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Zagazig University
Faculty of Pharmacy
Pharmaceutical
Organic Chemistry
Department

Program and Course Specifications

Master Degree

Master Degree

Program Specification

Program Specification

A- Basic Information

1- Program title: M. Pharm. Sci Degree in Pharmaceutical Organic Chemistry

2- Program type: Monodisciplinary.

3- Faculty/ University: Faculty of Pharmacy, Zagazig University

4- Department: Pharmaceutical Organic Chemistry

5- Coordinators: Prof. Dr. / Aza M. Kadry and Prof. Dr. Said A. H. El-Feky

6- Date of program specification approval: 2019

7- Teaching language: English

8- External Evaluator: Prof. Dr. Manal Kandil (Cairo University)

9- Internal Evaluator: Prof. Dr. Eatedal H. Abdel aal

10- Academic Standards:

a. The program ILOs were compared to the general guideline for postgraduate studies, 1st Edition, February 2009 issued by (NAQAA) (National Authority for Quality Assurance and Accreditation).

b.The program special courses were compared with postgraduates organic courses in Stockholm University, Sweden & Lund University, Sweden

B- Professional Information

1- Program aims:

1.1 To provide the postgraduate master students with a special and advanced knowledge in the field of Pharmaceutical organic chemistry.

1.2- To enable them to gain the skills and attributes required for design the experiments and conduction of research of Pharmaceutical Organic Chemistry .

Consistency of the program aims with the mission of Faculty of Pharmacy:

The faculty of Pharmacy, Zagazig University aims to provide the local and regional community with highly qualified, multidisciplinary and professional pharmacists with ethical values and able to participate in the development of drug industry and quality assurance as well as contribute to a distinguished health service to the society.

2-Intended Learning Outcomes (ILOs):

The Program provides excellent opportunities for students to demonstrate knowledge and understanding qualities and develop skills appropriate for **Pharmaceutical Organic Chemistry** Master of sciences degree.

2-1 - Knowledge and Understanding:

On successful completion of the Master degree Program, students will be able to:

A.1 - Illustrate the principles of advanced organic chemistry and its related subjects including advanced heterocyclic chemistry, fundamentals of combinatorial chemistry, organic chemistry of drug synthesis, instrumental analysis, spectrophotometry, electrochemistry, physical chemistry, chemical kinetics and drug stability.

A.2 – Describe different methods of synthesis of novel advantageous drug candidates.

A.3 - Outline recent applications of organic chemistry in drug synthesis as well as drug design and development.

A.4 - Describe the legal authorities for professional practices in advanced organic chemistry.

A.5 - Determine the basics to good laboratory practice and quality assurance in advanced organic chemistry.

A.6 – Outline ethics in all aspects of scientific research.

2-2 - Intellectual Skills:

On successful completion of the Master degree Program, students will be able to:

B.1 - Interpret quantitative and qualitative experimental data as well as spectroscopic data in a specific and a suitable form to identify new organic compounds.

B.2 - Employ the available data to predict the synthetic pathways and mechanisms.

B.3 - Evaluate the expected problems and side reactions that might emerge during the synthesis and successfully find out the necessary precautions for the recovery of a pure target.
B.4 - Design full schemes of the obtained results with conclusive significances.
B.5-Manage risks during dealing with chemical reagents.
B.6 - Improve a laboratory schemes for an advanced organic chemistry issue.
B.7 - Take professional decisions in proving target compounds.

2-3 - Professional and Practical Skills:

It is intended that, on successful completion of the Master degree Program, students will be able to:
C.1 - Apply professional skills in synthesis and analysis of different pharmaceutical organic compounds.
C.2 - Write down and discuss the results in the form of a thesis and scientific papers.
C.3 - Perform the proper techniques during practical work.

2-4 - General and Transferable Skills:

On successful completion of the Master degree Program, students will be able to:

D.1 - Contact effectively with others.
D.2 - Deal with computer and internet skills for collecting scientific materials.
D.3 - Persuit self estimation for personal learning needs.
D.4 - Retrieve information from different sources in the field of advanced organic chemistry.
D.5 - Apply standards for judging others performance
D.6 - Activate working as a member of a team.
D.7 - Run time successfully to get goals.
D.8 - Get independent learning for research studies.

Matrix1: Comparison between Master degree program ILOs and the Academic Reference Standards, 2009.

	ARS (2009)	Program ILOs
Knowledge and Understanding	2.1.1 - Theories and fundamentals related to the field of learning as well as in related areas.	A.1 - Illustrate the principles of advanc organic chemistry and its related subje including advanced heterocyclic chemist fundamentals of combinatorial chemist organic chemistry of drug synthes instrumental analysis, spectrophotomet electrochemistry, physical chemistry, chemi kinetics and drug stability.
	2.1.2 - Mutual influence between professional practice and its impact on the environment.	A.2 – Describe different methods of synthesis of novel advantageous drug candidates.
	2.1.3 - Scientific developments in the area of specialization.	A.3 - Outline recent applications of organic chemistry in drug synthesis as well as drug design and development.
	2.1.4 - Moral and legal principles for professional practice in the area of specialization.	A.4 - Describe the legal authorities for professional practices in advanced organic chemistry.
	2.1.5 - Principles and the basics of quality in professional practice in the area of specialization.	A.5 - Determine the basics to good laboratory practice and quality assurance in advanced organic chemistry.
	2.1.6- The fundamentals and ethics of scientific research.	A.6 – Outline ethics in all aspects of scientific research
Intellectual Skills	2.2.1 - Analyze and evaluate information in the field of specialization and analogies to solve problems	B.1 - Interpret quantitative and qualitative experimental data as well as spectroscopic data in a specific and a suitable form to identify new organic compounds.
	2.2.2 - Solve specified problems in the lack or missing of some information.	B.2 - Employ the available data to predict the synthetic pathways and mechanisms.

	ARS (2009)	Program ILOs
	2.2.3-Correlate and integrate different pharmaceutical knowledge to solve professional problems.	B.3 - Evaluate the expected problems and side reactions that might emerge during the synthesis and successfully find out the necessary precautions for the recovery of a pure target.
	2.2.4 - Conduct research and write a scientific report on research specified topics.	B.4 - Design full schemes on the obtained results with conclusive significances.
	2.2.5 - Evaluate and manage risks and potential hazards in professional practices in the area of specialization	B.5 - Manage risks during dealing with chemical reagents.
	2.2.6 - Plan to improve performance in the field of specialization.	B.6- Improve a laboratory schemes for an advanced organic chemistry issue.
	2.2.7 - Professional decision-making in the contexts of diverse disciplines.	B.7- Take professional decisions in proving target compounds.
Professional and Practical Skills	2.3.1 - Master basic and modern professional skills in the area of specialization.	C.1 - Apply professional skills in synthesis and analysis of different pharmaceutical organic compounds.
	2.3.2 - Write and evaluate professional reports.	C.2 - Write down and discuss results in the form of thesis and scientific papers.
	2.3.3 - Assess methods and tools existing in the area of specialization.	C.3 - Choose and implement perfectly the proper techniques during practical work.
General and Transferable Skills	2.4.1 - Communicate effectively.	D.1 - Contact effectively with professionals.
	2.4.2 - Effectively use information technology in professional practices	D.2 - Deals with computer and internet skills for collecting scientific materials.

	ARS (2009)	Program ILOs
	2.4.3 - Self-assessment and define his personal learning needs.	D.3 - Persuit self estimation in advanced organic chemistry for personal learning needs.
	2.4.4 - Use variable sources to get information and knowledge.	D.4 - Restore information from different sources in the field of advanced organic chemistry.
	2.4.5 - Set criteria and parameters to evaluate the performance of others	D.5 - Apply standards for judging others performance in the field of advanced organic chemistry.
	2.4.6- Work in a team and lead teams carrying out various professional tasks.	D.6 - Activate working as a member of a team.
	2.4.7- Manage time effectively.	D.7- Run time successfully to get goals.
	2.4.8- Continuous and self learning.	D.8 - Get independent learning for research studies.

3-Curriculum Structure and Contents:

- The Masters program can be completed in 3-5 years.
- The Faculty of pharmacy implements the credit hour system.
- Each academic year consists of 2 semesters
- Minimum credit hours that can be registered each semester: 8 credit hours
- Maximum credit hours that can be registered each semester: 12 credit hours
- The program is structured as:

1- Courses: General (1 year) and Special

No. of credit hours for program courses:

General: 20 credit hours (Compulsory: 12, Elective: (2x4) 8)

Special: (3courses x4 hours) 12 credit hours

2- Thesis: 30 hours

The candidate must complete a research project on an approved topic in the Pharmaceutical Sciences. To fulfill this requirement the student must present (written and oral) a research proposal and write a thesis.

