Zagazig University

Faculty of Pharmacy

Analytical Chemistry Department

Program and Course Specifications

Master and Ph.D. Degrees

2019

Master Degree

Program Specification

Program Specification

A- Basic Information

1- Program title: M. Pharm. Sci Degree in **Analytical Chemistry**

2- Program type: Single.

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

4- Department: Analytical Chemistry

5- Coordinator: Prof. Dr. Wafaa ElSayed

6- Date of program specification approval: 2019

7-**External Evaluator:** Prof. Gamal Saleh (Analytical Chemistry department – Faculty of Pharmacy – Assuit University)

8- **Internal Evaluator:** Prof. Hisham Ezzat

9- **Academic Reference 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 ILOs were compared to the MSc Analytical Chemistry provided by Birkbeck College, University of London, UK.

B- Professional Information

1- Program aims:

Analytical Chemistry master's program is a program aimed at enhancement of knowledge and skills of the graduates in analytical chemistry in different settings including Industry, Research and academia.

The broad objectives of the Program are:

1. To develop research skills as well as communication skills, problem solving and decision making

2. To provide appropriate theoretical knowledge and practical skills in analyzing materials even in trace amounts using modern analytical methods and instruments.
3. To enable students acquire the skill of interpretation of analytical data using statistical principles.
4. To advance the experience of students in the area of good chemical laboratory techniques for profound contribution in the pharmaceutical analytical chemistry as well as pharmaceutical industry.
5. To enable the students to conduct professionally and independently analysis of pharmaceutical compounds by different qualitative and quantitative methods in various pharmaceutical settings including academic, research and industrial institutes.

The Analytical Chemistry master's program graduates are able to work in different profession fields such as Research & Development Laboratories, Educational and Research institutes, Analytical and Bio-analytical laboratories, Medical Centers, Hospitals, Universities, National Quality Control & assurance Centers, Pharmaceutical Industry and Ministry of Health.

Graduate Attributes:

Master's program graduates should acquire the required attributes & skills in various Pharmaceutical Analytical and bioanalytical Chemistry features including the following:

1. Have the basic knowledge for practice of analytical and bio-analytical chemistry.
2. Apply the fundamental and advanced professional skills for appropriate applications in the field of pharmaceutical industry and pharmaceutical products development.
3. Analyze data, evaluate information and solve practiced problems.

4. Conduct research, starting from constructing experimental plans till writing and publishing scientific reports.
5. Appreciate scientific integrity and ethical principles for professional practice in the area of expertise.
6. Demonstrate continuous and self learning abilities.
7. Cooperate and work effectively with other team members.

2-Intended Learning Outcomes (ILOs):

The Program provides excellent opportunities for students to demonstrate knowledge and develop skills appropriate for **Analytical 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 basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry, physical chemistry and chemical kinetics.

A.2- Recognize good practice principles and environmental samples analysis.

A.3- Identify the major impact and applications of analytical chemistry in science, industries and environment.

A.4- Describe the most advanced Instrumental techniques in analytical chemistry and their applications.

A.5- Outline principles of drug design and development.

A.6- Figure out drug stability features and kinetics chemistry.

A.7- Comprehend the ethical issues related to drug analysis and research.

A.8- Demonstrate full commitment to good laboratory practice (GLP), good manufacture practice (GMP) and quality assurance in pharmaceutical and industrial analysis.

A.9- Demonstrate full awareness of ethics in all aspects of analytical techniques.

2-2 - Intellectual Skills:

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

B.1- Analyze and interpret both quantitative and qualitative data obtained from analytical chemistry research in a specific and suitable form.

B.2- Suggest the most appropriate analytical technique for analyzing the pharmaceutical or biological samples.

B.3- Integrate the gained knowledge of analytical chemistry, for analysis analytes of complex nature.

B.4- Write concrete reports on the obtained results with conclusive significances.

B.5-Identify possible hazards during work and how to deal with.

B.6- Evaluate the applied laboratory safety measures as well as proper use of analytical instruments.

B.7- Design a laboratory protocol for a requested analytical issue.

B.8-Assess problems encountered during analytical assay and make professional decisions.

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 the recent laboratory techniques and advanced analytical procedures as well as good laboratory practice.

C.2- Write reliable scientific reports in the form of published articles.

C.3- Validate novel methods of analysis.

C.4- Develop modern analytical techniques other than the traditional ones.

2-4 - General and Transferable Skills:

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

D.1- Interact effectively with others in a written and oral ways.

D.2- Demonstrate computer skills such as internet, word processing, chemometric and kinetic softwares.

D.3- Practice self-assessment and continue professional development.

D.4- Retrieve information from various sources.

D.5- Evaluate the performance of others in the team.

D.6- Work effectively as a team member.

D.7- Acquire team leader skills for the future work.

D.8- Handle working hours appropriately.

D.9- Develop problem solving, decision making as well as research skills.

3- 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 ILOs were compared to the MSc Analytical Chemistry provided by Birkbeck College, University of London, UK.

MatrixI: Comparison of MSc. Pharm. Sci Degree in Analytical Chemistry program with the Academic Reference Standard {ARS, 2009} developed by NAQAAE

Attributes of the graduates (ARS, 2009)	Attributes of the graduates (MSc. Pharm. Sci Degree in Analytical Chemistry)
1. Apply the specialized knowledge he has acquired in his professional practice	1. Have the basic knowledge for practice of analytical and bio-analytical chemistry. 2. Apply the fundamental and advanced professional skills for appropriate applications in the field of pharmaceutical industry and pharmaceutical products development
2. Identify and solve professional problems 5. Take decisions using available information	3. Analyze data, evaluate information and solve practiced problems.
3. Show good communication and leadership skills 7. Aware of his role in community service and development	7. Cooperate and work effectively with other team members.
4. Use technology effectively in his professional practice 6. Use available resources efficiently	4. Conduct research, starting from constructing experimental plans till writing and publishing scientific reports.
8. Reflect commitment to integrity, credibility and accountability	5. Appreciate scientific integrity and ethical principles for professional practice in the area of expertise.
9. Be a lifelong learner and able to develop himself	6. Demonstrate continuous and self learning abilities.

Matrix 2: Comparison between MSc. Pharm. Sci Degree in Analytical Chemistry program ILOs and the Academic Reference Standards (ARS 2009) developed by NAQAA

	(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 basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry, physical chemistry and chemical kinetics. A.5- Outline principles of drug design and development. A.6- Figure out drug stability features and kinetics chemistry.
	2.1.2- Mutual influence between professional practice and its impact on the environment.	A.2- Recognize good practice principles and environmental samples analysis. A.3- Identify the major impact and applications of analytical chemistry in science, industries and environment.
	2.1.3- Scientific developments in the area of specialization.	A.4- Describe the most advanced Instrumental techniques in analytical chemistry and their applications.
	2.1.4- Moral and legal principles for professional practice in the area of specialization.	A.9- Demonstrate full awareness of ethics in all aspects of analytical techniques.
	2.1.5- Principles and the basics of quality in professional practice in the area of specialization.	A.8- Demonstrate full commitment to good laboratory practice (GLP), good manufacture practice (GMP) and quality assurance in pharmaceutical and industrial analysis.
	2.1.6- The fundamentals and ethics of scientific	A.7- Comprehend the ethical issues related to drug analysis

	research.	and research.
Intellectual Skills	2.2.1- Analyze and evaluate information in the field of specialization and analogies to solve problems	B.1- Analyze and interpret both quantitative and qualitative data obtained from analytical chemistry research in a specific and suitable form.
	2.2.2- Solve specified problems in the lack or missing of some information.	B.2- Suggest the most appropriate analytical technique for analyzing the pharmaceutical or biological samples.
	2.2.3-Correlate and integrate different pharmaceutical knowledge to solve professional problems.	B.3- Integrate the gained knowledge of analytical chemistry, for analysis analytes of complex nature.
	2.2.4- Conduct research and write scientific report on research specified topics.	B.4- Write concrete reports 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-Identify possible hazards during work and how to deal with. B.6- Evaluate the applied laboratory safety measures as well as proper use of analytical instruments.
	2.2.6- Plan to improve performance in the field of specialization.	B.7- Design a laboratory protocol for a requested analytical issue.
	2.2.7- Professional decision-making in the contexts of diverse disciplines.	B.8-Assess problems encountered during analytical assay and make professional decisions.
Professional and Practical Skills	2.3.1- Master basic and modern professional skills in the area of specialization.	C.1- Apply the recent laboratory techniques and advanced analytical procedures as well as good laboratory practice.
	2.3.2- Write and evaluate professional reports.	C.2- Write reliable scientific reports in the form of published articles.

	2.3.3- Assess methods and tools existing in the area of specialization.	C.3- Validate novel methods of analysis. C4. Develop modern analytical techniques other than the traditional ones.
General and Transferable Skills	2.4.1- Communicate effectively.	D.1- Interact effectively with others in a written and oral ways.
	2.4.2- Effectively use information technology in professional practices	D.2- Demonstrate computer skills such as internet, word processing, chemometric and kinetic softwares.
	2.4.3- Self-assessment and define his personal learning needs. 2.4.8- Continuous and self learning.	D.3- Practice self-assessment and continue professional development.
	2.4.4- Use variable sources to get information and knowledge.	D.4- Retrieve information from various sources.
	2.4.5- Set criteria and parameters to evaluate the performance of others	D.5- Evaluate the performance of others in the team.
	2.4.6- Work in a team and lead teams carrying out various professional tasks.	D.6- Work effectively as a team member. D.7- Acquire team leader skills for the future work. D.9- Develop problem solving, decision making as well as research skills
	2.4.7- Manage time effectively.	D.8- Handle working hours appropriately.

