Ulf Madsen, 2002 , "Textbook of Drug Design and Discovery" Third edition, Taylor & Francis, London.

3- Jhoti H and Andrew R. L, 2007, "structure-based drug discovery" Springer, Dordrecht.

4- Thomas Nogrady, Donald F. Weaver, 2005,Medicinal Chemistry A Molecular and Biochemical Approac edition, Oxford University Press, Inc., New York.

5- Graham L. Patrick, 2013, "An Introduction to Medicinal Chemistry" 5th Edition, Oxford University Press Inc, New York.

6- Thomas L. Lemke, Victoria F. Roche, David A. Willaiams and S. William Zito, 2008, "Foye's Principles of Medicinal Chemistry" 6 th, Edition,., Lippincott Williams & Wilkins, a Wolters Kluwer business, Philadelphia.

7- K-H. Hellwich C. D. Siebert, 2006, "Stereochemistry Workbook" Springer-Verlag Berlin Heidelberg, Berlin.

8- Lectures Notes.

3- Electronic Materials and Web Sites *etc*.

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

IV. Facilities Required:

- Well-equipped lecture halls with data show facilities, whiteboards,

1 - **Accommodation:** net connection, etc.
- Well-equipped laboratories with all required equipment and reagents.

2 - **Computing resources:** - Computer laboratory with internet facilities.

V. 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.	
	▪ 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. ▪ 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.
4- Processes for verifying standards of students' achievement	
	▪ Checking of a sample of students' work by an independent faculty member. ▪ Periodic exchange and check marking of a sample of students' assignments with a faculty member from another institution. ▪ Adoption of scoring rubrics to assess the students' achievement (both for ongoing or summative assessments). ▪ Regular follow-up of laboratory logbooks to assess the practical achievement of students.
5- Procedures for periodically reviewing of course effectiveness and planning for improvement	

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	▪ Student rating and feedback ▪ Peer rating and feedback ▪ Regular meeting of the Curriculum Committee of the faculty.
6- Course development plans	
	▪ Conducting regular workshops for the staff for improving their course specification skills. ▪ Regular revision of course specification and syllabus items.

VIII. Course Policies: (including plagiarism, academic honesty, attendance etc)	
The University Regulations on academic misconduct will be strictly enforced. Please refer to ----------	
1	**Class Attendance:** ▪ 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.
2	**Tardy:** - 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.
3	**Exam Attendance/Punctuality:** ▪ Exam attendance is obligatory unless being excused by the department and faculty. ▪ Absence from assignments or exams will be dealt with according to the general policy of the university.
4	**Assignments & Projects:** ▪ Assignments: Written and oral; Laboratory logbook signed by the responsible demonstrator. ▪ Projects: Not applicable.

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5	**Cheating:** ▪ Punishment of cheating will be according to the general policy of the university in this respect.
6	**Plagiarism:** ▪ 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.
7	**Other policies:** ▪ General policies of the Students' Affairs of the University and the Quality Assurance Unit.

Course Plan of Drug discovery and Development

I- Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Tawfeek A. Al-Obaidy Jalal Abdulallah Hamoud	Office Hours					
Location & Telephone No.	770507931	SAT	SUN	MON	TUE	WED	THU
E-mail	Tawfik_93@yahoo.com		2h				

II- Course Identification and General Information:		
1-	**Course Title:**	Drug discovery and Development
2-	**Course Number & Code:**	**Ph51014**

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3-	**Credit hours:**	**C.H**				**C.H Th.**
		Th.	**Th.**	**Th.**	**Th.**	
		2	**2**	**2**	**2**	**2**
4-	**Study level/year at which this course is offered:**	5th level /2nd semester				
5-	**Pre –requisite (if any):**	Medicinal Chemistry I,II, III & IV				
6-	**Co –requisite (if any):**	-				
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				

III- Course description:

This course introduces students to the basic principle of drug discovery and development. It demonstrate properties of drug likeness and drugs. It also covers the fundamental knowledge about the drug design.