3- General University Requirements: 10 credit hours including:

a- TOEFL (400 units)

b- Computer course

c- Study plan:

Course Code	Course Title	Credit hours	Program ILOs Covered	Final examination duration
	General Courses:			
M101	Advanced instrumental analysis and chromatography I	4	A1, B1, D2	4 hours
M106	Physical chemistry	4	A1, B1, B3, D2, D6	4 hours
M109	Drug design	4	A3, D2	4 hours
ME3	Elective A Good practice for analysis of drugs and quality control	4	A1, A5, B1, B5, D2, D4	4 hours
ME2	Elective Course B	4	A1, B6, D2	4 hours

	Drug stability			
	Special Courses:			
Osp1	Advanced Organic Chemistry: Structure and Mechanism	4	A1, B2, B3, B5, D2, D4, D6 , D8	4 hours
Osp2	Advanced Organic Chemistry: Reactions and Synthesis	4	A1,B2, B3 B6 B7, D2, D4, D6, D7 , D8	4 hours
Osp3	Advanced Heterocyclic Organic Chemistry	4	A1,A3, B2, B3 B6 D1, D2, D4, D6, D7 , D8	4 hours
	Thesis	30	A1, A2, A3, A4, A5, A6, B1, B2, B3, B4, B5, B6, B7, C1, C2, C3, D1, D2, D3, D4, D5, D6 ,D 7, D8	

5-Program admission requirements:

General Admission Conditions

- The Applicant should finish or being permanently or temporarily exempted from the military service and temporary exemption should be valid for at least one year from the date of beginning of the study. (Exceptions apply, for demonstrators and assistant lecturers).
- The applicant admission to the M.Sc. program should be no later than ten years from the time of graduation.
- Acquisition of an approval from the Faculty Council following an approval of the concerned Departmental Board as well as Graduate Studies and Research Committee recommendation within a maximum of one month for any conditions stated by the concerned Departmental Board.

Admission Conditions for M.Sc. Degree

In addition to the general admission conditions stated before, applicants are admitted to M.Sc. Degree upon fulfillment of the following:

The applicants should be holders of Bachelor in Pharmaceutical Sciences from any Faculty of Pharmacy with a general grade at least good (cancelled by a decision of the university council) affiliated to the Egyptian Universities or an equivalent degree granted by any institute recognized by the Supreme Council of Universities.

The Faculty Council is allowed, with the consent of the concerned Departmental Board as well as Graduate Studies and Research Committee, to accept the student for registration of M.Sc. Degree if he has got a diploma from one of the Egyptian Universities in one of the pharmaceutical sciences fields, Faculties, or Institutes that are recognized by the Supreme Council of Universities with a general grade of Good regardless his grades in bachelor degree.

Students should fulfill all the admission requirements stated by the concerned Departmental Board (ICDL certificate, local TOEFL certificate with a grade at least 400).

Admission has to be done within the period announced by the university.

The candidate thesis discussion isn't before one calendar year from research point registration.

Regulations to complete the program:

The Faculty Council, in compliance with the concerned Departmental Board as well as Graduate Studies and Research

Committee recommendation awards the M.Sc. Degree upon fulfillment of the following requirements:

- Carrying out a deep research in the area of specialization for at least one or two calendar years and at most three years from the time of registration.
- The student has to succeed in all course examinations.
- Acceptance of the research thesis by the Jury Committee, according to statement 104 of universities regulating law.

Cancellation of Registration

The Faculty Board is allowed to cancel registration for M. Sc. programs in the following circumstances

- Student's failure to pass the course examinations for two times.
- Student's nonattendance or unsatisfactory progress (at least two annual reports) in research work being reported by the advisors and chief supervisor to the Departmental Board and forwarded to the Graduate Studies and Research Committee recommendation for approval of cancellation.
- Dissertation refusal by the Jury Committee.

The incapability of the student to graduate by the deadlines indicated

6- Admission Policy:

The faculty complies with the admission regulations and requirements of the Egyptian Supreme Council of Universities (ESCU).

7-Student assessment methods:

Method	ILOS
Written exam	Knowledge and Understanding and Intellectual Skills
Oral exam	Knowledge and Understanding, Intellectual Skills and General and Transferable Skills
Activity	Intellectual Skills and General and Transferable Skills
Seminars	Knowledge and Understanding ,Intellectual Skills & General and Transferable Skills
Follow up	Professional and practical Skills & General and Transferable Skills
Thesis and oral presentation	Knowledge and Understanding, Intellectual Skills, Professional and practical Skills & General and Transferable Skills

Grade Scale	Grade point average value (GPA)	Numerical scale
A+	5	≥ 95%
A	4.5	90- < 95%
B+	4	85- < 90%
B	3.5	80- < 85%
C+	3	75- < 80%
C	2.5	70- < 75%
D+	2	65- < 70%

D	1.5	60- < 65%
F	1	< 60%

8-Failure in Courses:

Students who fail to get 60% (1 point). In this case, students can register the course again and their grades are those obtained by repeating the course with maximum GPA being 3

9-Methods of program evaluation

Evaluator	Method	Sample
Internal evaluator: Prof. Dr. Eatedal H. Abdel aal	Program evaluation Courses evaluation	Program report Courses report
External evaluator: Prof. Dr. Manal Kandil (Cairo University)	Program evaluation Courses evaluation	Program report Courses report
Others methods	Matrix with NARS Questionnaires	The Matrix Results of the questionnaires

Program coordinator: Prof. Dr/ Aza M. Kadry

Head of Department: Prof. Dr./ Hanan Abdel Razik

Special Courses

Advanced Organic Chemistry: Structure and Mechanism

Course specification of Advanced Organic Chemistry: Structure and Mechanism

A- Course specifications:

- Program on which the course is given: Master of Pharmaceutical Sciences
- Major or Minor element of program: Major
- Department offering the program: Pharmaceutical organic chemistry
- Department offering the course: Pharmaceutical organic chemistry
- Date of specification approval: 2019
- The course was benchmarked with: **Advanced Organic Chemistry I provided by Stockholm University, Sweden**

1- Basic information:

Title: **Advanced Organic Chemistry: Structure and Mechanism**
Code: Osp1
Lectures: 4 hrs/week Credit hours: 4 hrs/week Total: 4hrs/week

2- Overall aim of the course:

On completion of the course, the students will be able to:

- Present a broad and fairly detailed view of the core area of organic reactivity.
- Evaluate and use the current literature in organic chemistry.

B- Intended learning outcomes (ILOs) of Advanced Organic Chemistry: Structure and Mechanism:

Knowledge and Understanding	
a1	Outline the basics of chemical bonding and molecular structure, Stereochemistry, stereoselectivity, stability and photochemistry.
a2	Point out the mechanism of nucleophilic substitution, polar addition, polar elimination, pericyclic reaction, free radical reactions and photochemical reaction.
a3	Explain the criteria of aromaticity and outline its utility.
Intellectual skills	
b1	Propose a mechanism for a given reaction.
b2	Determine the number of stereo isomers for a given organic compound.
b3	Find out whether a given cyclic compound is aromatic, non-aromatic or anti-aromatic.

General and Transferable Skills	
d1	Use computer skills to present information
d2	Collect information from a variety of sources
d3	Improve scientific brainstorming capabilities of team members
d4	Show independent learning skills.

3- Course Content of Advanced Organic Chemistry: Structure and Mechanism:

Week number	**Lecture contents (4hrs/week)**
1	Valence bond and molecular orbital theories
2	Factors affecting molecular structure
3	Stereochemistry and conformation
4	Stereoselectivity
5	Structural effects on stability and reactivity
6	Nucleophilic substitution
7	Polar addition and elimination reaction
8	Carbanions and other carbon nucleophile
9	Addition, condensation and substitution reactions of carbonyl compounds
10	**Activity (review article)/** Aromaticity

11	Aromatic substitution
12	Concerted pericyclic reaction
13	Free radical reaction
14	Photochemistry Illustrative examples for stability of organic pharmaceuticals
15	Final exam

4- Teaching and Learning Methods:

- Lectures
- Self learning
- Open discussion
- Critical thinking

5- Student Assessment methods:

Written exams to assess: a1, a2, a3, b1, b2 and b3
Oral exam assess: a1, a2, a3, b1, b2 and b3
Activity assess: d1, d2, d3, d4

Assessment schedule:

Assessment (1): Activity	Week 10
Assessment (2): Written exam	Week 15
Assessment (3): oral exam	Week 15

Weighting of Assessment:

Assessment method	Marks	Percentage
• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
TOTAL	**100**	**100%**

6- References and books:

A-Scientific papers

- Houk, K. N., Gonzalez, J., & Li, Y. (1995). Pericyclic reaction transition states: Passions and punctilios, 1935-1995.
- *Accounts of Chemical Research*, *28*(2), 81-90. Singh, J. (2005).
- *Photochemistry and pericyclic reactions*. New Age International.

Dinda, B. (2017).

B- Essential books:

Principles of Photochemical Reactions. In *Essentials of Pericyclic and Photochemical Reactions* (pp. 181-214). Springer, Cham. Francis A. CareyRichard J. Sundberg, Advanced Organic Chemistry Part A: Structure and Mechanisms, 2007

Facilities required for teaching and learning:

For lectures: White boards, computer, data show.

