



**Zagazig University**  
**Faculty of Pharmacy**  
**Analytical Chemistry Department**

**Program and Course Specifications**  
**Master and Ph.D.**  
**Degrees**

**2012/2013**

# Master Degree

# Program Specification

## Program Specification

### A- Basic Information

- 1- **Program title:** M. Pharm. Sci Degree in **Analytical Chemistry**
- 2- **Program type:** Monodisciplinary.
- 3- **Faculty/ University:** Faculty of Pharmacy, Zagazig University
- 4- **Department:** Analytical Chemistry
- 5- **Coordinator:** Prof. Dr. Hesham Ezzat
- 6- **Date of program specification approval:** 2012

### B- Professional Information

#### 1- Program aims:

The Analytical chemistry Master program aims to provide the postgraduate master students with a solid advanced background in the chemistry field to prepare them towards further higher degrees, to advance the experience of students in the area of good chemical laboratory techniques that will lead to a profound contribution in the pharmaceutical analytical chemistry as well as pharmaceutical industry and to enable the students to conduct professionally and independently analysis of pharmaceutical compounds by different methods qualitative- quantitative analysis.

#### 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** 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 basis of analytical chemistry and related subjects including: instrumental analysis, chemometry, physical chemistry, and chemical kinetics

A.2- Identify the major impact and applications of analytical chemistry on science, industries and on the environment.

A.3- Describe the most advanced techniques in analytical chemistry and their applications.

A.4- Comprehend the moral aspects required by professionals.

A.5- Demonstrate full commitment to good laboratory practice and quality assurance.

A.6- Demonstrate full awareness of ethics in all aspects of scientific research.

## **2-2 - Intellectual Skills:**

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

B.1- 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 assaying the pharmaceutical or biological samples.

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

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

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

B.6- Design a laboratory protocol for a requested analytical issue.

B.7-Assess problems encountered during analytical assay and take professional decisions in the area of specialization.

### **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- Recognize with personal command the recent laboratory techniques in the field of analytical chemistry.

C.2- Write with confidence reliable scientific reports.

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

### **2-4 - General and Transferable Skills:**

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

D.1- Interact effectively with patient and professionals.

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

D.3- Practice self assessment and continues working in the field analytical chemistry.

D.4- Retrieve information from various sources in the field of analytical chemistry.

D.5- Set rules for judging others performance in the field of analytical chemistry.

D.6- Work effectively as a member of team.

D.7- Optimize work hours

D.8- Study independently and plan research studies.

### **3- Academic Standards:**

- NARS (National Academic Reference Standards)

**Matrix:** Comparison between Master degree program ILOs and the National Academic Reference Standards

	NARS	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 basis of analytical chemistry and related subjects including: instrumental analysis, chemometry, physical chemistry, and chemical kinetics
	2.1.2- Mutual influence between professional practice and its impact on the environment.	A.2- Identify the major impact and applications of analytical chemistry on science, industries and on the environment.
	2.1.3- Scientific developments in the area of specialization.	A.3- Describe the most advanced techniques in analytical chemistry and their applications.
	2.1.4- Moral and legal principles for professional practice in the area of specialization.	A.4- Comprehend the moral aspects required by professionals.
	2.1.5- Principles and the basics of quality in professional practice in the area of specialization.	A.5- Demonstrate full commitment to good laboratory practice and quality assurance.
	2.1.6- The fundamentals and ethics of scientific research.	A.6- Demonstrate full awareness of ethics in all aspects of scientific research.
Intellectual Skills	2.2.1- Analyze and evaluate information in the field of specialization and analogies to solve problems	B.1- 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 assaying 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 assaying 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- Recognize possible hazards during work and how to deal with.
	2.2.6- Plan to improve performance in the field of specialization.	B.6- Design a laboratory protocol for a requested analytical issue.
	2.2.7- Professional decision-making in the contexts of diverse disciplines.	B.7- Assess problems encountered during analytical assay and take professional decisions in the area of specialization.
	Professional and Practical Skills	2.3.1- Master basic and modern professional skills in the area of specialization.
2.3.2- Write and evaluate professional reports.		C.2- Write with confidence reliable scientific reports.
2.3.3- Assess methods and tools existing in the area of specialization.		C.3- Develop and assess novel methods of analysis



General and Transferable Skills	2.4.1- Communicate effectively.	D.1- Interact effectively with patient and professionals.
	2.4.2- Effectively use information technology in professional practices	D.2- Acquire computer skills such as internet, word processing, chemometric and kinetic softwares.
	2.4.3- Self-assessment and define his personal learning needs.	D.3- Practice self assessment and continues working in the field analytical chemistry.
	2.4.4- Use variable sources to get information and knowledge.	D.4- 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.5- Set rules for judging others performance in the field of analytical chemistry.
	2.4.6- Work in a team and lead teams carrying out various professional tasks.	D.6- Work effectively as a member of team.
	2.4.7- Manage time effectively.	D.7- Optimize work hours
	2.4.8- Continuous and self learning.	D.8- Study independently and plan research studies.

#### 4-Curriculum Structure and Contents:

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

**b- 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 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 (400 units)

b- Computer course

**c-Program Curriculum:**

Course Code	Course Title	Credit hours	Program ILOs Covered
	General Courses:		
M109	Drug design	4	A1, A2, A3, B3,D4
M101	Advanced Instrumental Analysis & chromatography I	4	A1, A2, B1,D4
M106	Physical chemistry	4	A1, B1, B2, D2, D5, D6
ME3	Elective A Good practice for analysis of drugs and quality control	4	A1, A3, A5, B1,B5,D2,D4
	Elective B	4	A1, A2, A5, B1,

ME2	Drug Stability		B2
	Special Courses:		
Asp1	Potentiometry, voltammetry and electrochemical sensors	4	A1, A2, B6, B7, D2, D5, D6
Asp2	Kinetic methods of analysis	4	A1, A2, A4, A6, B1, B2, D4, D7, D8
Asp3	Spectrophotometry	4	A1, A2, B6, D4
	Thesis	30	A1, A2, A3, A4, A5, A6, B1, B2, B3, B4, B5, B6, B7, C1, C2, C3, D1, D2, D3, D4, D5, D6, D7 and D8

### 5-Program admission requirements:

- Candidate should have obtained the certificate of Bachelor degree in pharmaceutical sciences with general grade good and grade good in the specialty from one of the Egyptian universities or an equivalent certificate from a foreign institute recognized by the university.
- Admission is in October each year.

## 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%

### 8-Failure in Courses:

Students who fail to get 60% ( 1 point)

### 9-Methods of program evaluation

Evaluator	Method	Sample
<b>Internal evaluator:</b> Professor Dr. Hesham Ezzat	Program evaluation Courses evaluation	Program report Courses report
<b>External evaluator:</b> Professor Dr.	Program evaluation Courses evaluation	Program report Courses report
<b>Others methods</b>	Matrix with NARS Questionnaires	The Matrix Results of the questionnaires

**Program coordinator**  
Prof. Dr. Hesham Ezzat  
Balkeny

**Head of Department**  
Prof. Dr. Mohamed Naguib El-

# Physical Chemistry

## Course specification of Physical Chemistry

### **A- Course specifications:**

- Program on which the course is given: Master's of Pharmaceutical Sciences
- Major or Minor element of program: Major
- Department offering the program: Analytical Chemistry.
- Department offering the course: Analytical Chemistry.
- Date of specification approval: 2012/2013

### **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 will be able to outline the principles of physical, general chemistry, thermochemistry and thermodynamics and describe states of matter, units of measurements and calculations with chemical formulas and equations.

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

<b>A- Knowledge and Understanding</b>	
<b>a1</b>	Outline the principles of physical, general chemistry, thermochemistry and thermodynamics.
<b>a2</b>	Demonstrate the behavior and laws governing gas, solutions and colloids.
<b>B- Intellectual skills</b>	
<b>b<sub>1</sub></b>	Describe units of measurements and calculations with chemical formulas and equations.
<b>b<sub>2</sub></b>	Integrate the knowledge and information obtained from physical and general chemistry principles in determining molecular formulas and stoichiometry of the reaction.
<b>D- General and Transferable skills</b>	
<b>d<sub>1</sub></b>	Acquire Computer skills like preparing presentations and collecting information through different data-bases.
<b>d<sub>2</sub></b>	Work effectively as a member of team
<b>d<sub>3</sub></b>	Improve scientific brain storming capabilities of team members

### 4. Course Contents of Physical Chemistry:

<b>Week number</b>	<b>Contents</b>
1	<ul style="list-style-type: none"><li>• Introduction, classification, state and properties of matter</li></ul>
2	<ul style="list-style-type: none"><li>• Units of measurements and dimensional analysis.</li></ul>
3	<ul style="list-style-type: none"><li>• Calculations with chemical formulas and equations.</li></ul>



4	<ul style="list-style-type: none"><li>• Gases</li><li>• Physical behavior of gases.</li><li>• Measurement of gas pressure</li></ul>
5	<ul style="list-style-type: none"><li>• The gas laws:</li><li>• Boyles law.</li><li>• Charles law.</li><li>• Gay-lussac's law.</li><li>• Combined gas law.</li></ul>
6	<ul style="list-style-type: none"><li>• The ideal gas equation.</li><li>• Dalton Law.</li><li>• Graham's law.</li><li>• Deviation from ideal behavior.</li></ul>
7	<ul style="list-style-type: none"><li>• Thermochemistry:</li><li>• Introduction.</li><li>• Internal energy E.</li><li>• Heat content.</li><li>• Thermochemical equations.</li></ul>
8	<ul style="list-style-type: none"><li>• Heat of Combustion</li><li>• Heat of formation</li><li>• Variation of heat of reaction with temperature.</li><li>• Activity</li></ul>
9	<ul style="list-style-type: none"><li>• Thermodynamics:</li><li>• The second law of thermodynamics</li><li>• Measurement of the heat of the reaction</li></ul>
10	<ul style="list-style-type: none"><li>• Solutions:</li><li>• Principles and concentration and solubility.</li></ul>