IV- Intended learning outcomes (ILOs) of the course:

At the end of this course, the students will be able to:

1. Recognize the basic principles of drug discovery, design and development.
2. Illustrate the concepts of fragments, drug likeness and drugs properties and importance of combinatory and parallel synthesis in finding a drug likeness.
3. Discuss the basic concepts of drug targets.
4. Demonstrate the essential knowledge and understanding about the properties of drug likeness in designing new chemical entities of potential biological activities.
5. Explain the preclinical and clinical studies that proceed the getting drug to the market.
6. Determine the methods used to calculate the properties of drug molecules
7. Identify the 3D pharmacophore of drug and the binding sites
8. Diagram the schemes that describe the types drug designs
9. Apply the docking procedures for design of some enzyme inhibitors.
10. Practice the drug design using some computer program.
11. Work independently or collaboratively as a teamwork member to prepare seminars/ presentations or write reports to present some examples for drug design.
12. Use computer and technology efficiently to collect, analyze and interpret information to gain knowledge in field of drug discovery and design.

V- Course Content:

1 – Course Topics/Items:

a – Theoretical Aspect

Order	Topic List / Units	CILOs (symbols)	Sub-topic List	Week Due	Contact hours

1	**Introduction to Drug discovery, design and development**	a1, d1,d2	-Terminology related to Drug discovery, design and development - Stages of drug discovery, primary goals and major activities.	1	2
2	**Integral Part of Drug Discovery: from fragments, lead, drug-like molecule to drug molecule**	a2, b1, d1, d2	**-Lead compound and drug-like molecule** Finding a fragment and lead compound, What is a drug-like molecule Lipinski's Rule Veber Rules **-Basic concepts about drug targets What is drug molecule** **Structural Integrity of a Drug Molecule:** Pharmaceutical, Pharmacokinetic and Pharmacodynamic Phases **-Structural fragments of a drug molecule:** pharmacophore, toxicophore, metabophore **-The properties of drug molecules:** 1. solubility and partition coefficient 2. Shape (steric, conforma onal, topological) proper es 3. Stereochemical proper es 4. Electronic properties **- Combinatorial and parallel synthesis in medicinal chemistry projects**	2-4	6
3	**Basic concepts of drug targets**	a3,d1, d2	- Protein as drug targets - Enzymes as drug targets - Receptors as drug targets - Nucleic acids as drug targets - Miscellaneous drug targets	5,6	4
4	**Mid Exam**	a1, a2, a3,b1		7	2

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5	**Drug discovery, design, and development**	a4, b1, b2, b3, c1,c2, d1, d2	**-Molecular and quantum mechanics** Molecular mechanics Quantum mechanics Energy minimization **-Molecular properties:** Partial charges, Molecular electrostatic potentials, Molecular orbitals , Spectroscopic transitions , The use of grids in measuring molecular properties **-Conformational analysis -Structure comparisons and overlays** **-Identifying the active conformation** X-ray crystallography Comparison of rigid and non-rigid ligands **-3D pharmacophore identification:** X-ray crystallography Structural comparison of active compounds Automatic identification of Pharmacophores **-Docking procedures** **-Types of Computer aided drug design** **1-**Structure-based drug design (direct design) strategy (SBDD) 2- Ligand –based drug design (indirect design) strategy (LBDD) **-Docking procedures** **-Examples for drug modelling** **C- Optimizing target interactions** - Drug optimization: strategies in drug design **D- Optimizing access to the target**	8-13	12
6	**Getting the drug to market**	a5, d1,d2	**Preclinical and clinical trials** Toxicity testing Drug metabolism studies Pharmacology, formulation, and stability tests Clinical trials	14	2

7	**Review**	a1,a2,a3,a4,a 5, b1, b2, b3, c1, c2		15	2
8	**Final Exam**	a1,a2,a3,a4,a5, b1, b2, b3, c1, c2		16	2
Number of Weeks /and Units Per Semester				**16**	**32**

VIII- a-Teaching strategies of the course:
Lecture method, Group Discussion, Problem solving sessions and Computer based teaching and learning, Tutorials and brainstorming.
b- Assessment Methods:
Oral Exam, Quizzes, Attendance, Participation, Short answers, reports, homework, and Written exam.