- **Course Coordinators: Prof Dr/ Azza KAdry.**
  Prof. Dr. Said A. H. El-Feky.
- **Head of Department: Prof Dr/ Hanan Abdel Razik**
- **Date: 2019 -8 -27**

Matrix I of Advanced Organic Chemistry: Structure and Mechanism 2019

Week number	Course Contents	Knowledge and understanding			Intellectual skills			General and Transferable Skills			
		a1	a2	a3	b1	b2	b3	d1	d2	d3	d4
1	Valence bond and molecular orbital theories	X									
2	Factors affecting molecular structure	X									
3	Stereochemistry and conformation	X				x					
4	Stereoselectivity	X				x					
5	Structural effects on stability and reactivity	X									
6	Nucleophilic substitution		X		x						
7	Polar addition and elimination reaction		X		x						
8	Carbanions and other carbon nucleophile		X		x						
9	Addition, condensation and substitution reactions of carbonyl compounds		X		x						
10	Activity (review article) / Aromaticity			x			x	x	x	x	x
11	Aromatic substitution		X		x						
12	Concerted pericyclic reaction		X		x						
13	Free radical reaction		X		x						
14	Photochemistry	X			x						
14	Illustrative examples for stability of organic pharmaceuticals / Revision and open discussion.	x	x	x	x	x	x	x	x	x	x

Advanced Organic Chemistry: Reactions and Synthesis

Course specification of Advanced Organic Chemistry: Reactions and Synthesis

A- Course specifications:

- Program on which the course is given: Master of Pharmaceutical Sciences
- Major or Minor element of program: Major
- Department offering the program: Pharmaceutical organic chemistry
- Department offering the course: Pharmaceutical organic chemistry
- Date of specification approval: 2019
- The course was benchmarked with **Advanced Organic Chemistry II delivered by Stockholm University, Sweden**

1- Basic information:

Title: **Advanced Organic Chemistry: Reactions and Synthesis**
Code: Osp2
Lectures: 4 hrs/week Credit hours: 4 hrs/week
Total: 4hrs/week

2- Overall aim of the course:

On completion of the course, the students will be able to:

- Design efficient pathways for multistep pharmaceutical organic synthesis.
- Evaluate current literature in organic chemistry.

B- Intended learning outcomes (ILOs) of Advanced Organic Chemistry: Reactions and Synthesis:

Knowledge and Understanding

a1	Outline regiochemistry of enolate alkylation
a2	Point out functional group interconversion by substitution,including protection and deprotection
a3	Discuss reaction of carbon nucleophiles with carbonyl compounds
a4	Point out various addition,elimination,oxidation,reduction,organometallic reactions
a5	Compare aromatic substitution reactions to aliphatic analogues

a6	Explain the fundamentals of retrosynthesis
Intellectual skills	
b1	Propose a multistep synthetic scheme towards a required target
b2	Recognize the incompatibilties between functional groups during synthesis
b3	Apply retrosynthetic analysis on complex targets
b4	Evaluate the expected problems and side reactions that might emerge during the synthesis and successfully find out the necessary precautions for the recovery of a pure target

General and Transferable Skills	
d1	Use computer skills to present information
d2	Collect information from a variety of sources
d3	Improve scientific brainstorming capabilities of team members
d4	Run time successfully to get goals.
d5	Show independent learning skills.

3. Course Content of Advanced Organic Chemistry: Reactions and Synthesis:

Week number	**Lecture contents (4hrs/week)**
1	Alkylation of enolates and other carbon nucleophiles
2	Reactions of carbon nucleophiles with carbonyl compounds
3	Functional group interconversion by substitution,including protection and deprotection
4	Electrophilic addition to carbon-carbon multiple bonds
5	Reduction of carbon-carbon multiple bonds,carbonyl groups and other functional groups
6	Concerted cycloadditions,unimolecular rearrangement,and thermal eliminations
7	Organometallic compounds of group 1and 2 metals
8	Reactions involving transition metals

9	Reactions involving carbocations as reactive intermediates
10	Reactions involving carbenes,and radicals as reactive intermediates
11	**Activity (Problem solving)** /Aromatic substitution reactions
12	Oxidations
13	Retrosynthetic analysis
14	Synthetic equivalence and control of Stereochemistry Illustrative examples for multistep synthesis / **Activity (Problem solving)**
15	Final exam

4- Teaching and Learning Methods:

- Lectures
- Self learning
- Open discussion

5- Student Assessment methods:

- Written exams to assess: a1, a2, a3, a4, a5, a6, b1, b2, b3 and b4
- Oral exam assess: a1, a2, a3, a4, a5, a6, b1, b2, b3 and b4
- Activity assess: d1, d2, d3, d4 and d5.

Assessment schedule:

Assessment (1): Activity	Week 11 and 14
Assessment (2): Written exam	Week 15
Assessment (3): oral exam	Week 15

Weighting of Assessment:

Assessment method	Marks	Percentage
• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
TOTAL	**100**	**100%**

6- References and books:

A-Scientific papers

- Terrett, J. A., Cuthbertson, J. D., Shurtleff, V. W., & MacMillan, D. W. (2015). Switching on elusive organometallic mechanisms with photoredox catalysis. *Nature*, *524*(7565), 330-334.
- Lu, E., & Liddle, S. T. (2015). Uranium-mediated oxidative addition and reductive elimination. *Dalton Transactions*, *44*(29), 12924-12941.
- Wolczanski, P. T. (2018). Activation of Carbon–Hydrogen Bonds via 1, 2-RH-Addition/-Elimination to Early Transition Metal Imides. *Organometallics*, *37*(4), 505-516.

B- Essential books:

Francis A. CareyRichard J. Sundberg, Advanced Organic Chemistry Part II: Structure and Mechanisms, 2007

Facilities required for teaching and learning:

For lectures: White boards, computer, data show.

- **Course Coordinators: Prof. Dr. Azza Kadry.**
  Prof. Dr. Said A. H. El-Feky.
- **Head of Department: Prof Dr/ Hanan Abdel Razik**
- **Date: 2019 -8 -27**

Matrix I of Advanced Organic Chemistry: Reactions and Synthesis 2019

Week number	Course Contents	Knowledge and understanding						Intellectual skills				General and Transferable				
		a1	**a2**	**a3**	**a4**	**a5**	**a6**	**b1**	**b2**	**b3**	**b4**	**d1**	**d2**	**d3**	**d4**	**d5**
1	Alkylation of enolates and other carbon nucleophiles	x														
2	Reactions of carbon nucleophiles with carbonyl compounds			x												
3	Functional group interconversion by substitution,including protection and deprotection		x													
4	Electrophilic addition to carbon-carbon multiple bonds				x											
5	Reduction of carbon-carbon multiple bonds,carbonyl groups and other functional groups				x											
6	Concerted cycloadditions,unimolecular rearrangement,and thermal eliminations				x											
7	Organometallic compounds of group 1and 2 metals				x											
8	Reactions involving transition metals				x											
9	Reactions involving carbocations as reactive intermediates				x											
10	Reactions involving carbenes,and radicals as reactive intermediates				x											
11	**Activity (Problem solving)** /Aromatic substitution reactions					X						x	x	x	x	
12	Oxidations				x											
13	Retrosynthetic analysis					X	x			x						
14	Synthetic equivalence and control of stereochemistry			x					x		x					
14	Illustrative examples for multistep synthesis / **Activity (Problem solving)**			x				x	x		x	x	x	x	x	

Advanced Heterocyclic Organic Chemistry

Course specification of Advanced Heterocyclic Organic Chemistry

A- Course specifications:

- Program on which the course is given: Master of Pharmaceutical Sciences
- Major or Minor element of program: Major
- Department offering the program: Pharmaceutical organic chemistry
- Department offering the course: Pharmaceutical organic chemistry

- Date of specification approval: 2019
- The course was benchmarked with **Advanced Heterocyclic Chemistry delivered by Lund University, Sweden**

1- Basic information:

Title: **Advanced Heterocyclic Organic Chemistry**
Code: Osp3
Lectures: 4 hrs/week Credit hours: 4 hrs/week
Total: 4hrs/week

2- Overall aim of the course:

On completion of the course, the students will be able to:

- Understand the classic and modern methodologies of heterocyclic chemistry in the pharmaceutical organic synthesis.

3. Intended learning outcome s (ILOs) of Advanced Heterocyclic Organic Chemistry:

Knowledge and Understanding

a1	Outline the rules of nomenclature as well as structural and spectroscopic properties of heterocycles.
a2	Illustrate the ring synthesis of aromatic and non aromatic heterocycles.
a3	Point out the role of heterocycles in biochemistry and medicine.
a4	Discuss various types of reactions with electrophilic, nucleophilic, oxidizing and reducing reagents.

Intellectual skills

b1	Design effective synthetic routes to the desired heterocyclic pharmaceutical targets.
b2	Estimate the reactivity of electron deficient and electron rich heterocycles.
b3	Employ and modify heterocyclic chemistry literature procedures.

General and Transferable Skills	
d1	Use computer skills to present information
d2	Collect information from a variety of sources
d3	Improve scientific brainstorming capabilities of team members
d4	Run time successfully to get goals.
d5	Show independent learning skills.

4. Course Content of Advanced Heterocyclic Organic Chemistry:

Week number	**Lecture contents (4hrs/week)**
1	Heterocyclic nomenclature
2	Structures and spectroscopic properties of aromatic heterocycles
3	Ring synthesis of five-membered Heteroaromatics
4	Ring synthesis of six-membered Heteroaromatics
5	Ring synthesis of seven-membered Heteroaromatics
6	Typical reactivity of pyridines, quinolines and isoquinolines
7	Typical reactivity of pyrylium and benzopyrylium ions, pyrones and benzopyrones
8	Typical reactivity of the diazine: pyridazine, pyrimidine and pyrazine
9	Typical reactivity of pyrroles, furans and thiophenes
10	Benzanellated azoles: reactions and synthesis
11	Heterocycles containing a ring-junction nitrogen

	(bridgehead compounds)
12	Heterocycles containing more than two heteroatoms
13	Saturated and partially unsaturated heterocyclic compounds: reactions and synthesis
14	Heterocycles in biochemistry and natural Products Heterocycles in medicine / **Activty (Report)**
15	Final exam

5- Teaching and Learning Methods:

- Lectures
- Self learning
- Critical thinking

6- Student Assessment methods:

Written exams to assess: a1, a2, a3, a4, b1, b2 and b3
Oral exam assess: : a1, a2, a3, a4, b1, b2 and b3
Activity assess: d1, d2, d3, d4 and d5.