11	<ul style="list-style-type: none"><li>• Factors affecting solubility</li><li>• Solute-solvent interaction.</li><li>• Solubility and temperature.</li><li>• Effect of pressure on solubility.</li></ul>
12	<ul style="list-style-type: none"><li>• Solutions of liquids in liquids</li><li>• Solutions of solid in liquids (Colligative properties of solutions.)</li></ul>
13	<ul style="list-style-type: none"><li>• Colloids</li><li>• Types of colloids</li><li>• Preparation of sols.</li></ul>
14	<ul style="list-style-type: none"><li>• Purification of sols.</li><li>• Electrical properties of sols.</li></ul>
15	<ul style="list-style-type: none"><li>• Open discussion and revision</li></ul>

### **5- Teaching and Learning Methods:**

- Lectures
- Self learning
- Open discussion

### **6- Student Assessment methods :**

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

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

Activity to assess: d1, d2 and d3

### **Assessment schedule:**

<b>Assessment (1):</b> Activity	Week 8
<b>Assessment (2):</b> Written exam	Week 16
<b>Assessment (3):</b> oral exam	Week 16

### **Weighting of Assessment:**

<b>Assessment method</b>	<b>Marks</b>	<b>Percentage</b>
• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
<b>TOTAL</b>	<b>100</b>	<b>100%</b>

### **7- References and books:**

#### **A-Scientific papers**

#### **B- Essential books:**

Physical Chemistry , Developing A Dynamic Curriculum , Richard N. Schwenz & Robert G. Moore , American Chemical Society (1993)

#### **C- Suggested 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:**

[www.sciencedirect.com](http://www.sciencedirect.com)

[www.rsc.org](http://www.rsc.org)

#### **Facilities required for teaching and learning:**

- 1. For lectures:** Black (white) boards, computer, data show.
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- **Course Coordinator: Ass. Prof Dr/ Wafaa Hassan**
- **Head of Department: Prof. Dr. Mohamed Naguib El-Balkeny**
- **Date: 201-8-28 تم اعتماده فى مجلس القسم بتاريخ**

<b>Matrix I of Physical Chemistry</b>								
<b>Course Contents</b>		<b>ILOs</b>						
		Knowledge and understanding		Intellectual skills		General and Transferable skills		
		a1	a2	b1	b2	d <sub>1</sub>	d <sub>2</sub>	d <sub>3</sub>
<b>1</b>	Introduction, classification, state and properties of matter	<b>X</b>						
<b>2</b>	Units of measurements and dimensional analysis.			<b>x</b>				
<b>3</b>	Calculations with chemical formulas and equations.			<b>x</b>	<b>x</b>			
<b>4</b>	Gases Physical behavior of gases. Measurement of gas pressure	<b>X</b>						
<b>5</b>	The gas laws: Boyles law. Charles law. Gay-lussac's law. Combined gas law.		<b>x</b>					
<b>6</b>	The ideal gas equation. Dalton Law. Graham's law. Deviation from ideal behavior.		<b>x</b>					
<b>7</b>	Thermochemistry: Introduction. Internal energy E. Heat content. Thermochemical equations	<b>X</b>						
<b>8</b>	Heat of Combustion Heat of formation Variation of heat of reaction with temperature.	<b>X</b>				<b>X</b>	<b>X</b>	<b>X</b>

	Activity							
9	Thermodynamics: The second law of thermodynamics Measurement of the heat of the reaction	X						
10	Solutions: Principles and concentration and solubility.		x					
11	Factors affecting solubility Solute-solvent interaction. Solubility and temperature. Effect of pressure on solubility		x					
12	Solutions of liquids in liquids Solutions of solid in liquids (Colligative properties of solutions.)		x					
13	Colloids Types of colloids Preparation of sols		x					
14	Purification of sols. Electrical properties of sols.		x					
15	Open discussion and revision	X	x	x	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 basis of analytical chemistry and related subjects including: instrumental analysis, chemometry, physical chemistry, and chemical kinetics	a1	Introduction, classification, state and properties of matter--Physical behavior of gases. Measurement of gas pressure--Thermochemistry---Heat of combustion --- Thermodynamics	Textbooks, Scientific papers and self learning	x	x	x	x	
			a2	The Gas laws--- The ideal gas equation---Solutions --- Colloids---Purification of sols.						

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	
	2.2.2- 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	Calculations with chemical formulas and equations.	Textbooks, Scientific papers and self learning	x	x	x	x	
2.4	<b>2.4.2- Effectively use information technology in professional practices</b>	D.2- Acquire computer skills such as internet, word processing, chemometric and kinetic softwares.	d1	Activity						x

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	<b>2.4.6- Work in a team and lead teams carrying out various professional tasks.</b>	D.6- Work effectively as a member of team.	d2	Activity						X
	<b>2.4.5- Set criteria and parameters to evaluate the performance of others</b>	D.5- Set rules for judging others performance in the field of analytical chemistry.	d3	Activity						X



# **Courses offered by other departments**

## Course specification of Drug Design

### A- Course specifications:

- Program on which the course is given: Master of Pharmaceutical Sciences
- Major or Minor element of program: Major
- Department offering the program: Analytical chemistry Dept.
- Department offering the course: Medicinal chemistry Dept.
- Date of specification approval: 2012/2013

### 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 define the drug design, diagnose possible techniques for drug design and discuss different methods of drug development.

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

<b>Knowledge and Understanding</b>	
<b>a1</b>	Outline basic information related to drug design
<b>a2</b>	Identify applications of drug design and drug development
<b>a3</b>	Illustrate clearly the up-to date information & methods in drug design
<b>Intellectual skills</b>	
<b>b1</b>	Solve or propose solutions to specified problems in drug design
<b>General and Transferable skills</b>	
<b>d1</b>	Write reports and present it.

### 4. Course Content of Drug Design

<b>Week number</b>	<b>Lecture contents (4hrs/week)</b>
1	<ul style="list-style-type: none"><li>• Definition of drug design.</li></ul>
2	<ul style="list-style-type: none"><li>• Drug design applications.</li></ul>
3	<ul style="list-style-type: none"><li>• Docking.</li></ul>
4	<ul style="list-style-type: none"><li>• Docking.</li></ul>
5	<ul style="list-style-type: none"><li>• Combinatorial chemistry</li></ul>
6	<ul style="list-style-type: none"><li>• Combinatorial chemistry</li></ul>
7	<ul style="list-style-type: none"><li>• Drug development.</li><li>• <b>Activity(Reports)</b></li></ul>
8	<ul style="list-style-type: none"><li>• SAR &amp; QSAR in drug design</li></ul>
9	<ul style="list-style-type: none"><li>• Drug latentiantion.</li></ul>
10	<ul style="list-style-type: none"><li>• Drug latentiantion</li></ul>

11	<ul style="list-style-type: none"><li>Principles in drug Modeling</li></ul>
12	<ul style="list-style-type: none"><li>Computer-aided drug design</li><li>Activity( Reports)</li></ul>
13	<ul style="list-style-type: none"><li>Drug metabolism (Phase I)</li></ul>
14	<ul style="list-style-type: none"><li>Drug metabolism (Phase II)</li></ul>
15	<ul style="list-style-type: none"><li>Revision &amp; Open Discussion</li></ul>

### **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:**

<b>Assessment (1):</b> Activity	Week 7-12
<b>Assessment (2):</b> Written exam	Week 16
<b>Assessment (3):</b> oral exam	Week 16

### **Weighting of Assessment:**

Assessment method	Marks	Percentage
<ul style="list-style-type: none"><li>Activity</li></ul>	10	10 %
<ul style="list-style-type: none"><li>Written exam</li></ul>	75	75 %
<ul style="list-style-type: none"><li>Oral exam</li></ul>	15	15 %

<b>TOTAL</b>	<b>100</b>	<b>100%</b>
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## **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](http://www.Pubmed.Com)

[www.sciencedirect.com](http://www.sciencedirect.com)

### **Facilities required for teaching and learning:**

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

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- **Course Coordinators: Prof.Dr/Mohammed Al-hussany**
- **Head of Department: Prof.Dr/ Mansour Abukull**
- تم اعتماده فى مجلس القسم بتاريخ 3- 9- 2012

## Course specification of Advanced Instrumental Analysis & chromatography I

### A- Course specifications:

- Program on which the course is given: Master of Pharmaceutical Sciences
- Major or Minor element of program: Major
- Department offering the program: Analytical chemistry Dept.
- Department offering the course: Medicinal chemistry Dept.
- Date of specification approval: 2012/2013

### 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, state the concepts of diagnosing cardiac diseases, G.I.T diseases and infections through IR, HNMR and UV spectrophotometry and state the basic principles 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

<b>A-Knowledge and Understanding</b>	
<b>a1</b>	Illustrate properly theories of different instruments used in analysis
<b>a2</b>	State medicinal and pharmaceutical applications of spectroscopy , HPLC and GC
<b>B-Intellectual skills</b>	
<b>b1</b>	Analyze & interpret qualitative & quantitative data obtained from instrumental analysis
<b>D-General and Transferable skills</b>	
<b>d1</b>	Write reports and present it.