Matrix3: Comparison between MSc. Pharm. Sci Degree in Analytical Chemistry program ILOs and the MSc Analytical Chemistry provided by Birkbeck College, University of London,UK

	Birkbeck College, University of London,UK	Program ILOs
Knowledge and Understanding	1) Demonstrate a sound knowledge and understanding of the science underlying the key areas of analytical methodology and its practical applications.	A.1- Illustrate the basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry, physical chemistry and chemical kinetics. A.2- Recognize good practice principles and environmental samples analysis. A.3- Identify the major impact and applications of analytical chemistry in science, industries and environment. A.4- Describe the most advanced Instrumental techniques in analytical chemistry and their applications. A.5- Outline principles of drug design and development A.6- Figure out drug stability features and kinetics chemistry.
	2) Show a critical understanding of recent advances in their field of study	A.4- Describe the most advanced Instrumental techniques in analytical chemistry and their applications.
	3) Critically assess current literature in the discipline	D.4- Retrieve information from various sources.
	4) Formulate a research or method development plan and carry out the appropriate literature and data searches.	C.3- Validate novel methods of analysis. C4. Develop modern analytical techniques other than the traditional ones.
	5) Demonstrate a critical and professional approach to quality of analysis.	A.8- Demonstrate full commitment to good laboratory practice (GLP), good manufacture practice (GMP) and

		quality assurance in pharmaceutical and industrial analysis.
Intellectual Skills	6) Select the most appropriate analytical method.	B.2- Suggest the most appropriate analytical technique for analyzing the pharmaceutical or biological samples.
	7) Analyse a wide range of data types.	B.1- Analyze and interpret both quantitative and qualitative data obtained from analytical chemistry research in a specific and suitable form.
	8) Show critical reasoning. 12) Show independent reasoning and defense of ideas	B.4- Write concrete reports on the obtained results with conclusive significances.
	9) Gather and evaluate information.	B.3- Integrate the gained knowledge of analytical chemistry, for analysis analytes of complex nature.
	10) Solve problems.	B.5-Identify possible hazards during work and how to deal with. B.8-Assess problems encountered during analytical assay and make professional decisions.
	11) Formulate and test basic hypotheses.	B.7- Design a laboratory protocol for a requested analytical issue.
Professional and Practical Skills	13) Carry out chemical manipulations and operate advanced analytical equipment.	C.1- Apply the recent laboratory techniques and advanced analytical procedures as well as good laboratory practice
	14) Work safely and efficiently in a laboratory carrying out risk assessments where appropriate.	A.7- Comprehend the ethical issues related to drug analysis and conduct research. A.9- Demonstrate full awareness of ethics in all aspects of analytical techniques. B.6- Evaluate the applied laboratory safety measures as well as proper use of analytical instruments.

	15) Access a variety of subject-specific and more generic databases and information sources.	D.4- Retrieve information from various sources.
	16) Use molecular visualisation tools.	**Not covered**
	17) Apply skills to practical problems and, where appropriate develop new skills.	C.3- Develop and assess novel methods of analysis.
	18) Use different forms of IT confidently	D.2- Demonstrate computer skills such as internet, word processing, chemometric and kinetic softwares.
Personal and social Skills	19) Work as part of a team both in person and via virtual interaction.	D.5- Evaluate the performance of others in the team D.6- Work effectively as a team member. D.7- Acquire team leader skills for the future work.
	20) Manage time efficiently to balance the face-to-face and distance learning aspects of the programme	D.8- Handle working hours appropriately.
	21) Present and communicate material and ideas in both written (including electronic communication) and oral formats.	D.1- Interact effectively with others in a written and oral ways.
	22) Learn independently.	D.3- Practice self-assessment and continue professional development.
	23) Show a professionalism in analytical science	D.9- Develop problem solving, decision making as well as research skills

4-Curriculum Structure and Contents:

Program duration: 3- 5 years

Program structure:

- The Masters program can be completed in 3-5 years.
- The Faculty of pharmacy implements the credit hour system.
- The program is structured as:

1- Courses: General (1 year) and Special

No. of credit hours for program courses:

Compulsory: 12

Elective: (2x4) 8

Special: (3x4) 12

2- Thesis: 30 hours

The candidate must complete a research project on an approved topic related to instrumental analysis. To fulfill this requirement the student must present (written and orally) a research proposal and write a thesis.

3- General University Requirements: 10 credit hours including:

a- TOEFL (400 units)

b- Computer course

c-Program Curriculum:

5-Program admission requirements:

Course Code	Course Title	Credit hours	Program ILOs Covered
	General Courses:		
M109	Drug design	4	A5, D2
M101	Advanced Instrumental Analysis & chromatography I	4	A1, A4, B1,D2
M106	Physical chemistry	4	A1, A6, B1, B3, D2, D6, D9
ME3	Elective A Good practice for analysis of drugs and quality control	4	A2,A8,B1, B5, D2, D4
ME2	Elective B Drug Stability	4	A6, B7, D2,D4
	Special Courses:		
Asp1	Potentiometry, voltammetry and electrochemical sensors	4	A1, A3, B7, B8, D2, D5, D6, D7.
Asp2	Kinetic methods of analysis	4	A1, A6,A8, A9, B1, B2, D4, D8, D9.
Asp3	Spectrophotometry	4	A1, A3, B7, D4, D5, D7.
	Thesis	30	A1, A3, A4, A7, A8, A9, B1, B2, B3, B4, B5, B6, B7, B8, C1,

			C2, C3, C4, D1, D2, D3, D4, D5, D6, D7 ,D8, D9.

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 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 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 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, on consent of the concerned Departmental Board as well as Graduate Studies and Research Committee, to accept 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 450).

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

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

Regulations to complete the program:

Conditions of granting the degree

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 courses 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.
- 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	Knowledge and Understanding, Intellectual Skills, Professional and practical Skills & General and

oral presentation	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%

8-Failure in Courses:

Students who fail to get 60% (1 point)

9-Methods of program evaluation

Evaluator	Method	Sample
Internal evaluator: Professor Dr. Hesham Ezzat	Program evaluation Courses evaluation	Program report Courses report
External evaluator: Professor Dr. Gamal Saleh	Program evaluation Courses evaluation	Program report Courses report
Others methods	Matrix with NARS	The Matrix

	Questionnaires	Results of the questionnaires

Program coordinator **Head of Department**

Prof. Dr. Wafaa El-Sayed

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MSc. of Analytical chemistry -																															
Program Courses		Program intended learning outcomes																													
		Knowledge and understanding									Intellectual skills								Professional and practical skills				General and transferable skills								
		A1	A2	A3	A4	A5	A6	A7	A8	A9	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3	C4	D1	D2	D3	D4	D5	D6	D7	D8	D9
General courses	Drug design					x																		x							
	Advanced Inst.Anal.& Chromatography	x			x						x													x							
	Physical chemistry	X					x				x		x											x				x			x
	Good practice and quality control		x						x		x				x									x		x					
	Drug stability						x										x							x		x					
Special courses	Potentiometry, voltametry& electrochemical sensors	x		x													x	x						x			x	x	x		
	Kinetic methods of analysis	x					x		x	x	x	x														x				x	x
	Spectrophotometry	x		x													x									x	x		x		
Thesis		x		x	x			x	x	X	x	X	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Physical Chemistry

Course specification of Physical Chemistry

A- Course specifications:

- Program on which the course is given: Master's of Pharmaceutical Sciences in analytical chemistry
- Major or Minor element of program: Major
- Department offering the program: Analytical 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:**

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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 properties of solutions.)		**x**					

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 basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry, physical chemistry and chemical kinetics. A.6- Figure out drug stability features and kinetics chemistry.	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- Analyze and interpret both quantitative and qualitative data obtained from analytical chemistry research in a specific and suitable form.	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- Integrate the gained knowledge of analytical chemistry, for analysis analytes of complex nature.								
2.4	**2.4.2- Effectively use information technology in professional**	D.2- Demonstrate computer skills such as internet, word processing, chemometric and kinetic softwares.	d1	Activity						X

	practices									
	2.4.6- Work in a team and lead teams carrying out various professional tasks.	D.6- Work effectively as a team member.	d2	Activity						x
		D.9- Develop problem solving, decision making as well as research skills	d3							

Courses offered by other departments

Drug Design

Course specification of Drug Design

Course specifications:

- Program on which the course is given: Master of Pharmaceutical Sciences (Analytical chemistry)
- Major or Minor element of program: Major
- Department offering the program: Medicinal 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.5- Understand principles of 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	2.4.4- Use variable sources to get information and knowledge.	D.2- Demonstrate computer skills such as internet, word processing, chemometric and kinetic softwares	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 (Analytical chemistry)
- Major or Minor element of program: Major
- Department offering the program: analytical 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 basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry, physical chemistry and chemical kinetics	a1	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	Textbooks, Scientific papers and self learning	X	x	X	X	

				fluid chromatography (SFC) Capillary electrophoresis(CE)						
	2.1.3- Scintific development in the area of specialization	A.4- Describe the most advanced Instrumental techniques in analytical chemistry and their applications	a2	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 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- Analyze and interpret both quantitative and qualitative data obtained from analytical chemistry research in specific and suitable form.	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 learning needs	D.2- Demonstrate computer skills such as internet, word processing, chemometeric and kinetics softwares.	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 (Analytical chemistry)
- Major or Minor element of program: Major
- Department offering the program: Analytical 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.2- Recognize good practice principles and environmental samples analysis.	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	Textbooks, Scientific papers and self learning	X	x	X	X	

				analysis for dosage forms H1,C13,N15,F19 NMR 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.8- Demonstrate full commitment to good laboratory practice (GLP), good manufacture practice (GMP) and quality assurance in pharmaceutical and industrial analysis.	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- Analyze and interpret both quantitative and qualitative data obtained from analytical chemistry research in a specific and suitable form.	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-Identify possible hazards during work and how to deal with.	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- Retrieve information from various sources.	d1	Activity (Reports)	Internet Textbooks		x			X
	2.4.2- Effectively use information technology in professional practices	D.2- Demonstrate computer skills such as internet, word processing, chemometric and kinetic softwares.	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 (Analytical chemistry)
- **Major or Minor element of program:** Major
- **Department offering the program:** analytical chemistry Dept.
- **Department offering the course:** Pharmaceutics Dept.
- **Date of specification approval:**

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	2.1.3- Scientific developments in the area of specialization.	A.6- Figure out drug stability features and kinetics chemistry.	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.7- Design a laboratory protocol for a requested analytical 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- Demonstrate computer skills such as internet, word processing, chemometric and kinetic softwares.	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**

Special Courses

Potentiometry, Voltammetry and Electrochemical sensors

Course specification of Potentiometry, Voltammetry and Electrochemical sensors

A-Course specifications:

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

1- Basic information:

Title: **Potentiometry, Voltammetry and Electrochemical sensors**

Code: Asp1

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 principles and procedures of different potentiometric, ion selective and voltammetric methods of analysis, describe different types of electrochemical sensors and apply these techniques to analyze different analytes. Method development and validation will be covered as well.