Assessment schedule:

Assessment (1): Activity	Week 14
Assessment (2): Written exam	Week 15
Assessment (3): oral exam	Week 15

Weighting of Assessment:

Assessment method	**Marks**	**Percentage**
• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
TOTAL	**100**	**100%**

7- References and books:

A-Scientific papers

- Stollenz, M., Taher, D., Bhuvanesh, N., Reibenspies, J. H., Baranová, Z., & Gladysz, J. A. (2015). Steric control of the in/out sense of bridgehead substituents in macrobicyclic compounds: isolation of new "crossed chain" variants of in/out isomers. *Chemical Communications*, *51*(89), 16053-16056.
- Heinicke, J., Aluri, B. R., Adam, M. S. S., & Ullah, F. (2009). Contributions to the Chemistry of Twofold-Coordinated Group 15/14 Element Heterocycles (A Personal Account). *Phosphorus, Sulfur, and Silicon*, *184*(6), 1627-1647.

B- Essential books:

John A. Joule,Keith Mills (2009), Heterocycic chemistry,2009

C- Suggested books:

Bioactive heterocycles, R. R. Gupta, 2006 .

D- Websites:

pubmed, Sciencedirect

Facilities required for teaching and learning:

1. **For lectures:** white boards, computer, data show.

- **Course Coordinators: prof Dr/ Azza Kadry, Prof. Dr. Said El-Feky**
- **Head of Department: Prof Dr/ Hanan Abdel Razik**
- **Date: 2019 -8 -27**

Matrix I of Advanced Heterocyclic Organic Chemistry 2019

Week number	Course Contents	Knowledge and understanding				Intellectual skills								
		a1	**a2**	**a3**	**a4**	**b1**	**b2**	**b3**	**d1**	**d2**	**d3**	**d4**	**d5**	
1	Heterocyclic nomenclature	x												
2	Structures and spectroscopic properties of aromatic heterocycles	x												
3	Ring synthesis of five-membered Heteroaromatics		X					x						
4	Ring synthesis of six-membered Heteroaromatics		X					x						
5	Ring synthesis of seven-membered Heteroaromatics		X					x						
6	Typical reactivity of pyridines, quinolines and isoquinolines				X	x	x							
7	Typical reactivity of pyrylium and benzopyrylium ions, pyrones and benzopyrones				X	x	x							
8	Typical reactivity of the diazine: pyridazine, pyrimidine and pyrazine				X	x	x							
9	Typical reactivity of pyrroles, furans and thiophenes				X	x	x							
10	Benzanellated azoles: reactions and synthesis		X											
11	Heterocycles containing a ring-junction nitrogen (bridgehead compounds)		X											
12	Heterocycles containing more than two heteroatoms		X											
13	Saturated and partially unsaturated heterocyclic compounds: reactions and synthesis		X											
14	Heterocycles in biochemistry and natural products			x										
15	Heterocycles in medicine / **Activity (report)**			x					x	x	x	x	x	

Thesis Specification

Pharmaceutical Organic Chemistry department

Thesis of Master Degree

A- Thesis specifications:

- **Program on which the course is given:** Master of Pharmaceutical sciences (Pharmaceutical Organic Chemistry)
- **Major or Minor element of program:** Major
- **Department offering the program:** Pharmaceutical Organic Chemistry Dept.
- **Department offering the thesis:** Pharmaceutical Organic Chemistry Dept.
- **Date of specification approval: 2019**

1- Basic information:

Title: Master Thesis in Pharmaceutical Organic Chemistry

Credit hours: 30 hrs

2- Overall aim of the thesis:

On completion of the thesis, the students will be able to:

- Design a robust study to answer the research question
- Identify and perform different techniques and methods used in the experimental work according to the designed protocol
- Collect all the data needed to answer the research question using the developed study design
- Analyze the results of the study in the light of prior knowledge
- Draw conclusions about the contribution to knowledge made by the study.

3- Intended learning outcome's (ILOs):

Knowledge and Understanding	
a1	Understand all required knowledge related to thesis work.
a2	Select the point of the thesis according to the problems present in the community.
a3	Be aware with recent techniques and developments that can be used during study.
a4	Understand any legal aspects related to the thesis work.
a5	Demonstrate GLP and quality assurance related to practical work of the thesis.
a6	Identify and apply scientific experimental ethics.
Intellectual skills	
b1	Analyze and interpret the experimental data in a suitable form to solve the suggested problem.
b2	Apply analysis and predict synthetic pathways to solve the problem understudy.
b3	Integrate all required knowledge to solve problems and side reactions that may rise during practical work.
b4	Conduct a research project and write scientific reports.
b5	Manage risks and hazards during dealing with chemical reagents.
b6	Design a laboratory protocol for the work.
b7	Make decisions related to recent and future studies.
Professional and practical skills	
c1	Perform practical experiments related to the point understudy.
c2	Report the work in a written report.
c3	Asses used methods, tools and instruments in the research.
General and Transferable skills	
d1	Communicate effectively with professionals.
d2	Use information technology in review and thesis preparation.
d3	Evaluate the work and learning needs.
d4	Use various sources to get information about the subject understudy.

d5	Set rules for evaluation and judging others performance.
d6	Work effectively as a member of a team.
d7	Acquire time management skills.
d8	Study independently and plan research studies.

4. Thesis Content:

Steps	Content
1st	• Suggest the possible points/ problems of research that the candidate can work on in the frame of the aim of work and choose proper point related to the problems of the community and surrounding environment. • Collect all available information about this subject by all possible means. • Use internet, journals, books and others thesis to get previous and recent information about the subject understudy. • Design the protocol including the steps of work following the suitable timetable. • Increase the awareness of the recent chemical techniques that will be used during practical work and determined by the protocol. • Integrate different knowledge required to solve suggested problem. • Continuous evaluation to the thesis outcome according to the schedule.
2nd	• Identify different practical techniques and methods to assess chemical reactions related to the subject under study. • Evaluate and manage chemical hazards throughout the whole practical work.

	• Organize the experimental work according to the designed protocol. • Apply spectroscopic analysis for the new expected compounds (IR, 1HNMR, Mass and elemental analysis). • Predict synthetic pathways and mechanisms. • Use all possible means to prove target compounds. • Apply ethical recommendations in all aspects of scientific research e.g. citation, publication……
3rd	• Select some of the compounds for their pharmacological or microbiological activities. • Interpret the biological results. • Perform statistical analysis and biological correlation for the results. • Present and describe the results graphically. • Understand any legal aspects related to the thesis work especially those related to dealing with chemicals.
4th	• Communicate with supervisors to discuss results. • Work effectively as a member of a team (e.g. Supervisors and various professionals). • Present the results periodically in seminars. • Write scientific reports on the obtained results with conclusive significance. • Discuss obtained results in comparison with pervious literatures. • Suggest possible recommendations based on the outcome of the thesis and decide future plans. • Present the thesis in a written form. • Summarize the thesis in an understandable Arabic

	language for non professionals. • Write references in the required form (Thesis, Paper…….). • Demonstrate the thesis in a final power point presentation. • Continue self-learning throughout the experimental work and writing scientific papers.

5- Teaching and Learning Methods:

- Self learning (Activities, Research….)
- Open discussion

6- References:

- Websites: Pubmed, Sciencedirect, Weilyinterscience

Facilities required for:

1. **For practical work:** Heaters with magnetic stirrer- UV lamp- Rotary evaporator- Ice machine- Infrared- 1HNMR- Mass Spectrometer- Vacuum pump

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- **Head of Department: Prof. Dr. Hanan Abdel Razik**

Master Thesis (Pharmaceutical Organic Chemistry)				
NARS		Program ILOs	Thesis ILOs	Thesis content
Knowledge and understanding	2.1.1- Theories and fundamentals related to the field of learning as well as in related areas.	A.1-Illustrate the principles of advanced organic chemistry and its related subjects including advanced heterocyclic chemistry, fundamentals of combinatorial chemistry and organic chemistry of drug synthesis.	Understand all required knowledge related to thesis work.	• Collect all available information about this subject by all possible means.
	2.1.2- Mutual influence between professional practice and its impact on the environment.	A.2- Describe different methods of synthesis of novel advantageous drug candidates.	Select the point of the thesis according to the problems present in the community.	• Suggest the possible points/ problems of research that the candidate can work on in the frame of the aim of work and choose proper point related to the problems of the community and surrounding environment.
	2.1.3- Scientific developments in the area of specialization.	A.3- Outline recent applications of organic chemistry in drug synthesis.	Be aware with recent techniques and developments that can be used during study.	• Increase the awareness of the recent chemical techniques that will be used during practical work and determined by the protocol.

	2.1.4- Moral and legal principles for professional practice in the area of specialization.	A.4- Describe the legal authorities for professional practices in advanced organic chemistry.	Understand any legal aspects related to the thesis work.	• Understand any legal aspects related to the thesis work espically those related to dealing with chemicals.
	2.1.5- Principles and the basics of quality in professional practice in the area of specialization.	A.5- Determine the basics to good laboratory practice and quality assurance in advanced organic chemistry.	Demonstrate GLP and quality assurance related to practical work of the thesis.	• Identify different practical techniques and methods to assess chemical reactions related to the subject understudy.
	2.1.6- The fundamentals and ethics of scientific research.	A.6- Outline clearly full consciousness of ethics in all aspects of scientific research.	Identify and apply scientific experimental ethics.	• Apply ethical recommendations in all aspects of scientific research e.g citation, publication……..
Skills Intellectual	2.2.1- Analyze and evaluate information in the field of specialization and analogies to solve problems	B.1 - Interpret quantitative and qualitative experimental data as well as spectroscopic data in a specific and a suitable form to identify new organic compounds.	Analyze and interpret the experimental data in a suitable form to solve the suggested problem.	• Select some compounds for their pharmacological or microbiological activities. • Interpret the biological results. • Perform statistical analysis and biological correlation for the results. • Present and describe the results graphically.