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

<b>Week number</b>	<b>Lecture contents (4hrs/week)</b>
1	Ultra-violet spectroscopy
2	Vibrational spectroscopy (IR spectroscopy )
3	Nuclear magnetic resonance (NMR)
4	Mass spectrometry(MS)
5	Medicinal application of spectroscopy in diagnosis of diseases
6	Surface analysis
7	Liquid chromatography <b>Activity (Reports)</b>
8	HPLC & its theory



9	HPLC & its medicinal and pharmaceutical application
10	Gas chromatography its theory
11	GC & its medicinal and pharmaceutical application
12	Supercritical fluid chromatography (SFC)
13	Capillary electrophoresis(CE)
14	Analytical application of polymers <b>Activity (Reports)</b>
15	Revision & open discussion

### **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:**

<b>Assessment (1):</b> Activity	Week 7-14
<b>Assessment (2):</b> Written exam	Week 16
<b>Assessment (3):</b> oral exam	Week 16

### **Weighting of Assessment:**

Assessment method	Marks	Percentage
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• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
<b>TOTAL</b>	<b>100</b>	<b>100%</b>

## **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](http://www.Pubmed.Com)

[www.sciencedirect.com](http://www.sciencedirect.com)

### **Facilities required for teaching and learning:**

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

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• **Course Coordinators: Prof. Dr. Al Sayed Lashen**

• **Head of Department Prof.Dr/ Mansour Abukull**

• **Date: 2012-9-3 تم اعتماده في مجلس القسم بتاريخ**

# Good practice for analysis of drugs and quality control

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

### **A- Course specifications:**

- Program on which the course is given: Master of Pharmaceutical Sciences
- Major or Minor element of program: Major
- Department offering the program: Analytical chemistry Dept.
- Department offering the course: Medicinal chemistry Dept.
- Date of specification approval: 2012/2013

### **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, analyze 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

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

### **4. Course Content of Quality in Instrumental Analysis and Quality Control**

<b>Week number</b>	<b>Lecture contents (4hrs/week)</b>
1	<ul style="list-style-type: none"><li>• Good Manufacture Practice (GMP)</li></ul>
2	<ul style="list-style-type: none"><li>• Application of quantitative analysis</li></ul>
3	<ul style="list-style-type: none"><li>• Quality control</li></ul>
4	<ul style="list-style-type: none"><li>• Quality assurance</li></ul>
5	<ul style="list-style-type: none"><li>• Applications of Spectrophotometric analysis for dosage forms</li><li>• <b>Activity</b></li></ul>
6	<ul style="list-style-type: none"><li>• H1,C13,N15,F19 NMR</li></ul>
7	<ul style="list-style-type: none"><li>• Advanced techniques in mass spectroscopy</li></ul>

8	<ul style="list-style-type: none"><li>• Atomic absorption</li></ul>
9	<ul style="list-style-type: none"><li>• Fluorimetric analysis</li></ul>
10	<ul style="list-style-type: none"><li>• Radioimmune Assay</li></ul>
11	<ul style="list-style-type: none"><li>• Electrophoresis</li></ul>
12	<ul style="list-style-type: none"><li>• GC-MS chemistry</li><li>• <b>Activity</b></li></ul>
13	<ul style="list-style-type: none"><li>• Spectrodenistometric (TLC scanner)</li></ul>
14	<ul style="list-style-type: none"><li>• Forensic chemistry</li></ul>
15	<ul style="list-style-type: none"><li>• Revision &amp; Open Discussion</li></ul>

### **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:**

<b>Assessment (1):</b> Activity	Week 5,12
<b>Assessment (2):</b> Written exam	Week 16
<b>Assessment (3):</b> oral exam	Week 16

#### **Weighting of Assessment:**

<b>Assessment method</b>	<b>Marks</b>	<b>Percentage</b>
<ul style="list-style-type: none"><li>• Activity</li></ul>	10	10 %

• Written exam	75	75 %
• Oral exam	15	15 %
<b>TOTAL</b>	<b>100</b>	<b>100%</b>

## **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](http://www.Pubmed.Com)

[www.sciencedirect.com](http://www.sciencedirect.com)

### **Facilities required for teaching and learning:**

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

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- **Course Coordinators: Prof.Dr/ Sobhy ElAdl**

**Prof.Dr/ Mohammed Baraka**

- **Head of Department: Prof.Dr/ Mansour Abukull**

- **Date: 2012-9-3 تم اعتماده فى مجلس القسم بتاريخ**

# Drug stability



## Course specification of Drug stability

### A- Course specifications:

- **Program on which the course is given:** Master of Pharmaceutical Sciences
- **Major or Minor element of program:** Major
- **Department offering the program:** Analytical chemistry
- **Department offering the course:** Pharmaceutics Dept.
- **Date of specification approval:** 2012/2013

### 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 gain the ability to predict the degradation pathways of a drug design a stabilization protocol and predict a product shelf-life.

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

<b>Knowledge and Understanding</b>	
<b>a1</b>	Illustrate the principles of order of reactions and methods of determination order of reactions
<b>a2</b>	Describe the principles of physical and chemical degradation of drugs in different dosage forms
<b>a3</b>	Mention stability testing of different dosage forms
<b>Intellectual skills</b>	
<b>b1</b>	Suggest suitable stabilization methods for drugs in the various dosage forms.
<b>b2</b>	Design in a self-directed and original research investigations on drug stability in dosage forms from degradation pathways
<b>General and Transferable skills</b>	
<b>d1</b>	Demonstrate critical thinking and decision making during pharmaceutical preparations

### 4. Course Content of Drug stability:

<b>Week number</b>	<b>Lecture content (4 hr/w)</b>
1	<ul style="list-style-type: none"><li>• Rate of chemical reactions</li></ul>
2	<ul style="list-style-type: none"><li>• Orders of reactions</li><li>• Zero order</li></ul>
3	<ul style="list-style-type: none"><li>• First order</li></ul>
4	<ul style="list-style-type: none"><li>• Second order</li></ul>
5	<ul style="list-style-type: none"><li>• Apparent zero order reaction</li></ul>

	<ul style="list-style-type: none"><li>• Pseudo first order reaction</li></ul>
6	<ul style="list-style-type: none"><li>• Determination of order of reaction</li><li>• -Substitution method</li></ul>
7	<ul style="list-style-type: none"><li>• Graphical method <b>(Presentation)</b></li></ul>
8	<ul style="list-style-type: none"><li>• Half-life method</li></ul>
9	<ul style="list-style-type: none"><li>• Routes of degradation</li><li>• -Hydrolysis</li><li>• -Oxidation</li></ul>
10	<ul style="list-style-type: none"><li>• -Photochemical degradation</li><li>• -Incompatibility</li></ul>
11	<ul style="list-style-type: none"><li>• Physical degradation routes</li><li>• -Vaporization</li><li>• -Aging</li><li>• - adsorption</li></ul>
12	<ul style="list-style-type: none"><li>• Complex reactions</li></ul>
13	<ul style="list-style-type: none"><li>• Stability testing</li></ul>
14	<ul style="list-style-type: none"><li>• Revision</li></ul>
15	<ul style="list-style-type: none"><li>• Open discussion <b>(Final Presentation)</b></li></ul>

**5- Teaching and Learning Methods:**

- Lectures
- Self learning
- Open discussion

**6- Student Assessment methods:**

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

Oral exam to assess: a1, a2, a3, b1, b2, d1

Activities to assess: b1, b2, d1

**Assessment schedule:**

<b>Assessment (1):</b> Activity	Week 7,15
<b>Assessment (2):</b> Written exam	Week 16
<b>Assessment (3):</b> oral exam	Week 16

**Weighting of Assessment:**

Assessment method	Marks	Percentage
• Activity	10	10 %
• Written exam	75	75 %
• oral exam	15	15 %
<b>TOTAL</b>	<b>100</b>	<b>100%</b>

**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:** Handbook of Stability Testing in Pharmaceutical Development: Regulations, Methodologies, and Best Practices, Kim Huynh-Ba, 389 (2008).

**C- Websites:** Pubmed, Sciencedirect, Wileyinterscience

**Facilities required for teaching and learning:**

1. **For lectures:** Black (white) boards, data show.
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- **Course Coordinators: Dr/ Hanaa Abd El-Fattah El-Ghamry**
- **Head of Department: Prof Dr/ Mahmoud Abdul-Ghany Mahdy**
- **Date: 2012-9-3 تم اعتماده فى مجلس القسم بتاريخ**

# 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
- Major or Minor element of program: Major
- Department offering the program: Analytical Chemistry.
- Department offering the course: Analytical Chemistry.
- Date of specification approval: 2012/2013

### 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 will be able to outline principles and procedures of different potentiometric, ion selective and voltammetric methods of analysis and describe different types of electrochemical sensors.



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

<b>A- Knowledge and Understanding</b>	
<b>a1</b>	Outline the basis and principles of potentiometric, voltammetric and ion selective electrode.
<b>a2</b>	Describe different types of ion-selective electrodes and electrochemical sensors.
<b>a3</b>	Demonstrate different applications of potentiometry, voltammetry and ion selective electrode.
<b>B- Intellectual skills</b>	
<b>b<sub>1</sub></b>	Design appropriate experiments in the laboratory for assay of substances.
<b>b<sub>2</sub></b>	Assess the problems encountered during analytical procedures.
<b>D- General and Transferable skills</b>	
<b>d<sub>1</sub></b>	Acquire Computer skills like preparing presentations and collecting information through different data-bases.
<b>d<sub>2</sub></b>	Work effectively as a member of team
<b>d<sub>3</sub></b>	Improve scientific brain storming capabilities of team members

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

<b>Week number</b>	<b>Content</b>
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	Open discussion and Revision

### **5- Teaching and Learning Methods:**

- Lectures
- Self learning

- Open discussion

### **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:**

<b>Assessment (1):</b> Activity	Week 8
<b>Assessment (2):</b> Written exam	Week 16
<b>Assessment (3):</b> oral exam	Week 16

### **Weighting of Assessment:**

<b>Assessment method</b>	<b>Marks</b>	<b>Percentage</b>
• Activity	10	10 %
• Written exam	75	75 %
• oral exam	15	15 %
<b>TOTAL</b>	<b>100</b>	<b>100%</b>

### **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:**

[www.tandfonline.com/toc/lanl20/current](http://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.