3. Intended learning outcome s (ILOs) of Potentiometry, Voltammetry and Electrochemical sensors:

A- Knowledge and Understanding	
a1	Outline the basis and principles of potentiometric, voltammetric and ion selective electrode.
a2	Describe different types of ion-selective electrodes and electrochemical sensors.
a3	Mention different applications of potentiometry, voltammetry and ion selective electrode.
B- Intellectual skills	
b_1	Design appropriate experiment for assay of different substances.
b_2	Assess the problems encountered during analytical procedures.
D- General and Transferable skills	
d_1	Acquire Computer skills like preparing presentations and collecting information through different data-bases.
d_2	Work effectively in a team
d_3	Improve scientific brain storming and problem solving skills

4. Course Contents of Potentiometry, Voltammetry and Electrochemical sensors:

Week number	Content
1	Introduction to electrochemistry.
2	Potentionmetry: Introduction Principles of potentiometric measurements.
3	Reference electrodes and Metallic indicator electrodes.
4	Ion Selective Electrodes

	Theory Glass electrodes
5	Ion Selective Electrodes Liquid membrane electrodes Applications
6	Ion Selective Electrodes Solid state electrodes Coated wire electrodes
7	Applications of Potentiometry.
8	Voltammetry: Introduction Principles of voltammetric measurements. Activity
9	Voltammograms
10	Quantitative and Qualitative aspects of voltammetry
11	Voltametric Techniques
12	Quantitative voltammetric applications
13	Characterization voltammetric applications
14	Electrochemical Sensors
15	Written Exam

5- Teaching and Learning Methods:

- Lectures
- Self learning
- Open discussion
- Assignments

6- Student Assessment methods:

Written exams to assess: a1, a2, a3, b1, b2

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:

1-Analytical Electrochemistry, Joseph Wang, Wiley-VCH, 2000.

2- Modern Analytical Chemistry, David Harvey, McGraw-Hill Companies, 2000.

C-Websites/Journals:

Electrochemistry

Drug Testing and Analysis

Analytical Letters

www.sciencedirect.com

www.rsc.org

Facilities required for teaching and learning:

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

- **Course Coordinators: Prof. Magda El-Maamli**
  Prof. Hanaa Saleh
- **Head of Department: Prof. Dr. Magda El-Henawee**
- **Date:**

تم اعتماد توصيف المقرر في مجلس القسم بتاريخ

Matrix I of Potentiometry, Voltammetry and Electrochemical sensors

Course Contents		ILOs							
		Knowledge and understanding			Intellectual skills		General and Transferable skills		
		a1	a2	a3	b1	b2	d_1	d_2	d_3
1	Introduction to electrochemistry	x							
2	Potentionmetry: *Introduction *Principles of potentiometric measurements.	x							
3	Reference electrodes and Metallic indicator electrodes.		X						
4	Ion Selective Electrodes *Theory *Glass electrodes	x	X						
5	Ion Selective Electrodes *Liquid membrane electrodes *Applications		x	x	x	x			
6	Ion Selective Electrodes *Solid state electrodes *Coated wire electrodes		x						
7	Applications of Potentiometry .			x	x	x			
8	Voltammetry: *Introduction * Principles of voltammetric measurements. Activity	x					x	x	x
9	Voltammograms	x							
10	Quantitative and Qualitative aspects of voltammetry			x	x	x			
11	Voltametric Techniques	x							
12	Quantitative voltammetric applications			x	x	x			

13	Characterization voltammetric applications			**x**	**x**	**x**			
14	Electrochemical Sensors		**x**						

Matrix II of Potentiometry, Voltammetry and Electrochemical sensors

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 basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry and physical chemistry.	a1	Introduction to electrochemistry--Potentionmetry: Introduction and Principles of potentiometric measurements.--Ion Selective Electrodes: Theory--Voltammetry: Introduction and Principles of voltammetric measurements--Voltammograms---Voltametric Techniques	Textbooks, Scientific papers and self learning	x	x	x	x	

			a2	Reference electrodes and Metallic indicator electrodes---Glass electrodes---Liquid membrane electrodes---Solid state electrodes Coated wire electrodes---Electrochemical Sensors					x	
	2.1.2- Mutual influence between professional practice and its impact on the environment.	A.3- Identify the major impact and applications of analytical chemistry in science, industries and environment.	a3	Ion Selective Electrode: Applications---Applications of Potentiometry---Quantitative and Qualitative aspects of voltammetry----Quantitative voltammetric applications---Characterization voltammetric applications	Textbooks, Scientific papers and self learning	x	x	x	x	
2.2	2.2.6- Plan to improve performance in the field of specialization.	B.7- Design a laboratory protocol for a requested analytica issue.	b1	Ion Selective Electrode: Applications---Applications of Potentiometry---Quantitative and Qualitative aspects of voltammetry----Quantitative voltammetric applications---Characterization voltammetric applications	Textbooks, Scientific papers and self learning	x	x	x	x	

	2.2.7- Professional decision-making in the contexts of diverse disciplines.	B.8- Assess problems encountered during analytical assay and make professional decisions.	b2	Ion Selective Electrode: Applications---Applications of Potentiometry---Quantitative and Qualitative aspects of voltammetry----Quantitative voltammetric applications---Characterization voltammetric applications	Textbooks, Scientific papers and self learning	x	x	x	x	
	2.4.2- Effectively use information technology in professional practices	D.2- Demonstrate computer skills such as internet, word processing, chemometric and kinetic softwares.	d1	Activity						x
	2.4.6- Work in a team and lead teams carrying out various professional tasks.	D.6- Work effectively as a team member. D.7- Acquire team leader skills for the future work.	d2	Activity						x

	2.4.5- Set criteria and parameters to evaluate the performance of others	D.5- Evaluate the performance of others.	d3	Activity						x

Kinetic methods of analysis

Course specification of Kinetic methods of analysis

A- Course specifications:

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

1- Basic information:

Title: **Kinetic methods of analysis** Code: Asp2

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, reaction rates and factors affecting them, apply studied kinetic methods for determination of different pharmaceutical compounds and describe the analysis of kinetic results.

3. Intended learning outcomes (ILOs) of Kinetic methods of analysis:

A- Knowledge and Understanding	
a1	Outline the principles of kinetics, reaction rates and factors affecting them.
a2	Describe kinetic methods of analysis.
a3	Outline the moral code for maintaining the quality of analytical measures.
a4	Outline the basic steps toward quality of analytical measurements.
a5	State ethical approach implementation during analytical process.
B- Intellectual skills	
b_1	Manipulate data, calculate activation energy and interpret kinetic results
b_2	Suggest the most appropriate kinetic method of analysis for the assay of a chosen analyte.
D- General and Transferable Skills	
d_1	Retrieve information from various sources in the field of analytical chemistry.
d_2	Optimize work hours and manipulate time threats
d_3	Study independently with presentation of research results.

4. Course Contents of Kinetic methods of analysis:

Week number	Contents
1	• Mechanisms of chemical reactions
2	• Rates of the reaction and their measurement
3	• Order of the reaction (zero and first order)
4	• Order of the reaction (second and third order)

5	• Methods for the determination of the order of the reaction ○ Integration method • b)Method of equi-fractional part
6	• Concentrations and Time: Half- Lives
7	• Pseudo-order reactions
8	• Molecularity of a reaction • Activity
9	• Theories of reaction rate: • Collision theory
10	• Theories of reaction rate: • Transition state theory
11	• Catalysis
12	• Kinetic methods of analysis and the interpretation of kinetic results.
13	• Activation energy (Ea), Determination of rate constant and Ea (Arrhenuis plot)
14	• The Quality of Analytical Measurements • Average run length: cusum charts • Proficiency testing schemes • Collaborative trials • Uncertainty • Acceptable sampling
15	• Written exam

5- Teaching and Learning Methods:

- Lectures
- Self learning

- Problem solving and brain storming
- Open discussion

6- Student Assessment methods:

Written exams to assess: a1, a2, a3, a4,a5, b1, b2

Oral exam to assess: a1, a2, a3, a4,a5, b1, 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:

Chemical Kinetics: From Molecular Structure to Chemical Reactivity, By Luis G Arnaut, Sebastiao Jose Formosinho, Hugh Burrows, Oxford 1st ed 2007.

C- Suggested books:

Chemical Kinetics And Reaction Dynamics , Paul L. Houston ,

McGraw Hill comp., 2001.

D- Websites:

www.sciencedirect.com

www.rsc.org

Facilities required for teaching and learning:

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

- **Course Coordinators: Prof. Dr. Magda El-Maamli**
  Dr. Heba El-Sayed
- **Head of Department: Prof. Dr. Magda El Henawee**
- **Date:**

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Matrix I of Kinetic methods of analysis

Course Contents		ILOs									
		Knowledge and understanding					Intellectual skills		General and Transferable Skills		
		a1	a2	a3	a4	a5	b1	b2	d1	d2	d3
1	Mechanisms of chemical reactions	X									
2	Rates of the reaction and their measurement	X									
3	zero and first order Reactions	X									
4	second and third order reactions	X									
5	Methods for the determination of the order of the reaction	X									
6	Concentrations and Time: Half-Lives	X									
7	Pseudo-order reactions	X									
8	Molecularity of a reaction Activity	X							X	X	X
9	Collision theory	X									
10	Transition state theory	X									
11	Catalysis	X									
12	Kinetic methods of analysis and interpretation of kinetic results.		x				X	X			
13	Activation energy (Ea), Determination of rate constant and Ea (Arrhenuis plot)						X				
14	The Quality of Analytical Measurements Average run length: cusum charts Proficiency testing schemes Collaborative trials Uncertainty Acceptable sampling			x	x	x					

Matrix II of Kinetic methods of analysis

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 basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry, physical chemistry and chemical kinetics.	a1	Mechanisms of chemical reactions---Rates of the reaction and their measurement--Zero, First, Second and Third order of reaction---Methods for determining reaction order---Conc. And Time---Pseudo order reaction---Molecularity of Reaction ---Collision Theory---Transition state theory---Catalysis	Textbooks, Scientific papers and self learning	x	x	x	x	

	2.1.4- Moral and legal principles for professional practice in the area of specialization.	A.6- Figure out drug stability features and kinetics chemistry.	a2, a3	Kinetic methods of analysis and the interpretation of kinetic results Proficiency testing schemes Collaborative trials Uncertainty Acceptable sampling	Textbooks, Scientific papers and self learning	x	x	x	x	
	2.1.5- Principles and the basics of quality in professional practice in the area of specialization.	A.8- Demonstrate full commitment to good laboratory practice (GLP), good manufacture practice (GMP) and quality assurance in pharmaceutical and industrial analysis.	a4	The Quality of Analytical Measurements	Textbooks, Scientific papers and self learning	x	x	x	x	
	2.1.6- The fundamentals and ethics of scientific research.	A.9- Demonstrate full awareness of ethics in all aspects analytical techniques.	a5	the Quality of Analytical Measurements	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- Analyze and interpret both quantitative and qualitative data obtained from analytical chemistry research in a specific and suitable form.	b1	Kinetic methods of analysis and interpretation of kinetic results----Activation energy (Ea), Determination of rate constant and Ea (Arrhenuis plot)	Textbooks, Scientific papers and self learning	x	x	x	x	
	2.2.2- Solve specified problems in the lack or missing of some information.	B.2- Suggest the most appropriate analytical technique for assaying the pharmaceutical or biological samples.	b2	Kinetic methods of analysis and interpretation of kinetic results	Textbooks, Scientific papers and self learning	x	x	x	x	
	2.4.4- Use variable sources to get information and knowledge.	D.4- Retrieve information from various sources.	d1	Activity						x
	2.4.7- Manage time effectively.	D.8- Handle working hours appropriately.	d2	Activity						x
	2.4.6- Work in a team and lead teams carrying out various professional	D.9- Develop problem solving, decision making as well as research skills	d3	Activity						x

	tasks.									