	2.2.2- Solve specified problems in the lack or missing of some information.	B.2- Employ the available data to predict the synthetic pathways and mechanisms.	Apply analysis and predict synthetic pathways to solve the problem understudy.	• Predict synthetic pathways and mechanisms. • Apply spectroscopic analysis for the new expected compounds (IR, 1HNMR, Mass and elemental analysis.
	2.2.3-Correlate and integrate different pharmaceutical knowledge to solve professional problems.	B.3- Evaluate the expected problems and side reactions that might emerge during the synthesis and successfully find out the necessary precautions for the recovery of a pure target.	Integrate all required knowledge to solve problems and side reactions that may rise during practical work.	• Integrate different knowledge required to solve suggested problem.
	2.2.4- Conduct research and write scientific report on research specified topics.	B.4- Design full schemes on the obtained results with conclusive significances.	Conduct a research project and write scientific reports.	• Write scientific reports on the obtained results with conclusive significance.
	2.2.5- Evaluate and manage risks and potential hazards in professional practices in the area of specialization	B.5-Manage risks during dealing with chemical reagents	Manage risks and hazards during dealing with chemical reagents.	Evaluate and manage chemical hazards throughout the whole practical work.

	2.2.6- Plan to improve performance in the field of specialization.	B.6- Improve a laboratory schemes for an advanced organic chemistry issue.	Design a laboratory protocol for the work.	• Design the protocol including the steps of work following the suitable timetable. Suggest possible recommendations based on the outcome of the thesis and decide future plans.
	2.2.7- Professional decision-making in the contexts of diverse disciplines.	B.7- Take professional decisions in proving target compounds.	Make decisions related to recent and future studies.	•Suggest the possible points/ problems of research that the candidate can work on in the frame of the aim of work and choose proper point related to the problems of the community and surrounding environment. -Suggest possible recommendations based on the outcome of the thesis and decide future plans. - Use all possible means to prove target compounds.

Practical skills and	2.3.1- Master basic and modern professional skills in the area of specialization.	C.1- Apply professional skills in synthesis and analysis of different pharmaceutical organic compounds.	Perform practical experiments related to the point understudy.	• Predict synthetic pathways and mechanisms. • Apply spectroscopic analysis for the new expected compounds (IR, 1HNMR, Mass and elemental analysis. -Use all possible means to prove target compounds.
	2.3.2- Write and evaluate professional reports.	C.2- Write down and discuss results in the form of thesis and scientific papers.	Report the work in a written report.	• Present the thesis in a written form -Summarize the thesis in an understandable Arabic language for non professionals. • Write references in the required form (Thesis, Paper…….).
	2.3.3- Assess methods and tools existing in the area of specialization.	C.3- Choose and implement perfectly the proper techniques during practical work .	Asses used methods, tools and instruments in the research.	• Identify different practical techniques and methods to assess chemical reactions related to the subject understudy.
anera	2.4.1- Communicate effectively.	D.1- Contact effectively with professionals.	Communicate effectively with professionals.	• Communicate with supervisors to discuss results.

	2.4.2- Effectively use information technology in professional practices	D.2- Deal with computer and internet skills for collecting scientific materials.	Use information technology in review and thesis preparation.	• Present the results periodically in seminars • Demonstrate the thesis in a final power point presentation.
	2.4.3- Self-assessment and define his personal learning needs.	D.3- Persuit self estimation in advanced organic chemistry for personal learning needs.	Evaluate the work and learning needs.	• Continuous evaluation to the thesis outcome according to the schedule.
	2.4.4- Use variable sources to get information and knowledge.	D.4- Restore information from different sources in the field of advanced organic chemistry	Use various sources to get information about the subject understudy.	• Use internet, journals, books and others thesis to get previous and recent information about the subject understudy.
	2.4.5- Set criteria and parameters to evaluate the performance of others	D.5- Apply standards for judging others performance in the field of advanced organic chemistry.	Set rules for evaluation and judging others performance.	• Discuss obtained results in comparison with pervious literatures.
	2.4.6- Work in a team and lead teams carrying out various professional tasks.	D.6- Activate working as a member of a team.	Work effectively as a member of a team.	• Work effectively as a member of a team (e.g. Supervisors and various professionals).
	2.4.7- Manage time effectively.	D.7- Run time successfully to get goals.	Acquire time management skills.	· Organize the experimental work according to the designed protocol.
	2.4.8- Continuous and self learning.	D.8- Get independent learning for research studies.	Study independently and plan research studies.	• Continue self-learning throughout the experimental work and writing scientific papers.

Physical Chemistry

Course specification of Physical Chemistry

A-Course specifications:

- Program on which the course is given: Master's of Pharmaceutical Sciences in organic chemistry
- Major or Minor element of program: Major
- Department offering the program: Organic Chemistry.
- Department offering the course: Analytical Chemistry.
- Date of specification approval: 2019

1- Basic information:

Title: **Physical Chemistry** Code: M106

Lectures: 4 hrs/week Credit hours: 4 hrs/week

Total: 4 hrs/week

2- Overall aim of the course:

On completion of the course, the students should be able to outline the principles of kinetics, catalysis, solutions and photochemistry and describe theories of reaction rate, types of chemical reaction criteria of catalysis.

3. Intended learning outcome s (ILOs) of Physical Chemistry:

A- Knowledge and Understanding	
a1	Describe the principles of kinetics, catalysis, solutions and photochemistry
a2	Outline the behavior and laws governing, photochemistry, solutions and chemical reactions and their applications.
a3	Describe units of measurements and calculations with chemical formulas and equations.
B- Intellectual skills	
b_1	Implement the knowledge and information obtained from physical chemistry principles in determining rates of the reaction.
D- General and Transferable skills	
d_1	Acquire Computer skills like preparing presentations and collecting information through different data-bases.
d_2	Work effectively as a member of team
d_3	Improve scientific brain storming capabilities of team members

4. Course Contents of Physical Chemistry:

Week number	Contents
1	• Introduction of kinetics and rate of reactions
2	• Molecular and order of reaction.
3	• Parallel and consecutive reactions.
4	• Methods used for determination of the order of reactions
5	• Theories of reaction rates and chain reaction
6	• Criteria of catalysis.

7	• Homogenous and enzyme catalysis
8	• Heterogeneous catalysis
9	• Nature of electrolytes in solution.
10	• Photochemistry and properties of electromagnetic radiations.
11	• Laws of photochemical process, quantum yield and chain reaction.
12	• Solutions: • Principles and concentration and solubility.
13	• Factors affecting solubility • Solute-solvent interaction. • Solubility and temperature. • Effect of pressure on solubility.
14	• Solutions of liquids in liquids • Solutions of solid in liquids (Colligative properties of solutions.)
15	• Written Exam

5- Teaching and Learning Methods:

- Lectures
- Self learning
- Open discussion
- Internet based search

6- Student Assessment methods :

Written exams to assess: a1, a2, a3 and b1

Oral exam to assess: a1, a2, b1 and b2

Activity to assess: d1, d2 and d3

Assessment schedule:

Assessment (1): Activity	Week 8
Assessment (2): Written exam	Week 15
Assessment (3): oral exam	Week 15

Weighting of Assessment:

Assessment method	Marks	Percentage
• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
TOTAL	**100**	**100%**

7- References and books:

A-Scientific papers

B- Essential books:

- Principles of Physical Chemistry (Part 1-2) by Lion el M. Raff, Prentice Hall; 1st edition (2001).
- Physical chemistry of surfaces, Arthur Ademson, John Wiley & Sons.inc:1st edition (2000).

D- Websites/Journal:

Analytical Chemistry

www.sciencedirect.com

www.rsc.org

Facilities required for teaching and learning:

1. **For lectures:** Black (white) boards, computer, data show.

- **Course Coordinator: Prof Dr/ Wafaa Hassan**
  Prof Dr/ Mervat Hosny
- **Head of Department:**

Matrix I of Physical Chemistry

Course Contents		ILOs						
		Knowledge and understanding			Intellectual skills	General and Transferable skills		
		a1	a2	a3	b1	d_1	d_2	d_3
1	• Introduction of kinetics and rate of reactions	X						
2	• Molecular and order of reaction.			x				
3	• Parallel and consecutive reactions.			x	x			
4	• Methods used for determination of the order of reactions	X						
5	• Theories of reaction rates and chain reaction		X					
6	• Criteria of catalysis.		x					
7	• Homogenous and enzyme catalysis	X						
8	• Heterogeneous catalysis	X				X	X	X

9	• Nature of electrolytes in solution.	**X**						
10	• Photochemistry and properties of electromagnetic radiations.		**x**					
11	• Laws of photochemical process, quantum yield and chain reaction.		**x**					
12	• Solutions: • Principles and concentration and solubility.		**x**					
13	• Factors affecting solubility • Solute-solvent interaction. • Solubility and temperature. • Effect of pressure on solubility.		**x**					
14	• Solutions of liquids in liquids • Solutions of solid in liquids (Colligative		**x**					

	properties of solutions.)							