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- **Course Coordinators:** Ass. Prof. Dr/ Gamal Ragab
- **Head of Department:** Prof. Dr. Mohamed Naguib El-Balkeny
- **Date:** 2012-8-28 تم اعتماده في مجلس القسم بتاريخ

<b>Matrix I of Potentiometry, Voltammetry and Electrochemical sensors</b>								
<b>Course Contents</b>		<b>ILOs</b>						
		Knowledge and understanding			Intellectual skills		General and Transferable skills	
		<b>a1</b>	<b>a2</b>	<b>a3</b>	<b>b1</b>	<b>b2</b>	<b>d<sub>1</sub></b>	<b>d<sub>2</sub></b>
<b>1</b>	Introduction to electrochemistry	x						
<b>2</b>	Potentionmetry: *Introduction *Principles of potentiometric measurements.	x						
<b>3</b>	Reference electrodes and Metallic indicator electrodes.		x					
<b>4</b>	Ion Selective Electrodes *Theory *Glass electrodes	x	x					
<b>5</b>	Ion Selective Electrodes *Liquid membrane electrodes *Applications		x	x	x	x		
<b>6</b>	Ion Selective Electrodes *Solid state electrodes *Coated wire electrodes		x					
<b>7</b>	Applications of Potentiometry .			x	x	x		
<b>8</b>	Voltammetry: *Introduction * Principles of voltammetric measurements. Activity	x					x	x
<b>9</b>	Voltammograms	x						
<b>10</b>	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						
15	Open discussion and revision	x	x	x	x	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 basis of analytical chemistry and related subjects including: instrumental analysis, chemometry, physical chemistry, and chemical kinetics	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.2- Identify the major impact and applications of analytical chemistry on science, industries and on the 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.6- 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.7-Assess problems encountered during analytical assay and take professional decisions in the area of specialization.	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	
	<b>2.4.2- Effectively use information technology in professional practices</b>	D.2- Acquire computer skills such as internet, word processing, chemometric and kinetic softwares.	d1	Activity						x
	<b>2.4.6- Work in a team and lead teams carrying out various professional tasks.</b>	D.6- Work effectively as a member of team.	d2	Activity						x

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	<b>2.4.5- Set criteria and parameters to evaluate the performance of others</b>	D.5- Set rules for judging others performance in the field of analytical chemistry.	d3	Activity																	X
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# 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
- Major or Minor element of program: Major
- Department offering the program: Analytical Chemistry.
- Department offering the course: Analytical Chemistry.
- Date of specification approval: 2012/2013

### 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 will 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:

<b>A- Knowledge and Understanding</b>	
<b>a1</b>	Outline the principles of kinetics, reaction rates and factors affecting them.
<b>a2</b>	Describe kinetic methods of analysis.
<b>a3</b>	Establish a moral code by maintaining the quality of analytical measures.
<b>a4</b>	Outline the basic steps toward quality of analytical measurements.
<b>a5</b>	Maintain ethical approach all through analytical process.
<b>B- Intellectual skills</b>	
<b>b<sub>1</sub></b>	Manipulate data, calculate activation energy and interpret kinetic results
<b>b<sub>2</sub></b>	Suggest the most appropriate kinetic method of analysis for the assay of a chosen analyte.
<b>D- General and Transferable Skills</b>	
<b>d<sub>1</sub></b>	Retrieve information from various sources in the field of analytical chemistry.
<b>d<sub>2</sub></b>	Optimize work hours and manipulate time threats
<b>d<sub>3</sub></b>	Study independently and plan research studies.

### 4. Course Contents of Kinetic methods of analysis:

<b>Week number</b>	<b>Contents</b>
1	<ul style="list-style-type: none"><li>• Mechanisms of chemical reactions</li></ul>
2	<ul style="list-style-type: none"><li>• Rates of the reaction and their measurement</li></ul>
3	<ul style="list-style-type: none"><li>• Order of the reaction (zero and first order)</li></ul>

4	<ul style="list-style-type: none"><li>• Order of the reaction (second and third order)</li></ul>
5	<ul style="list-style-type: none"><li>• Methods for the determination of the order of the reaction<ul style="list-style-type: none"><li>○ Integration method</li></ul></li><li>• b) Method of equi-fractional part</li></ul>
6	<ul style="list-style-type: none"><li>• Concentrations and Time: Half- Lives</li></ul>
7	<ul style="list-style-type: none"><li>• Pseudo-order reactions</li></ul>
8	<ul style="list-style-type: none"><li>• Molecularity of a reaction</li><li>• Activity</li></ul>
9	<ul style="list-style-type: none"><li>• Theories of reaction rate:</li><li>• Collision theory</li></ul>
10	<ul style="list-style-type: none"><li>• Theories of reaction rate:</li><li>• Transition state theory</li></ul>
11	<ul style="list-style-type: none"><li>• Catalysis</li></ul>
12	<ul style="list-style-type: none"><li>• Kinetic methods of analysis and the interpretation of kinetic results.</li></ul>
13	<ul style="list-style-type: none"><li>• Activation energy (<math>E_a</math>), Determination of rate constant and <math>E_a</math> (Arrhenius plot)</li></ul>
14	<ul style="list-style-type: none"><li>• The Quality of Analytical Measurements</li><li>• Average run length: cusum charts</li><li>• Proficiency testing schemes</li><li>• Collaborative trials</li><li>• Uncertainty</li><li>• Acceptable sampling</li></ul>
15	<ul style="list-style-type: none"><li>• Open discussion and revision</li></ul>

## **5- Teaching and Learning Methods:**

- Lectures
- Self learning
- 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:**

<b>Assessment (1):</b> Activity	Week 8
<b>Assessment (2):</b> Written exam	Week 16
<b>Assessment (3):</b> oral exam	Week 16

### **Weighting of Assessment:**

<b>Assessment method</b>	<b>Marks</b>	<b>Percentage</b>
• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
<b>TOTAL</b>	<b>100</b>	<b>100%</b>

## **7- References and books:**

### **A-Scientific papers**

### **B- Essential books:**

Kinetic Methods of Analysis, K.B. Yatsimirskii, Pegamon Press,  
Oxford, 1966

**C- Suggested books:**

Chemical Kinetics And Reaction Dynamics , Paul L. Houston ,  
McGraw Hill comp., 2001.

**D- Websites:**

[www.sciencedirect.com](http://www.sciencedirect.com)

[www.rsc.org](http://www.rsc.org)

**Facilities required for teaching and learning:**

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

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- **Course Coordinators:** Ass. Prof Dr/ Mervat Hosny
- **Head of Department:** Prof. Dr. Mohamed Naguib El-Balkeny

**Date:** 2012-8-28 تم اعتماده في مجلس القسم بتاريخ



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

	Acceptable sampling											
15	Open discussion and revision	X	x	x	x	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 basis of analytical chemistry and related subjects including: instrumental analysis, chemometry, 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	

2.1.2- Mutual influence between professional practice and its impact on the environment.	A.2- Identify the major impact and applications of analytical chemistry on science, industries and on the environment.	a2	Kinetic methods of analysis and the interpretation of kinetic results	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.4- Comprehend the moral aspects required by professionals.	a3	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.5- Demonstrate full commitment to good laboratory practice and quality assurance.	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.6- Demonstrate full awareness of ethics in all aspects of scientific research.	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 (Arrhenius 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	2.4.4- Use variable sources to get information and knowledge.	D.4- Retrieve information from various sources in the field of analytical chemistry.	d1	Activity						x
	2.4.7- Manage time effectively.	D.7- Optimize work hours	d2	Activity						x

	2.4.8- Continuous and self learning.	D.8- Study independently and plan research studies.	d3	Activity							x
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# Spectrophotometry

## Course specification of Spectrophotometry

### A- Course specifications:

- Program on which the course is given: Master's of Pharmaceutical Sciences
- Major or Minor element of program: Major
- Department offering the program: Analytical Chemistry.
- Department offering the course: Analytical Chemistry.
- Date of specification approval: 2012/2013

### 1- Basic information:

Title: **Spectrophotometry**

Code: Asp3

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 the principles of spectrophotometry and describe theories, operation, instrumentation and applications of spectrophotometry and related techniques.



### 3. Intended learning outcomes (ILOs) of Spectrophotometry:

<b>A- Knowledge and Understanding</b>	
<b>a1</b>	Demonstrate the principles, instrumentation and operation of spectrophotometry, derivative spectrophotometry and flow injection spectrophotometry.
<b>a2</b>	Describe the instrumentation, pharmaceutical and biological applications of spectrophotometry, derivative spectrophotometry and flow injection spectrophotometry.
<b>B- Intellectual skills</b>	
<b>b<sub>1</sub></b>	Determine the most appropriate assay design for the chosen analyte.
<b>D- General and Transferable Skills</b>	
<b>d<sub>1</sub></b>	Retrieve information from various sources in the field of analytical chemistry.

### 4. Course Contents of Spectrophotometry:

<b>Week number</b>	<b>Contents</b>
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	Spectrophotometric 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
15	Open Discussion

### **5- Teaching and Learning Methods:**

- Lectures
- Self learning
- Open discussion

## **6- Student Assessment methods:**

Written exams to assess: a1, a2, b1

Oral exam to assess: a1, a2, b1

Activity to assess: d1

### **Assessment schedule:**

<b>Assessment (1):</b> Activity	Week 8
<b>Assessment (2):</b> Written exam	Week 16
<b>Assessment (3):</b> oral exam	Week 16

### **Weighting of Assessment:**

<b>Assessment method</b>	<b>Marks</b>	<b>Percentage</b>
• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
<b>TOTAL</b>	<b>100</b>	<b>100%</b>

## **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:** [www.tandfonline.com/toc/lanl20/current](http://www.tandfonline.com/toc/lanl20/current) (Analytical Letters)

[www.rsc.org](http://www.rsc.org)

**Facilities required for teaching and learning:**

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

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- **Course Coordinators:** Prof Dr/ Magda El-maamly
- **Head of Department:** Prof. Dr. Mohamed Naguib El-Balkeny
- **Date:** 2012-8-28 تم اعتماده في مجلس القسم بتاريخ

<b>Matrix I of Spectrophotometry</b>					
<b>Course Contents</b>		<b>ILOs</b>			
		Knowledge and Understanding		Intellectual skills	General and Transferable Skills
		<b>a1</b>	<b>a2</b>	<b>b1</b>	<b>d<sub>1</sub></b>
<b>1</b>	Introduction to light absorption	x			
<b>2</b>	Spectra of some important naturally occurring chromophores	x			
<b>3</b>	Spectrophotometer configuration	x			
<b>4</b>	Choice of spectrophotometer operating conditions	x			
<b>5</b>	Use of spectrophotometer	x			
<b>6</b>	Derivative spectrophotometry *Introduction *Instrumentation	x			
<b>7</b>	Derivative spectrophotometry *Practical Aspects *Applications		x	x	
<b>8</b>	Spectrophotometric assays *Introduction *Assay Design Activity		x	x	x
<b>9</b>	Spectrophotometric assay of protein		x	x	
<b>10</b>	Enzyme based spectrophotometric assay		x	x	
<b>11</b>	Luminescence based assay		x	x	
<b>12</b>	Flow-injection spectrophotometry	x	x	x	
<b>13</b>	Pharmaceutical and biological applications of spectrophotometry		x	x	
<b>14</b>	Revision	x	x	x	
<b>15</b>	Open discussion	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 basis of analytical chemistry and related subjects including: instrumental analysis, chemometry, physical chemistry, and chemical kinetics	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.2- Identify the major impact and applications of analytical chemistry on science, industries and on the environment.	a2	Derivative spectrophotometry *Practical Aspects *Applications---- Spectrophotometric assays- -- Spectrophotometric 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	
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2.2	2.2.6- Plan to improve performance in the field of specialization.	B.6- Design a laboratory protocol for a requested analytical issue.	b1	Derivative spectrophotometry *Practical Aspects *Applications---- Spectrophotometric assays-- -- Spectrophotometric 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 in the field of analytical chemistry.	d1	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:** 2012/2013

### **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 question
- Identify and perform different techniques and methods used in the experimental work according to the designed protocol
- Analyze the results of the study in the light of prior knowledge
- Draw conclusions about the contribution to knowledge made by the study.