Spectrophotometry

Course specification of Spectrophotometry

A- Course specifications:

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

1- Basic information:

Title: **Spectrophotometry** Code: Asp3

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 should be able to outline the principles of spectrophotometry, describe theories, operation, instrumentation and applications of spectrophotometry and related techniques, state the main theories, advantages and disadvantages of spectrophotometry, derivative spectrophotometry and flow injection spectrophotometry. Student will be also able to explain the basic components of spectrophotometer, carrying out different measurements on spectral analyzers after selecting the most appropriate assay design for the chosen analyte taking into consideration the nature and stability of compounds as well as economical and environmental factors and apply these techniques in the analysis of raw materials, pharmaceutical preparations and biological sample

3. Intended learning outcomes (ILOs) of Spectrophotometry:

A- Knowledge and Understanding	
a1	Demonstrate the principles, instrumentation and operation of spectrophotometry, derivative spectrophotometry and flow injection spectrophotometry.
a2	Describe the instrumentation, pharmaceutical and biological applications of spectrophotometry, derivative spectrophotometry and flow injection spectrophotometry.
B- Intellectual skills	
b_1	Determine the most appropriate assay design for the chosen analyte.
D- General and Transferable Skills	
d_1	Retrieve information from various sources in the field of analytical chemistry.
d_2	Work effectively with other researchers and judge their work.
d_3	Carry out responsibilities of either team leader or member.

4. Course Contents of Spectrophotometry:

Week number	Contents
1	Introduction to light absorption Electromagnetic spectrum Visible and ultraviolet spectra The Beer-Lambert law Deviation from Beer-Lambert law
2	Spectra of some important naturally occurring chromophores
3	Spectrophotometer configuration
4	Choice of spectrophotometer operating conditions

5	Use of spectrophotometer Baseline Isosbestic points Wavelength and absorbance calibration Choice and use of cuvettes Detailed examples
6	Derivative spectrophotometry Introduction Instrumentation
7	Derivative spectrophotometry Practical Aspects Applications
8	Spectrophotometric assays Introduction Assay Design Activity
9	Spectrophotometeric assay of protein
10	Enzyme based spectrophotometric assay
11	Luminescence based assay
12	Flow-injection spectrophotometry
13	Pharmaceutical and biological applications of spectrophotometry
14	Revision & Open Discussion
15	Written exam

5- Teaching and Learning Methods:

- Lectures
- Self learning

- Open discussion
- Critical thinking
- Cooperative assignments

6- Student Assessment methods:

Written exams to assess: a1, a2, b1

Oral exam to assess: a1, a2, b1

Activity to assess: d1, d2, 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:

Spectrophotometry and spectrofluorimetry, Michael G. Gore, Oxford University press, 2000.

C- Suggested books:

UV-visible spectrophotometry of water and wastewater, Olivier Thomas, Christopher Burgess, Elsevier, 2007.

Websites/Journals:

Spectrochemica Acta

Spectroscopy

Analytical Chemistry

www.tandfonline.com/toc/lanl20/current (Analytical Letters)

www.rsc.org

Facilities required for teaching and learning:

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

- **Course Coordinators: Prof Dr/ Magda El-Henawee**
  Head of Department: Prof. Dr. Magda El-Henawee
- **Date:**
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Matrix I of Spectrophotometry

	Course Contents	ILOs					
		Knowledge and Understanding		Intellectual skills	General and Transferable Skills		
		a1	a2	b1	d1	d2	d3
1	Introduction to light absorption	x					
2	Spectra of some important naturally occurring chromophores	x					
3	Spectrophotometer configuration	x					
4	Choice of spectrophotometer operating conditions	x					
5	Use of spectrophotometer	x					
6	Derivative spectrophotometry *Introduction *Instrumentation	x					
7	Derivative spectrophotometry *Practical Aspects *Applications		x	x			
8	Spectrophotometric assays *Introduction *Assay Design Activity		x	x	x		
9	Spectrophotometeric assay of protein		x	x			
10	Enzyme based spectrophotometric assay		x	x			
11	Luminescence based assay		x	x			
12	Flow-injection spectrophotometry	x	x	x			
13	Pharmaceutical and biological applications of spectrophotometry		x	x			
14	Revision	x	x	x			

Matrix II of Spectrophotometry

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 basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry, physical chemistry and kinetic chemistry.	a1	Introduction to light absorption---Spectra of some important naturally occurring chromophores---Spectrophotometer configuration----Choice of spectrophotometer operating conditions---Use of spectrophotometer---Derivative spectrophotometry *Introduction and Instrumentation ----Flow-injection spectrophotometry	Textbooks, Scientific papers and self learning	x	x	x	x	

	2.1.2- Mutual influence between professional practice and its impact on the environment.	A.3- Identify the major impact and applications of analytical chemistry in science, industries and environment.	a2	Derivative spectrophotometry *Practical Aspects *Applications---- Spectrophotometric assays--- Spectrophotometeric assay of protein---Enzyme based spectrophotometric assay---Luminescence based assay---Flow-injection spectrophotometry--- Pharmaceutical and biological applications of spectrophotometry	Textbooks, Scientific papers and self learning	x	x	x	x	

2.2	2.2.6- Plan to improve performance in the field of specialization.	B.7- Design a laboratory protocol for a requested analytical issue.	b1	Derivative spectrophotometry *Practical Aspects *Applications---- Spectrophotometric assays--- Spectrophotometeric assay of protein---Enzyme based spectrophotometric assay---Luminescence based assay---Flow-injection spectrophotometry--- Pharmaceutical and biological applications of spectrophotometry	Textbooks, Scientific papers and self learning	x	x	x	x	
2.4	2.4.4- Use variable sources to get information and knowledge.	D.4- Retrieve information from various sources	d1	Activity						x

2.4	2.4.5- Set criteria and parameters to evaluate the performance of others	D.5- Set rules for judging others chemists performance in the team.	d2	Activity						x
2.4	2.4.6- Work in a team and lead teams carrying out various professional tasks.	D.6- Work effectively as a team member. D.7- Acquire team leader skills for the future work.	d3	Activity						x

Thesis Specification

Thesis of Master Degree

A-Thesis specifications:

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

1- Basic information:

- Title: Master Thesis in Analytical 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 questions, identify and perform different analytical techniques and methods used for the experimental work according to the designed protocol, analyze results of the study in the light of prior knowledge and also draw conclusions about the contribution to knowledge by the study

3- Intended learning outcome's (ILOs):

Knowledge and Understanding	
a1	Outline theoretical and advanced bases of analytical chemistry related to main objectives of the thesis
a2	Determine the problem the thesis will handle in correlation with the community and surrounding environment
a3	Explain clearly the principles of different and advanced qualitative and quantitative analytical techniques
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	Solve problems related to practical work by obtained quantitative data from the practical work
b2	Discuss professional problems and suggest solutions relay on different pharmaceutical knowledge and recent information
b3	Combine required specialties to manage the subject under study
b4	Integrate scientific results and write report following conducting research
b5	Manage risks and hazards related to professional practical area
b6	Design a laboratory protocol for the work
b7	Decide what to do with full responsibility in scientific research
Professional and practical skills	
c1	Apply different techniques related to practical thesis work.
c2	Use and evaluate practical data to write report
c3	Apply various biochemical techniques involved in the protocol

General and Transferable skills	
d1	Communicate effectively with all people related to the work
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 biochemical and analytical techniques that will be used during practical work and determined by the protocol. Integrate different knowledge (analytical chemistry, pharmaceutical and organic chemistry knowledge, biostatistics, ……..) to solve suggested problem.

	Continuous evaluation to the thesis outcome according to the schedule.
2nd	Identify different practical techniques and methods to assess biochemical parameters related to the subject under study. Operate scientific instruments according to instructions. Evaluate and manage hazards (chemical) throughout the whole practical work. Organize the experimental work according to the designed protocol (either parallel or sequential experiments). Separation of samples for qualitative and quantitative determination and assay. Understand any legal aspects related to the thesis work.
3rd	Collect raw data for the tested biochemical parameters. Interpret raw data to get valuable information. Perform statistical analysis and biological correlation for the results. Present and describe the results graphically. Suggest solution to the problem understudy based on this presented data. Modify methods for analysis of samples
4th	Communicate with supervisors to discuss results . Work effectively as a member of a team (e.g. Supervisors, various professionals and Technicians). 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. 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….)
- Research group meetings
- Departmental seminars
- Critical thinking
- Problem solving

6- References:

Book: How to Write a Master's Thesis, By Yvonne N. Bui, SAGE publications Inc, 2009.

Websites: Pubmed, Sciencedirect, Weilyinterscience

Other resources: Faculty and University libraries

Facilities required for:

1. **For practical work:** U.V spectrophotometer, Sonicator, Colorimeter, Flouremeter, HPLC.

- **Head of Department: Prof. Dr.**

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Ph.D Degree

Program Specification

Program Specification

A- Basic Information

1- Program title: PhD. Pharm. Sci Degree in **Analytical Chemistry**

2- Program type: Single.

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

4- Department: Analytical Chemistry

5- Coordinator:

6- Date of program specification approval:

7- Teaching language: English

8-External Evaluator: Prof. Dr. Gamal Saleh (Analytical Chemistry department – Faculty of Pharmacy – Assuit University)

9- Internal Evaluator: Prof. Dr. Hisham Ezzat

10- Academic Reference Standards:

c. 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).

d. The program ILOs were compared to the MSc Analytical Chemistry provided by Birkbeck College, University of London, UK.

B- Professional Information

1- Program aims:

Analytical Chemistry Ph.D. is a program aimed for the enhancement of knowledge, skills and attitudes of chemists regarding analytical chemistry in different professional areas including research, drug analysis and also academic field.

The broad objectives of the Program are:

1. To acquire in-depth advanced theories underlying key areas of analytical science and their applications.
2. To develop practical skills for analyzing materials even in trace amounts and in complex matrices using modern analytical methods and instruments.
3. To provide master students with problem solving, research and data interpretation skills.
4. To investigate new approaches in drug analysis such as green analytical 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. **The Analytical Chemistry Ph.D. program** is useful for graduates who work in different fields such as Research & Development Laboratories, Educational and Research institutes, Analytical and Bio-analytical laboratories, Medical Centers, Hospitals, Universities, National Quality Control & assurance Centers, Pharmaceutical Industry and Ministry of Health. Graduate students have an excellent chance to catch advanced positions such as group leaders and managers in these places.