Matrix II of Physical Chemistry

NARS		Program ILOs	Course ILOs	Course contents	Sources	Teaching and learning methods		Method of assessment		
						Lecture	Self learning	Written exam	Oral Exam	Activity
2.1	2.1.1- Theories and fundamentals related to the field of learning as well as in related areas.	A.1 - Illustrate the principles of advanced organic chemistry and its related subjects including advanced heterocyclic chemistry, fundamentals of combinatorial chemistry, organic chemistry of drug synthesis, instrumental analysis, spectrophotometry, electrochemistry, physical chemistry, chemical kinetics and drug stability.	a1	• Introduction of kinetics and rate of reactions. • Methods used for determination of the order of reactions • Homogenous and enzyme catalysis • Heterogeneous catalysis • Nature of electrolytes in solution.	Textbooks, Scientific papers and self learning	x	X	x	x	

			a2 a3	• Theories of reaction rates and chain reaction • Criteria of catalysis. Photochemistry and properties of electromagnetic radiations. • Laws of photochemical process, quantum yield and chain reaction. Solutions: • Principles and concentration and solubility. Factors affecting solubility • Solute-solvent interaction. • Solubility and temperature. • Effect of pressure on solubility. • Solutions of liquids in liquids • Solutions of solid in liquids (Colligative properties of solutions.)						
2.2	2.2.1- Analyze and evaluate information in the field of specialization and analogies to solve problems	B.1 - Interpret quantitative and qualitative experimental data as well as spectroscopic data in a specific and a suitable form to identify new organic compounds.	b1	Units of measurements and dimensional analysis---Calculations with chemical formulas and equations.	Textbooks, Scientific papers and self learning	x	X	x	x	

	2.2.3-Correlate and integrate different pharmaceutical knowledge to solve professional problems.	B.3 - Evaluate the expected problems and side reactions that might emerge during the synthesis and successfully find out the necessary precautions for the recovery of a pure target.								
2.4	**2.4.2- Effectively use information technology in professional practices**	D.2 - Deals with computer and internet skills for collecting scientific materials.	d1	Activity						X
	2.4.6- Work in a team and lead teams carrying out various professional tasks.	D.6 - Activate working as a member of a team.	d2	Activity						x
			d3							x

Drug Design

Course specification of Drug Design

Course specifications:

- Program on which the course is given: Master of Pharmaceutical Sciences (Organic chemistry)
- Major or Minor element of program: Major
- Department offering the program: Organic chemistry Dept.
- Department offering the course: Medicinal chemistry Dept.
- Date of specification approval: 2019

1- Basic information:

Title: **Drug Design** Code: M109

Lectures: 4 hrs/week Credit hours: 4 hrs/week

Total: 4 hrs/week

2- Overall aim of the course:

On completion of the course, the students will be able to outline principles of drug design, docking and utilize combinatorial chemistry in synthesis of drugs.

3. Intended learning outcome s (ILOs) of Drug Design

Knowledge and Understanding	
a1	Outline principles of drug design and combinatorial chemistry.
a2	Describe applications of drug design and QSAR.
a3	Illustrate clearly the up-to date information & methods in drug design and docking.
Intellectual skills	
b1	Solve or propose solutions to specified problems in drug design
General and Transferable skills	
d1	Write reports and present it.

4. Course Content of Drug Design

Week number	Lecture contents (4hrs/week)
1	Principles of drug design
2	Combinatorial chemistry (combinatorial and parallel synthesis in medicinal chemistry projects)
3	Combinatorial chemistry (solid phase techniques)
4	QSAR (hydrophobicity, electronic effects)
5	QSAR(steric factors, other physicochemical parameters)
6	**Activity(Reports)**
7	Drug design and relationship of functional groups to biological activity (hydrophilic/ hydrophobic properties)
8	Drug design and relationship of functional groups to biological activity (resistance to chemical and enzymatic degradation)
9	Relationship between molecular structure and biological activity
10	Docking (Introduction)
11	Docking (procedures)
12	**Activity(Reports)**
13	Applications of drug design (self destruct drugs,

	peptidomimetics)
14	Applications of drug design (targeting drugs)
15	Written exam

5- Teaching and Learning Methods:

- Lectures
- Self learning
- Open discussions

6- Student Assessment methods:

Written exams to assess: a1,a2,a3&b1

Oral exams to asses: a1,a2,a3&b1

Activities to asses: d1

Assessment schedule:

Assessment (1): Activity	Week 6-12
Assessment (2): Written exam	Week 15
Assessment (3): oral exam	Week 15

Weighting of Assessment:

Assessment method	Marks	Percentage
• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
TOTAL	**100**	**100%**

7- References and books:

A-Scientific papers

B- Essential books:

i- Burger's medicinal chemistry and drug discovery

Edited by Manfred E.wolff(2006)

ii- Computer-aided molecular design

Application of Agrochemicals, Materials & pharmaceuticals

Edited by Charles H.Reynolds,M.Katharine Holloway and Harold K.COX(2003)

C- Suggested books:

i- The organic chemistry of drug design and drug action, second edition, Edited by Richard B.Silverman.(2005)

ii- Designing Bioactive molecules

Three dimensional Techniques and applications, Edited by Yvonne C.Martin and Peter Willett. (2009)

D- Websites:

http://www.ncbi.nlm.nih.gov/sites/entrez

http://journals.tubitak.gov.tr/chem/index.php

http://www.pharmacopoeia.co.uk/

www.Pubmed.Com

www.sciencedirect.com

Facilities required for teaching and learning:

For lectures: Black (white) boards, computers and data show.

Course Coordinators:

- **Head of Department:**
- **Date** تم اعتماد التوصيف بالقسم بتاريخ

Matrix I of Drug Design

Course Contents		ILOs of Drug Design course				
		Knowledge and understanding			Intellectual skills	General and Transferable skills
		a1	a2	a3	b1	d1
1	Principles of drug design	x				
2	Combinatorial chemistry (combinatorial and parallel synthesis in medicinal chemistry projects)	x				
3	Combinatorial chemistry (solid phase techniques)	x				
4	QSAR (hydrophobicity, electronic effects)		x			
5	QSAR(steric factors, other physicochemical parameters)		x			
6	**Activity(Reports)**					x
7	Drug design and relationship of functional groups to biological activity (hydrophilic/ hydrophobic properties)		x	x		
8	Drug design and relationship of functional groups to biological activity (resistance to chemical and enzymatic degradation)		x	x		
9	Relationship between molecular structure and biological activity		x	x		
10	Docking (Introduction)			x		
11	Docking (procedures)			x		
12	**Activity(Reports)**					x
13	Applications of drug design (self destruct drugs, peptidomimetics)				x	
14	Applications of drug design (targeting drugs)				**x**	

Matrix II of Drug Design

NARS		Program ILOs	Course ILOs	Course contents	Sources	Teaching and learning methods		Methods of assessment		
						Lecture	Self learning	Written exam	Oral exam	Activities
	2.1.3- Scientific developments in the area of specialization.	A.3 - Outline recent applications of organic chemistry in drug synthesis as well as drug design and development	a1, a2,a3,b1	Principles of drug design. Combinatorial chemistry QSAR Drug design and relationship of functional groups to biological activity. Relatioship between molecular structure and biological activity Drug design and relationship of functional groups to biological activity. Relationship between molecular structure and biological activity Docking. Applications of drug design	Textbooks, Scientific papers and self learning	x	x	x	x	

2.4	2.4.2 - Effectively use information technology in professional practices	D.2 - Deals with computer and internet skills for collecting scientific materials.	d1	Activity (Reports)	Internet Textbooks		x			x

Advanced Instrumental Analysis & chromatography I

Course specification of Advanced Instrumental Analysis & chromatography I

Course specifications:

- Program on which the course is given: Master of Pharmaceutical Sciences (Organic chemistry)
- Major or Minor element of program: Major
- Department offering the program: Organic chemistry Dept.
- Department offering the course: Medicinal chemistry Dept.
- Date of specification approval: 2019

1- Basic information:

Title: **Advanced Instrumental Analysis & chromatography I**

Code: M101

Lectures: 4 hrs/week Credit hours: 4 hrs/week

Total: 4 hrs/week

2- Overall aim of the course:

On completion of the course, the students will be able to demonstrate fundamental knowledge and basic theories in instrumental analysis, the concepts of diagnosing cardiac diseases, G.I.T diseases and infections through IR, HNMR and UV spectrophotometry **as well as** new aspects of (HPLC), HPLC/Mass, Gas Chromatography (GC) and GC/Mass and their medicinal applications.

3. Intended learning outcomes (ILOs) of Advanced Instrumental Analysis & chromatography I

Knowledge and Understanding	
a1	Illustrate theories for separation of different components in combined therapy and their determination quantitatively using different instrumental techniques.
a2	State medicinal and pharmaceutical applications of spectroscopy , HPLC and GC
Intellectual skills	
b1	Analyze & interpret qualitative & quantitative data obtained from instrumental analysis
General and Transferable skills	
d1	Write reports and present it.