### 3- Intended learning outcome's (ILOs):

<b>Knowledge and Understanding</b>	
<b>a1</b>	Outline theoretical and advanced bases of analytical chemistry related to main objectives of the thesis
<b>a2</b>	Determine the problem the thesis will handle in correlation with the community and surrounding environment
<b>a3</b>	Explain clearly the principles of different and advanced qualitative and quantitative analytical techniques
<b>a4</b>	Understand any legal aspects related to the thesis work.
<b>a5</b>	Demonstrate GLP and quality assurance related to practical work of the thesis
<b>a6</b>	Identify and apply scientific experimental ethics.
<b>Intellectual skills</b>	
<b>b1</b>	Solve problems related to practical work by obtained quantitative data from the practical work
<b>b2</b>	Discuss professional problems and suggest solutions relay on different pharmaceutical knowledge and recent information
<b>b3</b>	Combine required specialties to manage the subject under study
<b>b4</b>	Integrate scientific results and write report following conducting research
<b>b5</b>	Manage risks and hazards related to professional practical area
<b>b6</b>	Design a laboratory protocol for the work
<b>b7</b>	Decide what to do with full responsibility in scientific research
<b>Professional and practical skills</b>	
<b>c1</b>	Apply different techniques related to practical thesis work.

<b>c2</b>	Use and evaluate practical data to write report
<b>c3</b>	Apply various biochemical techniques involved in the protocol
<b>General and Transferable skills</b>	
<b>d1</b>	Communicate effectively with all people related to the work
<b>d2</b>	Use information technology in review and thesis preparation
<b>d3</b>	Evaluate the work and learning needs
<b>d4</b>	Use various sources to get information about the subject understudy
<b>d5</b>	Set rules for evaluation and judging others performance.
<b>d6</b>	Work effectively as a member of a team
<b>d7</b>	Acquire time management skills
<b>d8</b>	Study independently and plan research studies.

#### **4. Thesis Content:**

<b>Steps</b>	<b>Content</b>
1 <sup>st</sup>	<p>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.</p> <p>Collect all available information about this subject by all possible means.</p> <p>Use internet, journals, books and others thesis to get previous and recent information about the subject understudy.</p> <p>Design the protocol including the steps of work following the suitable timetable.</p> <p>Increase the awareness of the recent biochemical and analytical techniques that will be used during practical work and determined by</p>

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

<p>Present the results periodically in seminars.</p> <p>Write scientific reports on the obtained results with conclusive significance.</p> <p>Discuss obtained results in comparison with pervious literatures.</p> <p>Suggest possible recommendations based on the outcome of the thesis and decide future plans.</p> <p>Summarize the thesis in an understandable Arabic language for non professionals.</p> <p>Write references in the required form (Thesis, Paper.....).</p> <p>Demonstrate the thesis in a final power point presentation.</p> <p>Continue self-learning throughout the experimental work and writing scientific papers.</p>
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### **5- Teaching and Learning Methods:**

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

### **6- References:**

- **Websites:** Pubmed, Sciencedirect, Wileyinterscience

#### **Facilities required for:**

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

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- **Head of Department: Prof. Dr. Mohamed Naguib El-Balkeny**

<b>Masters of Analytical Chemistry</b>				
	<b>NARS</b>	<b>Program ILOs</b>	<b>Thesis ILOs</b>	<b>Thesis content</b>
<b>Knowledge and Understanding</b>	2.1.1- Theories and fundamentals related to the field of learning as well as in related areas	A.1- Illustrate the basis of analytical chemistry and related subjects including: instrumental analysis, chemometry, physical chemistry, and chemical kinetics	Outline theoretical and advanced bases of analytical chemistry related to main objectives of the thesis	<ul style="list-style-type: none"> <li>• Collect all available information about this subject by all possible means.</li> </ul>
	2.1.2- Mutual influence between professional practice and its impact on the environment.	A.2- Identify the major impact and applications of analytical chemistry on science, industries and on the environment.	Determine the problem the thesis will handle in correlation with the community and surrounding environment	<ul style="list-style-type: none"> <li>• 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.</li> </ul>
	2.1.3- Scientific developments in the area of specialization.	A.3- Describe the most advanced techniques in analytical chemistry and their applications.	Explain clearly the principles of different and advanced qualitative and quantitative analytical techniques	<ul style="list-style-type: none"> <li>• Increase the awareness of the recent analytical techniques that will be used during practical work and determined by the protocol.</li> </ul>

	2.1.4- Moral and legal principles for professional practice in the area of specialization.	A.4- Comprehend the moral aspects required by professionals.	Understand any legal aspects related to the thesis work.	<ul style="list-style-type: none"> <li>• Understand any legal aspects related to the thesis work.</li> </ul>
	2.1.5- Principles and the basics of quality in professional practice in the area of specialization.	A.5- Demonstrate full commitment to good laboratory practice and quality assurance.	Demonstrate GLP and quality assurance related to practical work of the thesis	<ul style="list-style-type: none"> <li>• Identify different analytical techniques and methods used to assess parameters related to the subject under study.</li> <li>• Operate scientific instruments according to instructions.</li> </ul>
	2.1.6- The fundamentals and ethics of scientific research.	A.6- Demonstrate full awareness of ethics in all aspects of scientific research.	Identify and apply scientific experimental ethics.	<ul style="list-style-type: none"> <li>• Understand any legal aspects related to the thesis work.</li> </ul>
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.	Solve problems related to practical work by obtained quantitative data from the practical work	<ul style="list-style-type: none"> <li>• Collect raw data for the tested samples.</li> <li>• Interpret raw data to get valuable information.</li> <li>• Perform statistical analysis for the results</li> <li>• Present and describe the results graphically.</li> <li>• Suggest solution to the problem</li> </ul>



				understudy based on this presented data.
	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.	Discuss professional problems and suggest solutions relay on different pharmaceutical knowledge and recent information	<ul style="list-style-type: none"> <li>• Discuss obtained results in comparison with pervious literatures.</li> <li>• Suggest possible recommendations based on the outcome of the thesis and decide future plans.</li> </ul>
	2.2.3-Correlate and integrate different pharmaceutical knowledge to solve professional problems.	B.3- Integrate the gained knowledge of analytical chemistry, for assaying analytes of complex nature.	Combine required specialties to manage the subject under study	<ul style="list-style-type: none"> <li>• Integrate different knowledge (analytical chemistry, pharmaceutical and organic chemistry knowledge, biostatistics, ..... ) to solve suggested problem.</li> </ul>

	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.	Integrate scientific results and write report following conducting research	• Write scientific reports on the obtained results with conclusive significance.
	2.2.5- Evaluate and manage risks and potential hazards in professional practices in the area of specialization	B.5-Recognize possible hazards during work and how to deal with.	Manage risks and hazards related to professional practical area	Evaluate and manage hazards(chemicals) throughout the whole practical work.
	2.2.6- Plan to improve performance in the field of specialization.	B.6- Design a laboratory protocol for a requested analytical issue.	Design a laboratory protocol for the work	• Design the protocol including the steps of work following the suitable timetable.
	2.2.7- Professional decision-making in the contexts of diverse disciplines.	B.7-Assess problems encountered during analytical assay and take professional decisions in the area of specialization.	Decide what to do with full responsibility in scientific research	•Suggest the possible points/problems of research that the candidate can work on in the frame of the aim of work and choose proper point related to the problems of the community and surrounding environment. . Suggest possible recommendations based on the outcome of the thesis and decide future plans.

Professional and Practical Skills	2.3.1- Master basic and modern professional skills in the area of specialization.	C.1- Recognize with personal command the recent laboratory techniques in the field of analytical chemistry	Apply different techniques related to practical thesis work.	<ul style="list-style-type: none"> <li>•Identify different analytical techniques and methods used to assess parameters related to the subject under study.</li> </ul>
	2.3.2- Write and evaluate professional reports.	C.2- Write with confidence reliable scientific reports.	Use and evaluate practical data to write report	<ul style="list-style-type: none"> <li>• Summarize the thesis in an understandable Arabic language for non professionals.</li> <li>• Write references in the required form (Thesis, Paper.....).</li> </ul>
	2.3.3- Assess methods and tools existing in the area of specialization	C.3- Develop and assess novel methods of analysis	Apply various biochemical techniques involved in the protocol	<ul style="list-style-type: none"> <li>• Operate scientific instruments according to instructions.</li> <li>•Separation of samples by qualitative and quantitative determination and assay by advanced instruments and techniques.</li> </ul>

General and Transferable Skills	2.4.1- Communicate effectively.	D.1- Interact effectively with patient and professionals.	Communicate effectively with all people related to the work	<ul style="list-style-type: none"> <li>• Communicate with supervisors to discuss results .</li> </ul>
	2.4.2- Effectively use information technology in professional practices	D.2- Acquire computer skills such as internet, word processing, chemometric and kinetic softwares.	Use information technology in review and thesis preparation	<ul style="list-style-type: none"> <li>• Present the results periodically in seminars</li> <li>• Demonstrate the thesis in a final power point presentation.</li> </ul>
	2.4.3- Self-assessment and define his personal learning needs.	D.3- Practice self assessment and continuous working in the field analytical chemistry.	Evaluate the work and learning needs	<ul style="list-style-type: none"> <li>• Continuous evaluation to the thesis outcome according to the schedule.</li> </ul>
	2.4.4- Use variable sources to get information and knowledge.	D.4- Retrieve information from various sources in the field of analytical chemistry.	Use various sources to get information about the subject understudy	<ul style="list-style-type: none"> <li>• Use internet, journals, books and others thesis to get previous and recent information about the subject understudy.</li> </ul>
	2.4.5- Set criteria and parameters to evaluate the performance of others	D.5- Set rules for judging others performance in the field of analytical chemistry.	Set rules for evaluation and judging others performance.	<ul style="list-style-type: none"> <li>• Discuss obtained results in comparison with previous literatures.</li> </ul>
	2.4.6- Work in a team and lead teams carrying out various professional tasks.	D.6- Work effectively as a member of team.	Work effectively as a member of a team	<ul style="list-style-type: none"> <li>• Work effectively as a member of a team (e.g. Supervisors, various professionals and Technicians).</li> </ul>