Graduate attributes:

Ph.D. graduates should acquire the required attributes & skills in various Pharmaceutical Analytical and bioanalytical Chemistry features including the following:

1. Have the required theoretical knowledge for analytical and bioanalytical techniques practice.
2. Demonstrate good application of analytical techniques with use of advanced analytical instrumentation.
3. Demonstrate problem solving, decision making, leadership, time management and communication skills.
4. Conduct research, starting from constructing experimental plans till writing and publishing scientific reports.
5. Demonstrate self learning abilities.
6. Work effectively either as a team leader or a member.

2-Intended Learning Outcomes (ILOs):

The Program provides excellent opportunities for students to demonstrate knowledge and understanding qualities and develop skills appropriate for **Analytical chemistry Ph.D.** of sciences degree.

2-1- Knowledge and Understanding:

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

A.1- Outline the theories and applications of advanced spectroscopy, electrochemistry and chromatography.

A.2- Illustrate the recent scientific techniques in the field of analytical chemistry.

A.3- Recall ethics, legal regulations and good laboratory practice principles in analytical research.

A.4- Recognize the concepts and basics of laboratory safety and waste disposal.

A.5- Identify the beneficial impact and applications of analytical chemistry towards a safe environment.

2-2 - Intellectual Skills:

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

B.1- Integrate knowledge to suggest the suitable analytical method for pharmaceutical, environmental and biological samples.

B.2- Analyze and interpret analytical data.

B.3 – Identify possible hazards and biohazards during conducting research and routine work and how to deal with them safely.

B.4 - Define the analytical problem, conduct a research plan and write scientific reports including conclusions with scientific evidences.

B.5 - Design the appropriate practical protocol for analysis.

B.6 – Solve different analytical problems encountered during the application of the designed protocol.

2-3 - Professional and Practical Skills:

It is intended that, on successful completion of the PhD degree Program, students will be able to:

C.1- Apply advanced analytical techniques with professional instrument operation.

C.2- Work safely and efficiently in a laboratory.

C.3- Develop and assess novel methods of analysis.

C.4 - Write reliable scientific reports and conclusions in pharmaceutical analysis.

2-4 - General and Transferable Skills:

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

D.1- Communicate effectively with others through written and oral manners.

D.2- Acquire advanced computer skills and train on new software used for instrumentation and data processing.

D.3- Retrieve information from various sources in the field of analytical chemistry.

D.4- Work effectively as a member of team.

D.5- Study independently and plan research studies.

D.6- Practice self assessment.

D7- Demonstrate team leadership in different fields of the profession with the ability of evaluation of others performance.

D8- Develop time management, problem solving and decision making skills.

.3- 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 ILOs were compared to the MSc Analytical Chemistry provided by Birkbeck College, University of London, UK.

Matrix1: Comparison of PhD. Pharm. Sci Degree in Analytical Chemistry program with the Academic Reference Standard {ARS, 2009} developed by NAQAAE

Attributes of the graduates (ARS, 2009)	Attributes of the graduates (PhD. Pharm. Sci Degree in Analytical Chemistry)

3. Apply the specialized knowledge he has acquired in his professional practice.	**1.** Have the required theoretical knowledge for analytical and bioanalytical techniques practice. **2.** Demonstrate good application of analytical techniques with use of advanced analytical instrumentation.
2. Identify and solve professional problems. 5. Take decisions using available information	3. Demonstrate problem solving, decision making, computer, time management and communication skills.
3. Show good communication and leadership skills	6. Work effectively either as a team leader or a member.
4. Use technology effectively in his professional practice 6. Use available resources efficiently 7. Aware of his role in community service and development 8. Reflect commitment to integrity, credibility and accountability	4. Conduct research, starting from constructing experimental plans till writing and publishing scientific reports.
9. Be a lifelong learner and able to develop himself	5. Demonstrate self learning abilities.

Matrix 2: Comparison of PhD. Pharm. Sci Degree in Analytical Chemistry program with the Academic Reference Standard {ARS, 2009} developed by NAQAAE

	(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	A1. Outline the theories and applications of advanced spectroscopy, electrochemistry and chromatography.
	2.1.2- Mutual influence between professional practice and its impact on the environment.	A.4- Recognize the concepts and basics of laboratory safety and waste disposal. A.5- Identify the beneficial impact and applications of analytical chemistry towards a safe environment.
	2.1.3- Scientific developments in the area of specialization.	A.2- Illustrate the recent scientific methodologies in the field of analytical chemistry.
	2.1.4- Moral and legal principles for professional practice in the area of specialization.	A.3- Recall ethics, legal regulations and good laboratory practice principles in analytical research.
	2.1.5- Principles and the basics of quality in professional practice in the area of specialization.	
	2.1.6- The fundamentals	

	and ethics of scientific research.	
Intellectual Skills	2.2.1- Analyze and evaluate information in the field of specialization and analogies to solve problems	B.2- Analyze and interpret analytical data.
	2.2.2- Solve specified problems in the lack or missing of some information.	B.6 – Solve different analytical problems encountered during the application of the designed protocol.
	2.2.3- Correlate and integrate different pharmaceutical knowledge to solve professional problems.	B.1- Integrate knowledge to suggest the suitable analytical method for pharmaceutical, environmental and biological samples.
	2.2.4- Conduct research and write scientific report on research specified topics.	B.4 - Define the analytical problem, conduct a research plan and write scientific reports including conclusions with scientific evidences.
	2.2.5- Evaluate and manage risks and potential hazards in professional practices in the area of specialization	B.3 - Recognize possible hazards and biohazards during conducting research and routine work and how to deal with them safely.

	2.2.6- Plan to improve performance in the field of specialization.	B.5 - Design the appropriate practical protocol for analysis.
	2.2.7- Professional decision-making in the contexts of diverse disciplines.	B.6 – Solve different analytical problems encountered during the application of the designed protocol.
Professional and Practical Skills	2.3.1- Master basic and modern professional skills in the area of specialization.	C.1- Apply advanced analytical techniques with professional instrument operation.
	2.3.2- Write and evaluate professional reports.	C.4 - Write reliable scientific reports and conclusions in pharmaceutical analysis.
	2.3.3- Assess methods and tools existing in the area of specialization.	C.2- Work safely and efficiently in a laboratory. C.3- Develop and assess novel methods of analysis.
General and Transferable Skills	2.4.1- Communicate effectively.	D.1- Communicate effectively with others through written and oral manners.
	2.4.2- Effectively use information technology in professional practices	D.2- Acquire advanced computer skills and train on new softwares used for instrumentation and data

		processing.
	2.4.3- Self-assessment and define his personal learning needs.	D.6- Practice self assessment.
	2.4.4- Use variable sources to get information and knowledge.	D.3- Retrieve information from various sources in the field of analytical chemistry.
	2.4.5- Set criteria and parameters to evaluate the performance of others	D.4- Work effectively as a member of team. D7- Demonstrate team leadership in different fields of the profession with the ability of evaluation of others performance.
	2.4.6- Work in a team and lead teams carrying out various professional tasks.	
	2.4.7- Manage time effectively.	D8- Develop time management, problem solving and decision making skills.
	2.4.8- Continuous and self learning.	D.5- Study independently and plan research studies.

Matrix 3: Comparison of PhD. Pharm. Sci. Degree in Analytical chemistry program ILOs and the MSc Analytical Chemistry provided by Birkbeck College, University of London, UK

	Birkbeck College, University of London,UK	Program ILOs
Knowledge and Understanding	1) Demonstrate a sound knowledge and understanding of the science underlying the key areas of analytical methodology and its practical applications.	A.1- Outline the theories and applications of advanced spectroscopy, electrochemistry and chromatography. A.5- Identify the beneficial impact and applications of analytical chemistry towards a safe environment.
	2) Show a critical understanding of recent advances in their field of study	A.2- Illustrate the recent scientific methodologies in the field of analytical chemistry.
	3) Critically assess current literature in the discipline	D.3- Retrieve information from various sources in the field of analytical chemistry.
	4) Formulate a research or method development plan and carry out the appropriate literature and data searches.	B.4 - Define the analytical problem, conduct a research plan and write scientific reports including conclusions with scientific evidences. B.5 - Design the appropriate practical protocol for analysis.

	5) Demonstrate a critical and professional approach to quality of analysis.	A.3- Recall ethics, legal regulations and good laboratory practice principles in analytical research. A.4- Recognize the concepts and basics of laboratory safety and waste disposal.
Intellectual Skills	6) Select the most appropriate analytical method.	B.1- Integrate knowledge to suggest the suitable analytical method for pharmaceutical, environmental and biological samples.
	7) Analyse a wide range of data types.	B.2- Analyze and interpret analytical data.
	8) Show critical reasoning. 11) Formulate and test basic hypotheses. 12) Show independent reasoning and defense of ideas	B.4 - Define the analytical problem, conduct a research plan and write scientific reports including conclusions with scientific evidences. B.5 - Design the appropriate practical protocol for analysis. C.4 - Write reliable scientific reports and conclusions in pharmaceutical analysis.
	9) Gather and evaluate information.	D.3- Retrieve information from various sources in the field of analytical chemistry.
	10) Solve problems.	B.3 – Identify possible hazards and biohazards during conducting research and routine work and how to deal with them safely

		B.6 – Solve different analytical problems encountered during the application of the designed protocol
Professional and Practical Skills	13) Carry out chemical manipulations and operate advanced analytical equipment.	C.1- Apply advanced analytical techniques with professional instrument operation.
	14) Work safely and efficiently in a laboratory carrying out risk assessments where appropriate.	C.2- Work safely and efficiently in a laboratory.
	15) Access a variety of subject-specific and more generic databases and information sources.	D.3- Retrieve information from various sources in the field of analytical chemistry.
	16) Use molecular visualisation tools.	**Not covered**
	17) Apply skills to practical problems and, where appropriate develop new skills.	C.3- Develop and assess novel methods of analysis.
	18) Use different forms of IT confidently	D.2- Acquire advanced computer skills and train on new software used for instrumentation and data processing.
Personal and social Skills	19) Work as part of a team both in person and via virtual interaction.	D.4- Work effectively as a member of team. D7- Demonstrate team leadership in

		different fields of the profession with the ability of evaluation of others performance
	20) Manage time efficiently to balance the face-to-face and distance learning aspects of the programme	D8- Develop time management, problem solving and decision making skills.
	21) Present and communicate material and ideas in both written (including electronic communication) and oral formats.	D.1- Communicate effectively with others through written and oral manners.
	22) Learn independently.	D.5- Study independently and plan research studies. D.6- Practice self assessment.
	23) Show a professionalism in analytical science	

4-Curriculum Structure and Contents:

a- Program duration: **3- 5** years

b- Program structure:

- The PhD program can be completed in 3-5 years.
- The Faculty of pharmacy implements the credit hour system.
- The program is structured as:

1- Courses:

No. of credit hours for program courses:

Special: (3x4) 12

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 orally) a research proposal and write a thesis.