4. Course Content of Advanced Instrumental Analysis & chromatography I:

Week number	**Lecture contents (4hrs/week)**
1	Advanced Ultra-violet spectroscopy
2	New aspects in vibrational spectroscopy (IR spectroscopy)
3	Application of Nuclear magnetic resonance (NMR)
4	Application of Mass spectrometry(MS)
5	Medicinal application of spectroscopy in diagnosis of diseases
6	Raman spectroscopy.
7	Advanced HPLC. **Activity (Reports)**

8	HPLC & its medicinal and pharmaceutical application
9	High performance thin layer chromatography (HPTLC).
10	Advanced Gas chromatography.
11	GC & its medicinal and pharmaceutical application
12	New aspects of Supercritical fluid chromatography (SFC) and ion exchange chromatography (IEC).
13	Capillary electrophoresis(CE)
14	Analytical application of dimeric and polymeric molecules. **Activity (Reports)**
15	Written exam

5- Teaching and Learning Methods:

- Lectures
- Self learning
- Open discussion

6- Student Assessment methods:

Written exams to assess: a1,a2&b1

Oral exams to assess: a1,a2&b1

Activities to asses: b1&d1

Assessment schedule:

Assessment (1): Activity	Week 7-14
Assessment (2): Written exam	Week 15

Assessment (3): oral exam	Week 15

Weighting of Assessment:

Assessment method	Marks	Percentage
• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
TOTAL	**100**	**100%**

7- References and books:

A-Scientific papers

B- Essential books:

-Chemical stability of pharmaceuticals, Kenneth A. Connors, Kenneth Antonio Connors, Gordon L. Amidon, Valentino J. Stella

-Pharmaceutical process validation Robert A. Nash, Alfred H. Wachter (2006)

C- Suggested books:

-Photostability of drugs and drug formulations, Hanne Hjorth Tønnesen (2004)

-U.S.P. & B.P (2010)

D- Websites:

http://www.ncbi.nlm.nih.gov/sites/entrez

http://journals.tubitak.gov.tr/chem/index.php

http://www.pharmacopoeia.co.uk/

www.Pubmed.Com

www.sciencedirect.com

Facilities required for teaching and learning:

1. **For lectures:** Black (white) boards, computer and data show.

- **Head of Department:**
- **Date:** تم اعتماد التوصيف بمجلس القسم بتاريخ

Matrix I of Advanced Instrumental Analysis & chromatography I

Course Contents		ILOs of Advanced Instrumental Analysis & chromatography I course			
		Knowledge and understanding		Intellectual skills	General and Transferable skills
		a1	a2	b1	d1
1	Advanced Ultra-violet spectroscopy	x	x	X	
2	New aspects of Vibrational spectroscopy (IR spectroscopy)	x	x	X	
3	Application of Nuclear magnetic resonance (NMR)	x	x	X	
4	Application of Mass spectrometry(MS)	x	x	X	
5	Medicinal application of spectroscopy in diagnosis of diseases		x	X	
6	Raman spectroscopy.	x			
7	Advanced HPLC. **Activity (Reports)**	x		X	X
8	HPLC & its medicinal and pharmaceutical application		x		
9	High performance thin layer chromatography (HPTLC)	x		X	
10	Advanced Gas chromatography	x			
11	GC & its medicinal and pharmaceutical application		x	X	
12	New aspects of Supercritical fluid chromatography (SFC) and ion exchange chromatography (IEC)	x	x		
13	Capillary electrophoresis(CE)	x	x		
14	Analytical application of dimeric and polymeric molecules. **Activity (Reports)**		x	X	x
15	Revision and open discussion	x	x	X	

Matrix II of Advanced Instrumental Analysis & chromatography I

NARS		Program ILOs	Course ILOs	Course contents	Sources	Teaching and learning methods		Method of assessment		
						Lecture	Self learning	Written exam	Oral exam	Activities
2.1	2.1.1- Theories and fundamentals related to the field of learning as well as in related areas.	A.1 - Illustrate the principles of advanced organic chemistry and its related subjects including advanced heterocyclic chemistry, fundamentals of combinatorial chemistry, organic chemistry of drug synthesis, instrumental analysis, spectrophotometry, electrochemistry, physical chemistry, chemical kinetics and drug stability.	a1 a2	Advanced Ultra-violet spectroscopy New aspects of Vibrational spectroscopy (IR spectroscopy) Application of Nuclear magnetic resonance (NMR) Application of Mass spectrometry(MS) Raman spectroscopy Advanced HPLC High performance liguid chromatography HPTLC Advanced Gas chromatography New aspects of Supercritical fluid chromatography (SFC) Capillary electrophoresis(CE) Analytical application of dimeric and polymeric molecules	Textbooks, Scientific papers and self learning	X	x	X	X	

2.2	2.2.1- Analyze and evaluate information in the field of specialization and analogies to solve problems	B.1 - Interpret quantitative and qualitative experimental data as well as spectroscopic data in a specific and a suitable form to identify new organic compounds.	b1	Advanced Ultra-violet spectroscopy New aspects of Vibrational spectroscopy (IR spectroscopy) Application of Nuclear magnetic resonance (NMR) Application of Mass spectrometry(MS) Medicinal application of spectroscopy in diagnosis of diseases Advanced HPLC & its medicinal and pharmaceutical application Advanced GC & its medicinal and pharmaceutical application	Textbooks, Scientific papers and self learning	X	x	X	X	
2.4	2.4.2 - Effectively use information technology in professional practices	D.2 - Deals with computer and internet skills for collecting scientific materials.	d1	Activity (Reports)	Internet Textbooks		x			x

Good practice for analysis of drugs and quality control

Course specification of Good practice for analysis of drugs and quality control

Course specifications:

- Program on which the course is given: Master of Pharmaceutical Sciences (Organic chemistry)
- Major or Minor element of program: Major
- Department offering the program: Organic chemistry Dept.
- Department offering the course: Medicinal chemistry Dept.
- Date of specification approval: 2019

1- Basic information:

Title: **Quality in Instrumental Analysis and Quality Control**

Code: ME3

Lectures: 4 hrs/week Credit hours: 4 hrs/week

Total: 4 hrs/week

2- Overall aim of the course:

On completion of the course, the students will be able to: choose & develop suitable analytical methodology and find an effective solution for a given complex problem.

3. Intended learning outcome s (ILOs) of Good practice for analysis of drugs and quality control

Knowledge and Understanding	
a1	Outline the new aspects in drug analysis & quality control
a2	Express up-to-date information in the field of drug analysis
a3	Illustrate the applications of quality control & quality assurance
Intellectual skills	
b1	Analyze & evaluate obtained results qualitatively & quantitatively
b2	Evaluate GMP to avoid any hazards
General and Transferable Skills	
d1	Improve professional abilities by evaluation of information from different sources.
d2	Write reports and present it.

4. Course Content :

Week number	Lecture contents (4hrs/week)
1	Validation parameters in analysis
2	Application of quantitative analysis for different drugs.
3	Quality control and how to minimize the synthesis errors.
4	Quality assurance and basic requirement.
5	Applications of Spectrophotometric analysis for dosage forms **Activity**
6	H^{1},C^{13},N^{15},F^{19}- NMR
7	Advanced techniques in mass spectroscopy
8	Atomic absorption
9	Fluorimetric analysis

10	Radioimmune Assay
11	Electrophoresis
12	Advanced GC-MS chemistry **Activity**
13	Spectrodenistometric (TLC scanner)
14	Forensic chemistry
15	Written exam

5- Teaching and Learning Methods:

- Lectures
- Self learning
- Open discussion

6- Student Assessment methods:

Written exams to assess: a1, a2, a3,b1,b2,d1&d2
Oral exams to assess: a1, a2, a3,b1,b2,d1&d2
Activities to assess: d1&d2

Assessment schedule:

Assessment (1): Activity	Week 5-12
Assessment (2): Written exam	Week 15
Assessment (3): oral exam	Week 15

Weighting of Assessment:

Assessment method	Marks	Percentage
• Activity	10	10 %
• Written exam	75	75 %
• oral exam	15	15 %
TOTAL	**100**	**100%**

7- References and books:

A-Scientific papers

B- Essential books:

Halpern,A in "Experimental physical chemistry"(2007)

Oxtoby,D and Nachtrieb, N in "Principles of Modern chemistry"(2009)

C- Suggested books:

Garfied, F .M., Klesta ,E and Hirsch, J in" Quality Assurance Principles for Analytical Laboratories"(2011)

D- Websites:

http://www.ncbi.nlm.nih.gov/sites/entrez

http://journals.tubitak.gov.tr/chem/index.php

http://www.pharmacopoeia.co.uk/

www.Pubmed.Com

www.sciencedirect.com

Facilities required for teaching and learning:

For lectures: Black (white) boards, data show.