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	2.4.7- Manage time effectively.	D.7- Optimize work hours	Acquire time management skills	<ul style="list-style-type: none"><li>• Organize the experimental work according to the designed protocol (either parallel or sequential experiments).</li></ul>
	2.4.8- Continuous and self learning.	D.8- Study independently and plan research studies.	Study independently and plan research studies.	<ul style="list-style-type: none"><li>• Continue self-learning throughout the experimental work and writing scientific papers.</li></ul>

# PhD Degree

# Program Specification

## Program Specification

### A- Basic Information

- 1- Program title:** PhD. Pharm. Sci Degree in **Analytical Chemistry**
- 2- Program type:** Monodisciplinary.
- 3- Faculty/ University:** Faculty of Pharmacy, Zagazig University
- 4- Department:** Analytical Chemistry
- 5- Coordinator:** Prof. Dr. Hesham Ezzat
- 6- Date of program specification approval:** 2012

### B- Professional Information

#### 1- Program aims:

The Analytical chemistry PhD program aims to enable the students to contribute towards research in analytical chemistry field and to make the students perfect in applying different research methods, techniques, and tools in the field of analytical chemistry.

#### 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 PhD degree.

#### 2-1- Knowledge and Understanding :

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

- A.1- Illustrate the basis of analytical chemistry and related subjects including: Chemometry, Spectroscopy and Chromatography
- A.2- Describe the vast important applications of analytical chemistry.



A.3- Comprehend the ethical aspects required by professionals.

A.4- Demonstrate full commitment to good laboratory practice and quality assurance.

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- Apply the proper testing and calculations for data interpretation.

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

B.3- Apply proper research tools to establish novel facts and solve new or existing analytical problems using scientific methods.

B.4- Establish a good knowledge in writing and publishing research papers.

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

B.6- Integrate the gained knowledge of analytical chemistry, for assaying pharmaceuticals of complex nature and Design a laboratory protocol for a requested analytical issue .

B.7- Take professional decisions in the area of specialization.

B.8- Show creativity in solving analytical problems.

B.9- Discuss different logical solutions for a given analytical problem.

## **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- Recognize with personal command the recent laboratory techniques in Analytical Chemistry research.

C.2- Write with confidence reliable scientific reports in analytical chemistry field.

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

C.4- Implement sophisticated analytical instruments for assay of analytes of complex nature.

C.5- Set a plan for the improvement of professionals and researchers.

### **2-4 - General and Transferable Skills:**

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

D.1- Interact effectively with patient and professionals.

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

D.3- Help your colleagues and coworkers to increase the quality of research.

D.4- Practice self assessment and continues working in the field analytical chemistry.

D.5- Retrieve information from various sources in the field of analytical chemistry.

D.6- Work effectively as a member of team, and improve leadership skills.

D.7- Optimize work hours, and call for periodical scientific meetings.

### **3- Academic Standards:**

- NARS (National Academic Reference Standards)

**Matrix:** Comparison between PhD degree program ILOs and the National Academic Reference Standards

	NARS	Program ILOs
Knowledge and Understanding	2.1.1- Fundamental and in-depth knowledge and basic theories in the field of specialty and the closely related areas of pharmaceutical sciences	A.1- Illustrate the basis of analytical chemistry and related subjects including: Chemometry, Spectroscopy and Chromatography
	2.1.2- Fundamentals, methods, techniques, tools and ethics of scientific research	A.2- Describe the vast important applications of analytical chemistry.
	2.1.3- The ethical and legal principles in pharmacy and academic practices	A.3- Comprehend the ethical aspects required by professionals.
	2.1.4- The principles and bases of quality assurance in professional practice in the field of specializations	A.4- Demonstrate full commitment to good laboratory practice and quality assurance.
	2.1.5- All relevant knowledge concerning the impact of professional practice on society and environment and the ways of their conservation and development	A.5- Identify the beneficial impact and applications of analytical chemistry towards a safe environment.
Intellectual Skills	2.2.1- Analyze, evaluate the data in his / her specified area, and utilize them in logical inference processes (induction/deduction).	B.1- Apply the proper testing and calculations for data interpretation.

2.2.2- Propose solutions to specified problems in the light of the available data (information).	B.2- Suggest the most appropriate analytical technique for assaying the pharmaceutical or biological samples.
2.2.3- Conduct research studies that add to the current knowledge.	B.3- Apply proper research tools to establish novel facts and solve new or existing analytical problems using scientific methods.
2.2.4- Formulate scientific papers.	B.4- Establish a good knowledge in writing and publishing research papers.
2.2.5- Assess hazards and risks in professional practice in his / her area of specialization.	B.5- Recognize possible hazards during work and how to deal with
2.2.6- Plan to improve performance in the pharmaceutical area of interest.	B.6- Integrate the gained knowledge of analytical chemistry for assaying pharmaceuticals of complex nature and Design a laboratory protocol for a requested analytical issue .
2.2.7- Take professional decisions and bears responsibility in wide array of pharmaceutical fields	B.7- Take professional decisions in the area of specialization.
2.2.8- Be creative and innovative	B.8- Show creativity in solving analytical problems.
2.2.9- Manage discussions and arguments based on evidence and logic.	B.9- Discuss different logical solutions for a given analytical problem

Professional and Practical Skills	2.3.1- Master basic and modern professional skills in the area of specialization.	C.1- Recognize with personal command the recent laboratory techniques in Analytical Chemistry research.
	2.3.2- Write and critically evaluate professional reports.	C.2- Write with confidence reliable scientific reports in analytical chemistry field.
	2.3.3- Evaluate and develop methods and tools existing in the area of specialization.	C.3- Develop and assess novel methods of analysis.
	2.3.4- Properly use technological means in a better professional practice	C.4- Implement sophisticated analytical instruments for assay of analytes of complex nature.
	2.3.5- Plan to improve professional practices and to improve the performance of other scholars	C.5- Set a plan for the improvement of professionals and researchers.
General and Transferable Skills	2.4.1- Effective communication in its different forms	D.1- Interact effectively with patient and professionals.
	2.4.2- Efficiently use the information technologies ( IT) in improving the professional practices	D.2- Acquire computer skills such as internet, word processing, chemometric and kinetic softwares.
	2.4.3- Help others to learn and evaluate their performance.	D.3- Help your colleagues and coworkers to increase the quality of research.
	2.4.4- Self-assessment and continuous working.	D.4- Practice self assessment and continues working in the field analytical chemistry.
	2.4.5- Use various sources to get information and knowledge.	D.5- Retrieve information from various sources in the field of

		analytical chemistry.
	2.4.6- Work as a member and lead a team of workers	D.6- Work effectively as a member of team, and improve leadership skills.
	2.4.7-Direct scientific meetings and to manage time effectively	D.7- Optimize work hours, and call for periodical scientific meetings.

#### **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	Advanced analytical chemistry	4	A1, A3, A4, B1, B2, B7, B9, D2, D3, D4
Asp5	Advanced spectroscopy of Analytical chemistry	4	A1, A2, A5, B2, B6, B8, D5, D6, D7
Asp6	Chromatographic Analysis of Pharmaceuticals	4	A1, A2, B2, B5, B6, D2, D3
	Thesis	30	A1, A2, A3, A4, A5, B1, B2, B3, B4, B5, B6, B7, B8, B9, C1, C2, C3, C4, C5, D1, D2, D3, D4, D5, D6 and D7

### 5-Program admission requirements:

- Candidate should have obtained the certificate of Master degree in pharmaceutical sciences in the same specialty from one of the

Egyptian universities or an equivalent certificate from a foreign institute recognized by the university.

### **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%

### 8-Failure in Courses:

Students who fail to get 60% ( 1 point)

### 9-Methods of program evaluation

Evaluator	Method	Sample
<b>Internal evaluator:</b> Professor Dr. Hesham Ezzat	Program evaluation Courses evaluation	Program report Courses report
<b>External evaluator:</b> Professor Dr.	Program evaluation Courses evaluation	Program report Courses report
<b>Others methods</b>	Matrix with NARS	The Matrix Results of the

	Questionnaires	questionnaires
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**Program coordinator**

**Head of Department**

**Prof. Dr. Hesham Ezzat  
Balkeny**

**Prof. Dr. Mohamed Naguib El-**

# Chemometric Analysis

## Course specification of Chemometric Analysis

### A- Course specifications:

- Program on which the course is given: Ph.D. of Pharmaceutical Sciences
- Major or Minor element of program: Major
- Department offering the program: Analytical Chemistry.
- Department offering the course: Analytical Chemistry.
- Date of specification approval: 2012/2013

### 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:

<b>A- Knowledge and Understanding</b>	
<b>a1</b>	Describe the design of analytical experiments using in chemometric analysis.
<b>a2</b>	Establish an ethical code by maintaining the quality of analytical measures.
<b>a3</b>	Outline the basic steps toward quality of analytical measurements.
<b>B- Intellectual skills</b>	
<b>b<sub>1</sub></b>	Apply the proper testing and statistics for determination of combination of errors and repeated measurements.
<b>b<sub>2</sub></b>	Describe the method of choice for the analyte.
<b>b3</b>	Decide the most appropriate experimental design for the analyte of choice.
<b>b4</b>	Discuss different possible methods for the assay of an analyte.
<b>D- General and transferable Skills</b>	
<b>d1</b>	Acquire computer-aided analytical skills such as chemometric and kinetic softwares.
<b>d2</b>	Help your colleagues and coworkers to proceed with a scientific plan and interpret data.
<b>d3</b>	Practice self-assessment and continues working in the field analytical chemistry.