3- General University Requirements: 10 credit hours including:

a- TOEFL (500 units)

b- Computer course

c- Program Curriculum:

Course Code	Course Title	Credit hours	Program ILOs Covered
	Special Courses:		
Asp4	Chemometric Analysis	4	A1, A2, B2, B3, B6, D2, D4, D5, D7, D8.
Asp5	Advanced spectroscopy of Analytical chemistry	4	A1, A2, B1, B6, D3, D4, D5, D7.
Asp6	Chromatographic Analysis of Pharmaceuticals	4	A1, A2, B1, B3, D3, D4, D5, D7.
	Thesis	30	A1, A2, A3, A4, A5, B1, B2, B3, B4, B5, B6, B7, C1, C2, C3, C4, D1, D2, D3, D4, D5, D6, D7 ,D8.

5-Program admission requirements:

Applicants are admitted to PhD degree any time throughout the academic year upon fulfillment of the following:

1. The applicants should be holders of Bachelor in Pharmaceutical Sciences from any Faculty of Pharmacy and also finish M.Sc. degree affiliated to the Egyptian Universities affiliated to the Egyptian Supreme Council of Universities (ESCU).
2. Students should fulfill all the admission requirements stated by the concerned Departmental Board.

Regulations to complete the program:

Conditions of granting the degree

The Faculty Council, in compliance with the concerned Departmental Board as well as Graduate Studies and Research Committee recommendation awards the PhD degree upon fulfillment of the following requirements:

1. Carrying out a deep research in the area of specialization for at least two calendar years from the time of registration.
2. The student has to succeed in all courses examinations.
3. Acceptance of the research thesis by the judges Committee according to statement 104 of universities regulating law.

Cancellation of Registration

The Faculty Board is allowed to cancel registration for PhD programs in the following circumstances:

1. Student's failure to pass the course examinations for two times.
2. Student's nonattendance or unsatisfactory progress in research work being reported by the advisors to the Departmental Board and forwarded to the Graduate Studies and Research Committee for approval of cancellation.

3. Dissertation refusal by the Jury Committee.
4. 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).

9-Methods of program evaluation

Evaluator	Method	Sample
Internal evaluator: Professor Dr. Hisham Ezzat	Program evaluation Courses evaluation	Program report Courses report
External evaluator: Professor Dr. Gamal Saleh	Program evaluation Courses evaluation	Program report Courses report
Others methods	Matrix with ARS Questionnaires	The Matrix Results of the questionnaires

Program coordinator **Head of Department**

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Matrix of PhD program of Analytical chemistry

Program Courses		Program intended learning outcomes																					
		Knowledge and understanding					Intellectual skills						Professional and practical skills				General and transferable skills						
		A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	D1	D2	D3	D4	D5	D6	D7	D8
Special courses	Chemometric analysis	x	x					x	x			x						x		x	x		x	x
	Advanced Spectroscopy of Analytical chemistry	x	x				x					x							x	x	x		x	
	Chromatographic analysis of pharmaceuticals	x	x				x		x										x	x	x		x	
Thesis		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Chemometric Analysis

Course specification of Chemometric Analysis

A- Course specifications:

- Program on which the course is given: Ph.D. of Pharmaceutical Sciences (Analytical chemistry)
- Major or Minor element of program: Major
- Department offering the program: Analytical Chemistry.
- Department offering the course: Analytical Chemistry.
- Date of specification approval: 2019

1- Basic information:

Title: **Chemometric Analysis** Code: Asp4

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 statistical and chemometrics methods used in analytical chemistry and apply chemometric analysis for different analytical problems.

3. Intended learning outcome s (ILOs) of Chemometric Analysis:

A- Knowledge and Understanding	
a1	Describe different types of multivariate chemometric UV spectrophotometric methods.
a2	outline different types of errors in quantitative analysis, statistical parameters of repeated measurements and significant tests.
B- Intellectual skills	
b_1	Apply the proper multivariate chemometric method for quantitative determination of analytes in combination or in complex matrix.
b2	Apply the proper statistical parameters for determination of combination of errors and repeated measurements.
b3	Analyze and interpret the data.
b4	Solve the problems encountered in the chemometric model application.
D- General and transferable Skills	
d1	Acquire computer-aided analytical skills such as chemometric software.
d2	Work effectively in a team.
d3	Study independently.
d4	Improve problem solving skills

4. Course Contents of Chemometric Analysis:

Week number	Contents
1	**Multivariate Analysis** Initial analysis Principal component analysis

2	**Multivariate Analysis** Cluster analysis Discriminate analysis
3	**Multivariate Analysis** K-nearest neighbor method Disjoint class modeling
4	**Multivariate Analysis** Multiple regression Principal component regression
5	**Multivariate Analysis** Multivariate regression Partial least squares regression
6	**Multivariate Analysis** Multivariate calibration Artificial neural networks
7	**Errors in quantitative analysis**
8	**Errors in quantitative analysis** **Activity**
9	**Statistics of Repeated Measurements** Mean and standard deviation The distribution of repeated measurements The sampling distribution of the mean

10	**Statistics of Repeated Measurements** Confidence limits of the mean for large samples Presentation of results.
11	**Statistics of Repeated Measurements** Confidence limits of the geometric mean for a log-normal distribution Propagation of errors
12	**Significance Tests** Comparison of an experimental mean with a known value Comparison of two experimental means Paired t-test
13	**Significance Tests** One-sided and two-sided tests F-test for the comparison of standard deviations Outliers Analysis of variance
14	**Significance Tests** Comparison of several means The arithmetic of ANOVA calculations The chi-squared test Testing for normality of distribution
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, b1, b2, b3, b4

Oral exam to assess: a1, a2, b1, b2, b3,b4

Activity to assess: d1, d2, d3 and d4

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: Books:

Chemometrics**,** Data Analysis for the Laboratory and Chemical Plant, Richard G.,(University of Bristol, UK , John Wiley & Sons, Ltd.2003).

Statistics for Environmental Science and Management, Manly, B. F. J., (Chapman & Hall, 2001).

C- Websites:

www.sciencedirect.com

www.Pubmed.com

www.rsc.org

Facilities required for teaching and learning:

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

- **Course Coordinators: Prof. Dr. Hanaa Salah**
  Prof. Dr. Hisham Ezzat
- **Head of Department: Prof. Dr.**
- **Date:**

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Matrix I of Chemometric Analysis

	Course Contents	ILOs									
		Knowledge and understanding		Intellectual skills				General and Transferable skills			
		a1	a2	b1	b2	b3	b4	d1	d2	d3	d4
1	Multivariate Analysis Initial analysis Principal component analysis	x		x		x	x	x			x
2	Multivariate Analysis Cluster analysis Discriminate analysis	x		x		x	x	x			x
3	Multivariate Analysis K-nearest neighbor method Disjoint class modeling	x		x		x	x	x			x
4	Multivariate Analysis Multiple regression Principal component regression	x		x		x	x	x			x
5	Multivariate Analysis Multivariate regression Partial least squares regression	x		x		x	x	x			x
6	Multivariate Analysis Multivariate calibration Artificial neural networks	x		x		x	x	x			x
7	Errors in quantitative analysis		x		x	x	x	x			x
8	Errors in quantitative analysis Activity		x		x	x	x	x	x	x	x
9	Statistics of Repeated Measurements Mean and standard deviation The distribution of repeated measurements The sampling distribution of the mean		x		x	x	x	x			x
10	Statistics of Repeated Measurements Confidence limits of the mean for large samples Presentation of results.		x		x	x	x	x			x

11	**Statistics of Repeated Measurements** Confidence limits of the geometric mean for a log-normal distribution Propagation of errors		**x**		**x**	**x**	**x**	**x**			**x**
12	**Significance Tests** Comparison of an experimental mean with a known value Comparison of two experimental means Paired t-test		**x**		**x**	**x**	**x**	**x**			**x**
13	**Significance Tests** One-sided and two-sided tests F-test for the comparison of standard deviations Outliers Analysis of variance		**x**		**x**	**x**	**x**	**x**			**x**
14	**Significance Tests** Comparison of several means The arithmetic of ANOVA calculations The chi-squared test Testing for normality of distribution		**x**		**x**	**x**	**x**	**x**			**x**

Matrix II of chemometric analysis

ARS		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 basics of analytical chemistry and related subjects with additional depth in advanced spectroscopy, electrochemistry and chromatography.	a1,a2	**Multivariate Analysis** Initial analysis,Principal component analysis,Cluster analysis,Discriminate analysi, K-nearest neighbor method, Disjoint class modeling**,** Multiple regression ,Principal component regression, Multivariate regression, Partial least squares, regression,Multivariate calibration, Artificial neural	Textbooks , Scientific papers and self learning	x	x	x	x	

				networks **Errors in quantitative analysis** **Statistics of Repeated Measurements** **Significance Tests** Comparison of an experimental mean with a known value, Comparison of two experimental means, Paired t-test, One-sided and two-sided tests, F-test for the comparison of standard deviations, Outliers, Analysis of variance**,** Comparison of several means**,** The arithmetic of ANOVA calculations, The chi-squared test, Testing for normality of distribution						
	2.1.3- Scientific developments in the area of specialization.	A.2- Illustrate the recent scientific methodologies in the field of analytical chemistry.	a1	**Multivariate Analysis** Initial analysis,Principal component analysis,Cluster analysis,Discriminate analysi, K-nearest neighbor method, Disjoint class modeling**,** Multiple regression ,Principal component regression,	Textbooks , Scientific papers and self learning	x	x	x	x	

				Multivariate regression, Partial least squares, regression,Multivariate calibration, Artificial neural networks						
2.2	2.2.1- Analyze and evaluate information in the field of specialization and analogies to solve problems	B.2- Analyze and interpret analytical data.	b3	All contents except Activity	Textbooks , Scientific papers and self learning	x	x	x	x	
	2.2.2- Solve specified problems in the lack or missing of some information.	B.3- Solve the problems which obstacle to research plan and research results.	b4	All contents except Activity	Textbooks , Scientific papers and self learning	x	x	x	x	

	2.2.6- Plan to improve performance in the field of specialization.	B.6- Design the appropriate practical protocol for analysis.	b1,b2	All contents except Activity	Textbooks , Scientific papers and self learning	x	x	x	x	
2.4	**2.4.2- Effectively use information technology in professional practices**	D.2- Acquire advanced computer skills and train on new softwares used for instrumentation and data processing.	d1	- All contents - Activity	Textbooks , Scientific papers and self learning	x	x	x	x	x
	2.4.6- Work in a team and lead teams carrying out various professional tasks.	D.4- Work effectively as a member of team. D7- Demonstrate team leadership in different fields of the profession.	d2	- Activity						x

	2.4.7- Manage time effectively.	D8- Develop time management, problem solving and decision making skills.	d4	- All contents - Activity	Textbooks, Scientific papers and self learning	x	x	x	x	x
	2.4.8- Continuous and self learning.	D.5- Study independently and plan research studies.	d3	- Activity						x

Advanced Spectroscopy of Analytical Chemistry

Course specification of Advanced Spectroscopy of Analytical Chemistry

A- Course specifications:

- Program on which the course is given: Ph.D. of Pharmaceutical Sciences (Analytical chemistry)
- Major or Minor element of program: Major
- Department offering the program: Analytical Chemistry.
- Department offering the course: Analytical Chemistry.
- Date of specification approval: 2019

1- Basic information:

Title: **Advanced Spectroscopy of Analytical Chemistry**

Code: Asp5

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 and procedures of different spectroscopic techniques such as NMR and Mass spectrometry, describe theories and apply studied spectroscopic techniques for the assay and detection of different analysis of pharmaceutical, biological or environmental origin, optimize and validate new methods to analyze professionally different sample components using the studied advanced techniques and Analyze active ingredients in different dosage forms, in biological fluids or of complex nature.