- **Course Coordinators:**
- **Head of Department**
- **Date** تم اعتماد توصيف المقرر بمجلس القسم بتاريخ

Matrix I of Good practice for analysis of drugs and quality control

Course Contents		ILOs of Quality in Instrumental Analysis and Quality Control course						
		Knowledge and understanding			Intellectual skills		General and Transferable skills	
		a1	**a2**	**a 3**	**b1**	**b 2**	**d1**	**d 2**
1	Validation parameters in analysis	x		x				
2	Application of quantitative analysis for different drugs.	x	x	x				
3	Quality control and how to minimize the systemic errors.	x		x	X			
4	Quality assurance and basic requirements of GMP	x		x				
5	Application of Spectrophotometric analysis(UV-VIS-IR) **Activity**		x		X	x	x	X
6	H^{1},C^{13},N^{15},F^{19}- NMR	x	x			x		
7	Advanced techniques in mass spectroscopy		x			x		
8	Atomic absorption			x		x		
9	Fluorimetric analysis		x			x		
10	Radioimmune Assay		x					
11	Electrophoresis		x					
12	Advanced GS-MS chemistry. **Activity**	x		x			x	X
13	Spectrodenistometric (TLC scanner)	x		x	X			
14	Forensic chemistry.	x	x					

Matrix II of Good practice for analysis of drugs and quality control

NARS		Program ILOs	Course ILOs	Course contents	Sources	Teaching and learning methods		Method of assessment		
						Lecture	Self learning	Written exam	Oral exam	Activities
2.1	2.1.1- Theories and fundamentals related to the field of learning as well as in related areas.	A.1 - Illustrate the principles of advanced organic chemistry and its related subjects including advanced heterocyclic chemistry, fundamentals of combinatorial chemistry, organic chemistry of drug synthesis, instrumental analysis, spectrophotometry, electrochemistry, physical chemistry, chemical kinetics and drug stability.	a1,a2	Validation parameters in analysis Application of quantitative analysis for different drugs H^1,C^{13},N^{15},F^{19}- NMR Forensic chemistry Spectrodenistometric (TLC scanner) Advanced GC-MS Techniques Application of quantitative analysis for different drugs Applications of Spectrophotometric analysis for dosage forms H1,C13,N15,F19 NMR	Textbooks, Scientific papers and self learning	X	x	X	X	

				Advanced techniques in mass spectroscopy Fluorimetric analysis Radioimmune Assay Electrophoresis Forensic chemistry						
	2.1.5- Principles and the basics of quality in professional practice in the area of specialization.	A.5 - Determine the basics to good laboratory practice and quality assurance in advanced organic chemistry.	a3	Spectrodenistometric (TLC scanner) Atomic absorption GC-MS Techniques Validation parameters in analysis Application of quantitative analysis Quality control and how to minimize systemic erros. Quality assurance and basic requirements of GMP	Textbooks, Scientific papers and self learning	X	x	X	X	

	2.2.1- Analyze and evaluate information in the field of specialization and analogies to solve problems	B.1 - Interpret quantitative and qualitative experimental data as well as spectroscopic data in a specific and a suitable form to identify new organic compounds.	b1	Application of quantitative analysis for different drugs H^{1},C^{13},N^{15},F^{19}- NMR	Textbooks, Scientific papers and self learning	x	x	x	x	
	2.2.5- Evaluate and manage risks and potential hazards in professional practices in the area of specialization	B.5 - Manage risks during dealing with chemical reagents.	b2	Quality control and how to minimize systemic .erros Quality assurance and basic requirements of GMP	Textbooks, Scientific papers and self learning	x	x	x	x	

	2.4.4- Use variable sources to get information and knowledge.	D.4 - Restore information from different sources in the field of advanced organic chemistry.	d1	Activity (Reports)	Internet Textbooks		x			X
	2.4.2- Effectively use information technology in professional practices	D.2 - Deals with computer and internet skills for collecting scientific materials.	d2	Activity (Reports)	Internet Textbooks		x			x

Drug Stability

Course specification of Drug stability

Course specifications:

- **Program on which the course is given:** Master of Pharmaceutical Sciences (Organic chemistry)
- **Major or Minor element of program:** Major
- **Department offering the program:** Organic Dept.
- **Department offering the course:** Pharmaceutics Dept.

- **Date of specification approval:** 2019

1- Basic information:

Title: **Drug stability** Code: ME2
Lectures: 4 hrs/week Credit hours: 4 hrs/week
Total: 4 hrs/week

2- Overall aim of the course:

On completion of the course, the students will be able to describe the degradation of drugs and the methods to determine the order of reaction, illustrate the stability programs for pharmaceutical products and the latest regulations for stability testing and ability to predict the degradation pathways of a drug design a stabilization protocol and predict a product shelf-life and discuss regulations and methodologies for drug stability program.

3- Intended learning outcome s (ILOs) of Drug stability:

Knowledge and Understanding	
a1	Illustrate the principles drug stability
a2	Describe the regulations for drug stability program
a3	Describe the methodologies for drug stability program
Intellectual skills	
b1	Suggest suitable stability methods for drugs in the various dosage forms.
b2	Design in a self-directed and original research investigations on drug stability in dosage forms from degradation pathways
General and Transferable skills	
d1	Use computer skills to present information
d2	Collect information from a variety of sources

4. Course Content of Drug stability:

Week number	Lecture content (4 hr/w)
1	• Drug stability (Overview – importance)
2	• Stability regulations (overview)
3	• Critical regulatory requirements for a stability program
4	• Global stability practices
5	• Understanding and predicting pharmaceutical product shelf life
6	• Stability methodologies (overview)
7	• Development of stability indicating methods • **(Presentation)**
8	• Overview of USP-NF requirements for stability
9	• Non chromatographic methods for stability program
10	• Vibrational spectroscopic methods for quantitative analysis
11	• Evaluation of stability data
12	• Qualification, calibration and maintenance of stability chambers
13	• **Stability operation practices**
14	• Stability studies in biologics • **(Final Presentation)**
15	• Written exam

5- Teaching and Learning Methods:

- Lectures
- Self learning
- Open discussion
- Problem solving

6- Student Assessment methods:

Written exams to assess: a1, a2, a3, b1, b2
Oral exam to assess: a1, a2, a3, b1, b2
Activities to assess: d1, d2

Assessment schedule:

Assessment (1): Activity	Week 7-15
Assessment (2): Written exam	Week 15
Assessment (3): oral exam	Week 15

Weighting of Assessment:

Assessment method	Marks	Percentage
• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
TOTAL	**100**	**100%**

7- References and books:

A- Essential books: Drug Stability: Principles and Practices (Drugs and the Pharmaceutical Sciences) by Jens T. Carstensen and Christopher Rhodes (2000).

B- Suggested books:

1- Handbook of Stability Testing in Pharmaceutical Development: Regulations, Methodologies, and Best Practices, Kim Huynh-Ba, 389 (2008).
2- Extended Stability for Parenteral Drugs, 5th Edition (Extended Stability of Parenteral Drugs), Fifth Edition, Caryn Dellamorte Bing R.PH. M.S. FASHP and Anna Nowobilski-Vasilios , American Society of Health-System Pharmacists; (2013)

C- Websites: Pubmed, Sciencedirect, Weilyinterscience

Facilities required for teaching and learning:

1. **For lectures:** Black (white) boards, data show.

- **Course Coordinators:**
- **Head of Department:**
- **Date:** تم اعتماد التوصيف بمجلس القسم

Matrix I of Drug Stability

	Course Contents	ILOs of drug stability course						
		Knowledge and understanding			Intellectual skills		Transferable and general skills	
		a1	a2	a3	b1	b2	d1	d2
1	Drug stability (Overview – importance)	X						
2	Stability regulations (overview)		x					
3	Critical regulatory requirements for a stability program		x					
4	Global stability practices		x					
5	Understanding and predicting pharmaceutical product shelf life		x			x		
6	Stability methodologies (overview)			x				
7	Development of stability indicating methods **(Presentation)**			x			x	x
8	Overview of USP-NF requirements for stability			x				
9	Non chromatographic methods for stability program			x	x			
10	Vibrational spectroscopic methods for quantitative analysis			x	x			
11	Evaluation of stability data			x	x			
12	Qualification, calibration and maintenance of stability chambers			x				
13	Stability operation practices			x				
14	Stability studies in biologics			x				
15	Open discussion **(Final Presentation)**	x	x	x	x	x	X	x

Matrix II of Drug stability										
NARS		Program ILOs	Course ILOs	Course contents	Sources	Teaching and learning methods		Method of assessment		
						Lecture	Self learning	Written exam	Oral Exam	Activity
2.1	2.1.1 - Theories and fundamentals related to the field of learning as well as in related areas.	A.1 - Illustrate the principles of advanced organic chemistry and its related subjects including advanced heterocyclic chemistry, fundamentals of combinatorial chemistry, organic chemistry of drug synthesis, instrumental analysis, spectrophotometry, electrochemistry, physical chemistry, chemical kinetics and drug stability.	a1	Drug stability (Overview – importance)	Textbooks, Scientific papers and self learning	x	xx	x	x	
			a2	Stability regulations (overview) Critical regulatory requirements for a stability program Global stability practices Understanding and predicting pharmaceutical product shelf life	Textbooks, Scientific papers and self learning	x	x	X	x	

			a3	Stability methodologies (overview) Development of stability indicating methods Overview of USP-NF requirements for stability Non chromatographic methods for stability program Vibrational spectroscopic methods for quantitative analysis Evaluation of stability data Qualification, calibration and maintenance of stability chambers Qualification, calibration and maintenance of stability chambers Stability operation practices Stability studies in biologics	Textbooks, Scientific papers and self learning	x	X	X	x	
	2.2.6- Plan to improve performance in the field of specialization.	B.6- Improve a laboratory schemes for an advanced organic chemistry issue.	b1	Understanding and predicting pharmaceutical product shelf life	Textbooks, Scientific papers and self learning	x	x	x	x	

2.2			b2	Non chromatographic methods for stability program Vibrational spectroscopic methods for quantitative analysis Evaluation of stability data	Textbooks, Scientific papers and self learning	x	x	x	x	
2.4	2.4.2- Effectively use information technology in professional practices	D.2 - Deals with computer and internet skills for collecting scientific materials.	d1	Activity	Textbooks, Scientific papers and self learning		x			**X**

	2.4.4- Use variable sources to get information and knowledge.	D.4- Retrieve information from different sources.	d2	Activity	Textbooks, Scientific papers and self learning		x			**x**