### 4. Course Contents of Chemometric Analysis:

<b>Week number</b>	<b>Contents</b>
1	<b>Experimental Design and Optimization</b> Randomization and blocking Two-way ANOVA Latin squares and other designs

	<p>Interactions</p> <p>Factorial versus one-at-a-time design</p> <p>Factorial design and optimization</p>
2	<p><b>Experimental Design and Optimization</b></p> <p>Optimization: basic principles and univariate methods</p> <p>Optimization using the alternating variable search method</p> <p>The method of steepest ascent</p> <p>Simplex optimization</p> <p>Simulated annealing</p>
3	<p><b>Calibration Methods in Instrumental Analysis</b></p> <p>Calibration graphs in instrumental analysis</p> <p>The product-moment correlation coefficient</p> <p>The line of regression of y on x</p> <p>Errors in the slope and intercept of the regression line</p> <p>Calculation of a concentration and its random error</p> <p>Limits of detection</p> <p>The method of standard additions</p>
4	<p><b>Calibration Methods in Instrumental Analysis</b></p> <p>Use of regression lines for comparing analytical methods</p> <p>Weighted regression lines<sup>4</sup></p> <p>Intersection of two straight lines</p> <p>ANOVA and regression calculations</p>

	Curve fitting Outliers in regression
5	<b>Multivariate Analysis</b> Initial analysis Principal component analysis Cluster analysis Discriminate analysis K-nearest neighbor method Disjoint class modeling Multiple regression
6	<b>Multivariate Analysis</b> Principal component regression Multivariate regression Partial least squares regression Multivariate calibration Artificial neural networks
7	<b>Non-parametric and Robust Methods</b> The median: initial data analysis The sign test The Wald-Wolfowitz runs test The Wilcoxon signed rank test Simple tests for two independent samples
8	<b>Non-parametric and Robust Methods</b> Non-parametric tests for more than two samples Rank correlation Non-parametric regression methods

	<p>Robust methods</p> <p>Robust regression methods</p> <p>The Kolmogorov test for goodness of fit</p> <p><b>Activity</b></p>
<b>9</b>	<b>Errors in quantitative analysis</b>
<b>10</b>	<b>Statistics of Repeated Measurements</b> <p>Mean and standard deviation</p> <p>The distribution of repeated measurements</p> <p>The sampling distribution of the mean</p> <p>Confidence limits of the mean for large samples</p> <p>Presentation of results</p> <p>Confidence limits of the geometric mean for a log-normal distribution</p> <p>Propagation of errors</p>
<b>11</b>	<b>Significance Tests</b> <p>Comparison of an experimental mean with a known value</p> <p>Comparison of two experimental means</p> <p>Paired t-test</p> <p>One-sided and two-sided tests</p> <p>F-test for the comparison of standard deviations</p> <p>Outliers</p> <p>Analysis of variance</p>
<b>12</b>	<b>Significance Tests</b> <p>Comparison of several means</p> <p>The arithmetic of ANOVA calculations</p> <p>The chi-squared test</p>



	Testing for normality of distribution
13	<b>The Quality of Analytical Measurements</b> Sampling Separation and estimation of variances using ANOVA Quality control methods Stewhart charts Establishing the process capability
14	<b>The Quality of Analytical Measurements</b> Average run length: cusum charts Proficiency testing schemes Collaborative trials Uncertainty Acceptable sampling
15	<b>Revision and open discussion</b>

### **5- Teaching and Learning Methods:**

- Lectures
- Self learning
- Open discussion

### **6- Student Assessment methods:**

Written exams to assess: a1, a2, a3, b1, b2, b3,b4

Oral exam to assess: a1, a2, a3, b1, b2, b3,b4

Activity to assess: d1, d2 and d3

### **Assessment schedule:**

<b>Assessment (1):</b> Activity	Week 8
<b>Assessment (2):</b> Written exam	Week 16

Assessment (3): oral exam	Week 16
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**Weighting of Assessment:**

Assessment method	Marks	Percentage
• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
<b>TOTAL</b>	<b>100</b>	<b>100%</b>

**7- References and books:**

**A-Scientific papers**

**B- Essential books:** Chemometrics for analytical chemistry, M.

Meloun, J. Militky and M. Forina.

Ellis Horwoodseries in analytical chemistry, 1992.

**C- Suggested books:** Statistics for the Quality Control Laboratory,

Mullins, E., (RSC, 2003).

Statistics for Environmental Science and Management, Manly, B. F. J.,

(Chapman & Hall, 2001).

**D- Websites:**

[www.sciencedirect.com](http://www.sciencedirect.com)

[www.rsc.org](http://www.rsc.org)

**Facilities required for teaching and learning:**

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

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- **Course Coordinators: Prof Dr/ Hanaa Salah**
  - **Head of Department: Prof. Dr. Mohamed Naguib El-Balkeny**
  - **Date: 2012-8-28 تم اعتماده فى مجلس القسم بتاريخ**

<b>Matrix I of Chemometric Analysis</b>										
<b>Course Contents</b>		<b>ILOs</b>								
		Knowledge and understanding			Intellectual skills				General and Transferable skills	
		<b>a1</b>	<b>a2</b>	<b>a3</b>	<b>b1</b>	<b>b2</b>	<b>b3</b>	<b>b4</b>	<b>d<sub>1</sub></b>	<b>d<sub>2</sub></b>
<b>1</b>	Experimental Design and Optimization	x					x			
<b>2</b>	Experimental Design and Optimization	x					x			
<b>3</b>	Calibration Methods in Instrumental Analysis					x		x		
<b>4</b>	Calibration Methods in Instrumental Analysis					x		x		
<b>5</b>	Multivariate Analysis					x		x		
<b>6</b>	Multivariate Analysis					x		x		
<b>7</b>	Non-parametric and Robust Methods					x		x		
<b>8</b>	Non-parametric and Robust Methods Activity						x		x	x
<b>9</b>	Errors in quantitative analysis		x			x				
<b>10</b>	Statistics of Repeated Measurements					x				
<b>11</b>	Significance Tests					x				
<b>12</b>	Significance Tests					x				
<b>13</b>	The Quality of Analytical Measurements					x				
<b>14</b>	The Quality of Analytical Measurements		x	x						
<b>15</b>	Revision and open discussion	x	x	x	x	x	x	x		

## Matrix II of Chemometric 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- Fundamental and in-depth knowledge and basic theories in the field of specialty and the closely related areas of pharmaceutical sciences	A.1- Illustrate the basis of analytical chemistry and related subjects including: Chemometry, Spectroscopy and Chromatography	a1	Experimental Design and Optimization	Textbooks, Scientific papers and self learning	x	x	x	x	
	2.1.3- The ethical and legal principles in pharmacy and academic practices	A.3- Comprehend the ethical aspects required by professionals.	a2	The Quality of Analytical Measurements---Errors in quantitative analysis	Textbooks, Scientific papers and self learning	x	x	x	x	

	2.1.4- The principles and bases of quality assurance in professional practice in the field of specializations	A.4- Demonstrate full commitment to good laboratory practice and quality assurance.	a3	The Quality of Analytical Measurements	Textbooks, Scientific papers and self learning	x	x	x	x	
2.2	2.2.1- Analyze, evaluate the data in his / her specified area, and utilize them in logical inference processes (induction/deduction).	B.1- Apply the proper testing and calculations for data interpretation.	b1	Errors in quantitative analysis----Statistics of Repeated Measurements---Significance Tests	Textbooks, Scientific papers and self learning	x	x	x	x	
	2.2.2- Propose solutions to specified problems in the light of the available data (information).	B.2- Suggest the most appropriate analytical technique for assaying the pharmaceutical or biological samples.	b2	Calibration Methods ----Non-parametric and Robust Methods----Multivariate Analysis	Textbooks, Scientific papers and self learning	x	x	x	x	

	2.2.7- Take professional decisions and bears responsibility in wide array of pharmaceutical fields	B.7- Take professional decisions in the area of specialization.	b3	Experimental Design and Optimization	Textbooks, Scientific papers and self learning	x	x	x	x	
	2.2.9- Manage discussions and arguments based on evidence and logic.	B.9- Discuss different logical solutions for a given analytical problem	b4	Calibration Methods ----Non-parametric and Robust Methods----Multivariate Analysis	Textbooks, Scientific papers and self learning	x	x	x	x	
2.4	2.4.2- Efficiently use the information technologies ( IT) in improving the professional practices	D.2- Acquire computer skills such as internet, word processing, chemometric and kinetic softwares.	d1	Activity						x

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	2.4.3- Help others to learn and evaluate their performance.	D.3- Help your colleagues and coworkers to increase the quality of research.	d2	Activity							x
	2.4.4- Self-assessment and continuous working.	D.4- Practice self assessment and continues working in the field analytical chemistry.	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
- Major or Minor element of program: Major
- Department offering the program: Analytical Chemistry.
- Department offering the course: Analytical Chemistry.
- Date of specification approval: 2012/2013

### 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 i.e. NMR and Mass spectrometry and describe theories and applications of NMR, Mass and tandem Mass spectrometry.

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

<b>A- Knowledge and Understanding</b>	
<b>a1</b>	Outline the basis and theory and operation of NMR and Mass and tandem mass spectrometry.
<b>a2</b>	Apply studied spectroscopic techniques for the assay and detection of different analytes of pharmaceutical, biological or environmental origin.
<b>a3</b>	Describe an advanced technique for assaying analytes of complex nature.
<b>B- Intellectual skills</b>	
<b>b<sub>1</sub></b>	Decide the use of the most appropriate instrumental technique in pharmaceutical, biological assay or environmental assay.
<b>b<sub>2</sub></b>	Integrate the acquired knowledge in compound detection and structure elucidation
<b>b<sub>3</sub></b>	Integrate the power of sophisticated techniques for the development of novel analytical assay models.
<b>D- General and Transferable Skills</b>	
<b>d1</b>	Retrieve information from various sources in the field of analytical chemistry.
<b>d2</b>	Work effectively as a member of team, and improve leadership skills.
<b>d3</b>	Optimize work hours, and call for periodical scientific meetings.