VII. Assignments:

No.	Assignments	Aligned CILOs (symbols)	Week Due	Mark
1	Homework Assignments	a1,a2, a5, b1, c1-2, d1-2	Sporadic through the semester	**5**
2	Reports	a1-a4, b2, c1-2, d1-2		

VI. 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, Participation, reports and quizzes**	**All Weeks**	5	5%	a1-a4,b2,c1-2,d1-2

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ا.م.د.توفيق العبيدي	ا.د. محمود البريهي	ا.م.د.توفيق العبيدي	د.خالد الشوبة	ا.م.د. هدى العماد	ا.د. القاسم محمد عباس ا.م.دجلال القدسي

2	**Oral Tests and Homeworkassignments**	Sporadic through the semester	5	5%	a1,a2, a5, b1, c1-2, d1-2
3	**Theoretical mid-semester exam**	7th	20	20%	a1, a2, a3, b1
4	**Final Exam (theoretical)**	**16th**	70	70%	a1,a2,a3,a4,a5, b1, b2, b3, c1, c2
	Total		**100**	**100%**	

VII. Students' Support:

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

VIII. Learning Resources:

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

3- Donald J. Abraham," BURGER'S Medicinal Chemistry and Drug Discovery" 6 th edition, A John Wiley and Sons, Inc, Virginia

4- 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.

2- Recommended Books and Reference Materials.

9- Andrew Davis A, E Ward S, 2015, "The Handbook of Medicinal Chemistry Principles and Practice". 3rd edition, The Royal Society of Chemistry. Cambridge

10- Povl Krogsgaard-Larsen, Tommy Liljefors and Ulf Madsen, 2002 , "Textbook of Drug Design and

Discovery" Third edition, Taylor & Francis, London.

11- Jhoti H and Andrew R. L, 2007, "structure-based drug discovery" Springer, Dordrecht.

12- Thomas Nogrady, Donald F. Weaver, 2005,Medicinal Chemistry A Molecular and Biochemical Approac edition, Oxford University Press, Inc., New York.

13- Graham L. Patrick, 2013, "An Introduction to Medicinal Chemistry" 5th Edition, Oxford University Press Inc, New York.

14- Thomas L. Lemke, Victoria F. Roche, David A. Willaiams and S. William Zito, 2008, "Foye's Principles of Medicinal Chemistry" 6 th, Edition,., Lippincott Williams & Wilkins, a Wolters Kluwer business, Philadelphia.

15- K-H. Hellwich C. D. Siebert, 2006, "Stereochemistry Workbook" Springer-Verlag Berlin Heidelberg, Berlin.

16- Lectures Notes.

3- Electronic Materials and Web Sites *etc*.

2- http://www.chemaxon/marvin

2 - http://www.webmolecules.com

3-http://www.acdlabs.com

4- http://www.pdb.com

5-PASSPrediction of Activity Spectra for Substance) (http://www.ibmh.msk.su/PASS).

IX. 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.
3 - Computing resources:	- Computer laboratory with internet facilities

X. Course Improvement Processes:

6- 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.

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- Meeting with students and faculty (once per semester).

7- 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).
8- Processes for improvement of teaching.	
	▪ 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. ▪ 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.
9- Processes for verifying standards of students' achievement	
	▪ Checking of a sample of students' work by an independent faculty member. ▪ Periodic exchange and check marking of a sample of students' assignments with a faculty member from another institution. ▪ Adoption of scoring rubrics to assess the students' achievement (both for ongoing or summative assessments). ▪ Regular follow-up of laboratory logbooks to assess the practical achievement of students.
10- Procedures for periodically reviewing of course effectiveness and planning for improvement	
	▪ Student rating and feedback ▪ Peer rating and feedback ▪ Regular meeting of the Curriculum Committee of the faculty.
6- Course development plans	
	▪ Conducting regular workshops for the staff for improving their course specification skills. ▪ Regular revision of course specification and syllabus items.

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

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

1	**Class Attendance:** ▪ 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.
2	**Tardy:** - 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.
3	**Exam Attendance/Punctuality:** ▪ Exam attendance is obligatory unless being excused by the department and faculty. ▪ Absence from assignments or exams will be dealt with according to the general policy of the university.
4	**Assignments & Projects:** ▪ Assignments: Written and oral; Laboratory logbook signed by the responsible demonstrator. ▪ Projects: Not applicable.
5	**Cheating:** ▪ Punishment of cheating will be according to the general policy of the university in this respect.
6	**Plagiarism:** ▪ 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.
7	**Other policies:** ▪ General policies of the Students' Affairs of the University and the Quality Assurance Unit.

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