3. Intended learning outcomes (ILOs) of Advanced Spectroscopy of Analytical Chemistry:

A- Knowledge and Understanding	
a1	Outline the basis and theory and operation of NMR and Mass and tandem mass spectrometry.
a2	Apply studied spectroscopic techniques for the assay and detection of different analytes of pharmaceutical, biological or environmental origin.
a3	Describe an advanced technique for assaying analytes of complex nature based on previous published and gained information.
B- Intellectual skills	
b_1	Decide the use of the most appropriate instrumental technique in pharmaceutical, biological assay or environmental assay.
b_2	Integrate the acquired knowledge in compound detection and structure elucidation
D- General and Transferable Skills	
d1	Retrieve information from various sources in the field of analytical chemistry.
d2	Work effectively as a member of team, and improve leadership skills.
d3	Study independently.

4. Course Content of Advanced Spectroscopy of Analytical Chemistry:

Week number	Contents
1	**Spectroscopy** Introduction Theory
2	**Classification of spectroscopic techniques**
3	**Nuclear magnetic resonance spectroscopy (NMR)** Principals

	Vector Model
4	**Nuclear magnetic resonance spectroscopy (NMR)** Nuclear spin states Nuclear magnetic moments Absorption of Energy Resonance
5	**Nuclear magnetic resonance spectroscopy (NMR)** Chemical shift Local diamagnetic shielding Spin-spin splitting
6	**Nuclear magnetic resonance spectroscopy (NMR)** Typical ^{1}H NMR absorptions by type of compound
7	**Nuclear magnetic resonance spectroscopy (NMR)** Carbon – 13 spectra, including heteronuclear coupling with other nuclei.
8	**Mass Spectrometry** Principle Mass spectrometer Sample introduction **Activity**
9	**Mass Spectrometry** Ionization methods: Electron ionization EI Chemical ionization CI Desorption ionization techniques (SIMS, FAB and MALDI) Electrospray ionization ESI

10	**Mass Spectrometry** Mass analysis Detection and Quantification
11	**Tandem Mass Spectrometry (MS/MS)** Introduction Scan modes Reactions studied in MS/MS
12	**Tandem Mass Spectrometry (MS/MS)** Applications: Structure elucidation Selective detection Ion-molecule reaction
13	**Mass spectrometry/ Chromatography coupling** Coupling techniques: GC/MS, HPLC/MS, CE/MS Pharmaceutical, biological and environmental applications
14	**Revision**
15	**Written exam**

5- Teaching and Learning Methods:

- Lectures
- Self learning
- Open discussion
- Assignments
- Library visits

6- Student Assessment methods:

Written exams to assess: a1, a2, a3, b1, b2

Oral exam to assess: a1, a2, a3, b1, 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:

1-Introduction to spectroscopy, Donald L. Pavia, Gary M. Lampman, BROOKS/COOL, 2009.

2- Mass Spectrometry, Principles and Applications, Edmond de Hoffmann, Vincent Stroobant, Johns Wiley and Sons Ltd, 2002.

Websites/Journals:

Rapid Communications in Mass Spectrometry

Spectrochemica Acta

Pharmaceutical and Biomedical Analysis

www.tandfonline.com/toc/lanl20/current (Analytical Letters)

www.rsc.org

Facilities required for teaching and learning:

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

- **Course Coordinators: Prof. Dr. Mervat Hosny**
- **Head of Department:**
- **Date:**

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Matrix I of Advanced Spectroscopy of Analytical Chemistry

	Course Contents	ILOs							
		Knowledge and understanding			Intellectual skills		General and Transferable Skills		
		a1	a2	a3	b1	b2	d1	d2	d3
1	Spectroscopy *Introduction *Theory	x							
2	Classification of spectroscopic techniques	x							
3	NMR :*Principals *Vector Model	x							
4	NMR: *Nuclear spin states *Nuclear magnetic moments *Absorption of Energy *Resonance	x							
5	NMR: *Chemical shift *Local diamagnetic shielding *Spin-spin splitting	x							
6	Typical 1H NMR absorptions by type of compound	x							
7	Carbon – 13 spectra, including heteronuclear coupling with other nuclei	x							
8	Mass Spectrometry: *Principle *Mass spectrometer *Sample introduction Activity	x					x	x	x
9	Mass Spectrometry: *Ionization methods	x							
10	Mass Spectrometry: *Mass analysis *Detection and Quantification		x		x				
11	MS/MS: *Introduction *Scan modes *Reactions studied in MS/MS		x		x				
12	MS/MS: *Applications		x	x	x	x			
13	Mass spectrometry/ Chromatography coupling: Coupling techniques, Applications		x	x	x	x			
14	Revision	x	x	x	x	x			

Matrix II of Advanced Spectroscopy of Analytical Chemistry

ARS		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 basics of analytical chemistry and related subjects with additional depth in advanced spectroscopy, electrochemistry and chromatography.	a1,a2	Spectroscopy *Introduction *Theory Classification of spectroscopic techniques NMR :*Principals *Vector Model *Nuclear spin states *Nuclear magnetic moments *Absorption of Energy *Resonance *Chemical shift *Local diamagnetic shielding *Spin-spin splitting Typical 1H NMR absorptions by type of compound Carbon – 13 spectra, including heteronuclear coupling with other nuclei	Textbooks , Scientific papers and self learning	x	x	x	x	

				Mass Spectrometry: *Principle *Mass spectrometer *Sample introduction *Ionization methods *Mass analysis *Detection and Quantification MS/MS: *Introduction *Scan modes *Reactions studied in MS/MS *Applications Mass spectrometry/ Chromatography coupling: Coupling techniques, Applications Revision						
	2.1.3- Scientific developments in the area of specialization.	A.2- Illustrate the recent scientific methodologies in the field of analytical chemistry.	a3	*Applications Mass spectrometry/ Chromatography coupling: Coupling techniques, Applications Revision	Textbooks , Scientific papers and self learning	x	x	x	x	
2.2	2.2.3- Correlate and integrate different pharmaceutical knowledge to solve professional problems.	B.1- Integrate knowledge to suggest the suitable analytical method for pharmaceutical, environmental and biological samples.	b2	*Applications Mass spectrometry/ Chromatography coupling: Coupling techniques, Applications Revision	Textbooks , Scientific papers and self learning	x	x	x	x	

	2.2.6- Plan to improve performance in the field of specialization.	B.6- Design the appropriate practical protocol for analysis.	b1	Mass analysis *Detection and Quantification MS/MS: *Introduction *Scan modes *Reactions studied in MS/MS *Applications Mass spectrometry/ Chromatography coupling: Coupling techniques, Applications Revision	Textbooks, Scientific papers and self learning	x	x	x	x	
2.4	2.4.4- Use variable sources to get information and knowledge.	D.3- Retrieve information from various sources in the field of analytical chemistry.	d1	- Activity	Textbooks, Scientific papers and self learning					x
	2.4.6- Work in a team and lead teams carrying out various professional tasks.	D.4- Work effectively as a member of team. D7- Demonstrate team leadership in different fields of the profession.	d2	- Activity						x

	2.4.8- Continuous and self learning.	D.5- Study independently and plan research studies.	d3	- Activity						x

Chromatographic Analysis of Pharmaceuticals

Course specification of Chromatographic Analysis of Pharmaceuticals

A- Course specifications:

- Program on which the course is given: Ph.D. of Pharmaceutical Sciences (Analytical Chemistry)
- Major or Minor element of program: Major
- Department offering the program: Analytical Chemistry.
- Department offering the course: Analytical Chemistry.
- Date of specification approval: 2019

1- Basic information:

Title: **Chromatographic Analysis of Pharmaceuticals**

Code: Asp6

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 practical ways of using chromatographic techniques for solving chemical problems qualitatively and quantitively and describe theories and applications of different chromatographic techniques.

3. Intended learning outcomes (ILOs) of Chromatographic Analysis of Pharmaceuticals:

A- Knowledge and Understanding	
a1	Outline the basis, theory and operation of chromatographic analysis.
a2	Describe the pharmaceutical and biological applications of chromatographic techniques.
B- Intellectual skills	
b_1	Assess the problems encountered during analytical procedures.
b2	Integrate the information and knowledge gained from the course in developing new sensitive chromatographic methods using appropriate reagents for the determination of different compounds.
D- General and transferable Skills	
d1	Retrieve information from various sources in the field of analytical chemistry.
d2	Work effectively as a member of team, and improve leadership skills.
d3	Study independently.

4. Course Contents of Chromatographic Analysis of Pharmaceuticals:

Week number	Contents
1	**General aspects of chromatography** General concept of analytical chromatography The chromatogram Column efficiency Retention parameters
2	**General aspects of chromatography** Optimization of chromatographic analysis Classification of analytical techniques. Problems

3	**Gas Chromatography** Components of GC installation. Carrier gas and flow regulation. Sample introduction and the injection chamber Thermostatically controlled oven Columns Stationary Phases
4	**Gas Chromatography** Principal gas chromatographic detectors. Retention indexes and stationary phase constants problems and applications
5	**High performance liquid chromatography** The beginnings of HPLC. General concept of HPLC system. Pumps and gradient elution. Injectors. Columns.
6	**High performance liquid chromatography** Stationary phases. Mobile phases. Paired ion chromatography. Principal detectors. Applications and problems.
7	**Ion chromatography** Basics of ion chromatography Stationary phases Mobile phases. Conductivity detectors.

8	**Ion Chromatography** Areas of the peaks and data treatment. External standard method Internal standard method Problems and applications. **Activity**
9	**Thin layer chromatography** Principle of TLC. Characteristics of TLC. Stationary phases. Separation and retention parameters. Quantitative TLC. Problems.
10	**Supercritical fluid chromatography** Supercritical fluids. Instrumentation. SFC in chromatographic techniques.
11	**Size exclusion chromatography** Principle of SEC Stationary and mobile phases. Instrumentation and applications.
12	**Capillary electrophoresis and electrochromatography** Principal Instrumentation Capillary electrochomatography Problems and applications

13	**Planar chromatography** Introduction Materials and techniques Detection Method development*Applications
14	**Revision and open discussion**
15	**written exam**

5- Teaching and Learning Methods:

- Lectures
- Self learning
- Open discussion
- Practical problem solving
- Troubleshooting

6- Student Assessment methods:

Written exams to assess: a1, a2, b1, b2
Oral exam to assess: a1, a2, b1, 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:

1-Chemical Analysis, Modern Instrumentation Methods And Techniques, Francis Rouessac, and Annick Rouessac, John Wiley and Sons, Ltd, 2007.

2- Chromatographic analysis of pharmaceutics, John A. Adamovics, Marcel Dekker, 1997.

Websites/Journals:

www.sciencedirect.com

Journal of Chromatography A and B

Chromatographia

Journal of Liquid Chromatography

www.tandfonline.com/toc/lanl20/current (Analytical Letters)

www.rsc.org

Facilities required for teaching and learning:

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

- **Course Coordinators: Prof. Dr. Wafaa Hassan**
- **Head of Department:**

  Date:

  تم اعتماد توصيف المقرر في مجلس القسم بتاريخ

Matrix I of Chromatographic Analysis of Pharmaceuticals

	Course Contents	ILOs						
		Knowledge and understanding		Intellectual skills		General and transferable Skills		
		a1	a2	b1	b2	d1	d2	d3
1	General aspects of chromatography:*General concept of analytical chromatography *The chromatogram *Column efficiency *Retention parameters	x						
2	General aspects of chromatography: *Optimization of chromatographic analysis *Classification of analytical techniques. *Problems *Safety Measures all through the analytical process	x		x				
3	GC *Components of GC installation *Carrier gas and flow regulation. *Sample introduction and the injection chamber *Thermostatically controlled oven *Columns *Stationary Phases	x						
4	GC: *Principal gas chromatographic detectors. *Retention indexes and stationary phase constants *problems and applications	x	x	x	x			
5	HPLC: *The beginnings of HPLC *General concept of HPLC system *Pumps and gradient elution *Injectors *Columns	x						
6	HPLC: *Stationary phases *Mobile phases *Paired ion chromatography *Principal detectors *Applications and problems	x	x	x	x			
7	Ion chromatography *Basics of ion chromatography *Stationary phases *Mobile phases *Conductivity detectors	x						
8	Ion Chromatography: * Areas of the peaks and data treatment *External standard method *Internal standard method *Problems and applications **Activity**	x	x	x	x	x	x	x

9	TLC: * Principle *Characteristics of TLC *Stationary phases *Separation and retention parameters *Quantitative TLC *Problems	**x**	**x**	**x**				
10	SFC: * Supercritical fluids *Instrumentation *SFC in chromatographic techniques.	**x**						
11	SEC: *Principle of SEC *Stationary and mobile phases *Instrumentation and applications	**x**	**x**		**x**			
12	CE and electrochromatography * Principal *Instrumentation *Capillary electrochomatography *Problems and applications	**x**	**x**	**x**	**x**			
13	Planar chromatography: * Introduction*Materials and techniques *Detection *Method development *Applications	**x**	**x**		**x**			
14	Revision and open discussion	**x**	**x**	**x**	**x**			

Matrix II of Chromatographic Analysis of Pharmaceuticals

ARS		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 basics of analytical chemistry and related subjects with additional depth in advanced spectroscopy, electrochemistry and chromatography.	a1,a2	Spectroscopy *Introduction *Theory Classification of spectroscopic techniques NMR :*Principals *Vector Model *Nuclear spin states *Nuclear magnetic moments *Absorption of Energy *Resonance *Chemical shift *Local diamagnetic shielding *Spin-spin splitting Typical 1H NMR absorptions by type of compound Carbon – 13 spectra, including heteronuclear coupling with other nuclei	Textbooks, Scientific papers and self learning	x	x	x	x	

				Mass Spectrometry: *Principle *Mass spectrometer *Sample introduction *Ionization methods *Mass analysis *Detection and Quantification MS/MS: *Introduction *Scan modes *Reactions studied in MS/MS *Applications Mass spectrometry/ Chromatography coupling: Coupling techniques, Applications Revision						
	2.1.3- Scientific developments in the area of specialization.	A.2- Illustrate the recent scientific methodologies in the field of analytical chemistry.	a1	Spectroscopy *Introduction *Theory Classification of spectroscopic techniques NMR :*Principals *Vector Model *Nuclear spin states *Nuclear magnetic moments *Absorption of Energy *Resonance *Chemical shift *Local diamagnetic shielding *Spin-spin splitting Typical 1H NMR absorptions by type of compound Carbon – 13 spectra, including heteronuclear coupling with other nuclei Mass Spectrometry: *Principle *Mass spectrometer *Sample introduction *Ionization methods *Mass analysis *Detection and Quantification MS/MS: *Introduction *Scan modes *Reactions studied in MS/MS *Applications	Textbooks , Scientific papers and self learning	x	x	x	x	

				Mass spectrometry/ Chromatography coupling: Coupling techniques, Applications Revision						
2.2	2.2.3- Correlate and integrate different pharmaceutical knowledge to solve professional problems.	B.1- Integrate knowledge to suggest the suitable analytical method for pharmaceutical, environmental and biological samples.	b2	- Applications in lecture 4,6,8,11,12 and 13 - Revision	Textbooks, Scientific papers and self learning	x	x	x	x	
	2.2.2- Solve specified problems in the lack or missing of some information.	B.3- Solve the problems which obstacle to research plan and research results.	b1	Problems in lecture 2,4,6,8,9 and 12 - Revision	Textbooks, Scientific papers and self learning	x	x	x	x	
2.4	2.4.4- Use variable sources to get information and knowledge.	D.3- Retrieve information from various sources in the field of analytical chemistry.	d1	- Activity	Textbooks, Scientific papers and self learning					x

	2.4.6- Work in a team and lead teams carrying out various professional tasks.	D.4- Work effectively as a member of team. D7- Demonstrate team leadership in different fields of the profession.	d2	- Activity						x
	2.4.8- Continuous and self learning.	D.5- Study independently and plan research studies.	d3	- Activity						x

Thesis Specification

Thesis Specification of PhD Degree

A-Thesis specifications:

- **Program on which the course is given:** Ph.D of Pharmaceutical sciences (Analytical chemistry)
- **Major or Minor element of program:** Major
- **Department offering the program:** Analytical chemistry Dept.
- **Department offering the thesis:** Analytical chemistry Dept.
- **Date of specification approval:**

1- Basic information:

- Title: Ph.D Thesis in Analytical chemistry
- Credit hours: 30 hrs

2- Overall aim of the thesis:

On completion of the thesis, the students will be able to identify and perform advanced and accurate analytical techniques and methods used in the experimental work according to the designed protocol, critique own and other work, successfully write research articles for international publication, present his/her results in scientific meetings and conferences, derive and interpret the results of the study from the data collected, draw conclusions about the contribution to knowledge made by the study which may be concerned with the problem under investigation, the methods deployed or the student as a researcher.

3- Intended learning outcome's (ILOs):

Knowledge and Understanding	
a1	Outline theoretical and advanced bases of analytical chemistry related to main objectives of the thesis
a2	Determine the problem the thesis will handle in correlation with the community and surrounding environment
a3	Explain clearly the principles of different and advanced qualitative and quantitative analytical techniques
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	Solve problems related to practical work by obtained quantitative data from the practical work
b2	Discuss professional problems and suggest solutions rely on knowledge and recent information
b3	Plan a research in the research field
b4	Integrate scientific results and write report following conducting research
b5	Manage risks and hazards related to professional practical area
b6	Outline principles that should be followed in research to develop laboratory performance
b7	Decide what to do with full responsibility in scientific research
b8	Demonstrate creativity and innovation in modifying techniques and in utilization of various therapy.
Professional and practical skills	

c1	Apply different techniques related to practical thesis work.
c2	Use and evaluate practical data to write report
c3	Use IT skills in collecting information, presenting results and writing thesis
c4	Improve laboratory techniques.
General and Transferable skills	
d1	Communicate effectively with all people related to the work.
d2	Use information technology in review and thesis preparation.
d3	Use various sources to get information about the subject understudy.
d4	Study independently and evaluate learning needs in analytical chemistry.
d5	Use up-to-date information in analytical chemistry.
d6	Implement tasks as a member of a team.
d7	Utilize time effectively to achieve goals

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 biochemical and analytical

	techniques that will be used during practical work and determined by the protocol. Integrate different knowledge (analytical chemistry, pharmaceutical and organic chemistry knowledge, biostatistics, ……..) to solve suggested problem. Continuous evaluation to the thesis outcome according to the schedule.
2nd	Identify different practical techniques and methods to assess biochemical parameters related to the subject under study. Operate scientific instruments according to instructions. Evaluate and manage hazards (chemical) throughout the whole practical work. Organize the experimental work according to the designed protocol (either parallel or sequential experiments). Separation of samples for qualitative and quantitative determination and assay. Understand any legal aspects related to the thesis work.
3rd	Collect raw data for the tested biochemical parameters. Interpret raw data to get valuable information. Perform statistical analysis and biological correlation for the results. Present and describe the results graphically. Suggest solution to the problem understudy based on this presented data. Modify methods for analysis of samples
4th	- Communicate with supervisors to discuss results Work effectively as a member of a team (e.g. Supervisors, various professionals and Technicians). 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. 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….)
- Research group meetings
- Departmental seminars
- Instrumental troubleshooting
- Investigation and problem solving

6- References:

Websites: Pubmed, Sciencedirect, Weilyinterscience

International Journals such as: J. Chromatography B, Drug Testing and Analysis, Analytical Chemistry.

Books:

- How to Write A Thesis, By Murray, Rowena, McGraw-Hill International, 3rd edition 2011.
- Authoring a PhD: How to Plan, Draft, Write and Finish a Doctoral Thesis or dissertation , By Patrick Dunleavy, 2003.

Facilities required:

1. **For practical work:** U.V spectrophotometer, Sonicator, Colorimeter, Flouremeter, HPLC-UV, Atomic Absorption Spectrometer, GC-FID

Head of Department:

تم اعتماد توصيف المقرر في مجلس القسم بتاريخ