### 4. Course Content of Advanced Spectroscopy of Analytical Chemistry:

<b>Week number</b>	<b>Contents</b>
1	<b>Spectroscopy</b> Introduction Theory
2	<b>Classification of spectroscopic techniques</b>

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

	MALDI) Electrospray ionization ESI
10	<b>Mass Spectrometry</b> Mass analysis Detection and Quantification
11	<b>Tandem Mass Spectrometry (MS/MS)</b> Introduction Scan modes Reactions studied in MS/MS
12	<b>Tandem Mass Spectrometry (MS/MS)</b> Applications: Structure elucidation Selective detection Ion-molecule reaction
13	<b>Mass spectrometry/ Chromatography coupling</b> Coupling techniques: GC/MS, HPLC/MS, CE/MS Pharmaceutical, biological and environmental applications
14	<b>Revision</b>
15	<b>Open Discussion</b>

### **5- Teaching and Learning Methods:**

- Lectures
- Self learning
- Open discussion

### **6- Student Assessment methods:**

Written exams to assess: a1, a2, a3, b1, b2, b3

Oral exam to assess: a1, a2, a3, b1, b2, b3, b4

Activity to assess: d1, d2 and d3

### Assessment schedule:

Assessment (1): Activity	Week 8
Assessment (2): Written exam	Week 16
Assessment (3): oral exam	Week 16

### Weighting of Assessment:

Assessment method	Marks	Percentage
• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
<b>TOTAL</b>	<b>100</b>	<b>100%</b>

## 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:

[www.tandfonline.com/toc/lanl20/current](http://www.tandfonline.com/toc/lanl20/current) (Analytical Letters)

[www.rsc.org](http://www.rsc.org)

**Facilities required for teaching and learning:**

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

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- **Course Coordinators:** Prof Dr/ Magda Elhenawee
- **Head of Department:** Prof. Dr. Mohamed Naguib El-Balkeny
- **Date:** 2012-8-28 تم اعتماده في مجلس القسم بتاريخ

<b>Matrix I of Advanced Spectroscopy of Analytical Chemistry</b>										
<b>Course Contents</b>		<b>ILOs</b>								
		Knowledge and understanding			Intellectual skills			General and Transferable Skills		
		a1	a2	a3	b1	b2	b3	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	X			
13	Mass spectrometry/ Chromatography coupling: Coupling techniques, Applications		x	X	x	x	X			
14	Revision	x	x	X	x	x	x			
15	Open discussion	x	x	x	x	x	x			

## Matrix II of Advanced Spectroscopy of Analytical 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- Fundamental and in-depth knowledge and basic theories in the field of specialty and the closely related areas of pharmaceutical sciences	A.1- Illustrate the basis of analytical chemistry and related subjects including: Chemometry, Spectroscopy and Chromatography	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	Textbooks, Scientific papers and self learning	X	x	x	x	



				*Mass spectrometer *Sample introduction *Ionization methods						
	2.1.2- Fundamentals, methods, techniques, tools and ethics of scientific research	A.2- Describe the vast important applications of analytical chemistry.	a2	*Mass Spectrometry: Detection and Quantification *MS/MS: Reactions studied *Mass spectrometry/ Chromatography coupling	Textbooks, Scientific papers and self learning	X	x	X	x	
	2.1.5- All relevant knowledge concerning the impact of professional practice on society and environment and the ways of their	A.5- Identify the beneficial impact and applications of analytical chemistry towards a safe environment.	a3	MS/MS: Applications *Mass spectrometry/ Chromatography coupling	Textbooks, Scientific papers and self learning	X	x	x	x	

	conservation and development									
2.2	2.2.2- Propose solutions to specified problems in the light of the available data (information).	B.2- Suggest the most appropriate analytical technique for assaying the pharmaceutical or biological samples.	b1	*Mass Spectrometry: Detection and Quantification *MS/MS: Reactions studied *Mass spectrometry/ Chromatography coupling	Textbooks, Scientific papers and self learning	X	x	x	x	
	2.2.6- Plan to improve performance in the pharmaceutical area of interest.	B.6- Integrate the gained knowledge of analytical chemistry, for assaying pharmaceuticals of complex nature.	b2	MS/MS: Applications *Mass spectrometry/ Chromatography coupling	Textbooks, Scientific papers and self learning	X	x	x	x	
	2.2.8- Be creative and innovative	B.8- Show creativity in solving analytical problems.	b3	MS/MS: Applications *Mass spectrometry/ Chromatography coupling	Textbooks, Scientific papers and self learning	X	x	x	x	

2.4	2.4.5- Use various sources to get information and knowledge.	D.5- Retrieve information from various sources in the field of analytical chemistry.	d1	Activity						X
	2.4.6- Work as a member and lead a team of workers	D.6- Work effectively as a member of team, and improve leadership skills.	d2	Activity						X
	2.4.7-Direct scientific meetings and to manage time effectively	D.7- Optimize work hours, and call for periodical scientific meetings.	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
- Major or Minor element of program: Major
- Department offering the program: Analytical Chemistry.
- Department offering the course: Analytical Chemistry.
- Date of specification approval: 2012/2013

### 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 quantitatively and describe theories and applications of different chromatographic techniques.

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

<b>A- Knowledge and Understanding</b>	
<b>a1</b>	Outline the basis, theory and operation of chromatographic analysis.
<b>a2</b>	Describe the pharmaceutical and biological applications of chromatographic techniques.
<b>B- Intellectual skills</b>	
<b>b1</b>	Assess the problems encountered during analytical procedures.
<b>b2</b>	Implement and apply safety measures all through analytical procedures.
<b>b3</b>	Integrate the information and knowledge gained from the course in developing new sensitive analytical methods using appropriate reagents for the determination of different compounds.
<b>D- General and transferable Skills</b>	
<b>d1</b>	Acquire computer-aided analytical skills such as chemometric and kinetic softwares.
<b>d2</b>	Help your colleagues and coworkers to proceed with a scientific plan and interpret data.

### 4. Course Contents of Chromatographic Analysis of Pharmaceuticals:

<b>Week number</b>	<b>Contents</b>
1	<b>General aspects of chromatography</b> General concept of analytical chromatography The chromatogram Column efficiency Retention parameters
2	<b>General aspects of chromatography</b> Optimization of chromatographic analysis Classification of analytical techniques.

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

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



	Principal Instrumentation Capillary electrochromatography Problems and applications
13	<b>Planar chromatography</b> Introduction Materials and techniques Detection Method development*Applications
14	<b>Revision and open discussion</b>
15	<b>Revision and open discussion</b>

### **5- Teaching and Learning Methods:**

- Lectures
- Self learning
- Open discussion
- 

### **6- Student Assessment methods:**

Written exams to assess: a1, a2, b1, b2, b3  
Oral exam to assess: a1, a2, a3, b1, b2, b3, b4  
Activity to assess: d1, d2 and d3

### **Assessment schedule:**

<b>Assessment (1):</b> Activity	Week 8
<b>Assessment (2):</b> Written exam	Week 16
<b>Assessment (3):</b> oral exam	Week 16

### **Weighting of Assessment:**

<b>Assessment method</b>	<b>Marks</b>	<b>Percentage</b>
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• Activity	10	10 %
• Written exam	75	75 %
• Oral exam	15	15 %
<b>TOTAL</b>	<b>100</b>	<b>100%</b>

## **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 pharmaceuticals, John A. Adamovics, Marcel Dekker, 1997.

### **Websites:**

[www.sciencedirect.com](http://www.sciencedirect.com)

[www.tandfonline.com/toc/lanl20/current](http://www.tandfonline.com/toc/lanl20/current) (Analytical Letters)

[www.rsc.org](http://www.rsc.org)

### **Facilities required for teaching and learning:**

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

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- **Course Coordinators: Prof Dr/ Mohamed El-Belkeni**
- **Head of Department: Prof. Dr. Mohamed Naguib El-Balkeny**
- **Date: 2012-8-28 تم اعتماده في مجلس القسم بتاريخ**

<b>Matrix I of Chromatographic Analysis of Pharmaceuticals</b>								
<b>Course Contents</b>		<b>ILOs</b>						
		Knowledge and understanding		Intellectual skills			General and transferable Skills	
		a1	a2	b1	b2	b3	d1	d2
<b>1</b>	General aspects of chromatography: *General concept of analytical chromatography *The chromatogram *Column efficiency *Retention parameters	x						
<b>2</b>	General aspects of chromatography: *Optimization of chromatographic analysis *Classification of analytical techniques. *Problems *Safety Measures all through the analytical process	x	x	x	x	x		
<b>3</b>	GC *Components of GC installation *Carrier gas and flow regulation. *Sample introduction and the injection chamber *Thermostatically controlled oven *Columns *Stationary Phases	x						
<b>4</b>	GC: *Principal gas chromatographic detectors. *Retention indexes and stationary phase constants *problems and applications	x	x	x		x		
<b>5</b>	HPLC: *The beginnings of HPLC *General concept of HPLC system *Pumps and gradient elution *Injectors *Columns	x						
<b>6</b>	HPLC: *Stationary phases *Mobile phases *Paired ion chromatography *Principal detectors *Applications and problems	x	x	x		x		
<b>7</b>	Ion chromatography *Basics of ion chromatography *Stationary phases *Mobile phases *Conductivity detectors	x						
<b>8</b>	Ion Chromatography: * Areas of the peaks and data treatment *External standard method *Internal standard method	x	x	X		x	X	x

	*Problems and applications Activity							
<b>9</b>	TLC: * Principle *Characteristics of TLC *Stationary phases *Separation and retention parameters *Quantitative TLC *Problems	<b>x</b>	<b>x</b>	<b>X</b>		<b>x</b>		
<b>10</b>	SFC: * Supercritical fluids *Instrumentation *SFC in chromatographic techniques.	<b>x</b>						
<b>11</b>	SEC: *Principle of SEC *Stationary and mobile phases *Instrumentation and applications	<b>x</b>	<b>x</b>	<b>X</b>		<b>x</b>		
<b>12</b>	CE and electrochromatography * Principal *Instrumentation *Capillary electrochromatography *Problems and applications	<b>x</b>	<b>x</b>	<b>x</b>		<b>x</b>		
<b>13</b>	Planar chromatography: * Introduction*Materials and techniques *Detection *Method development *Applications	<b>x</b>	<b>x</b>	<b>x</b>		<b>x</b>		
<b>14</b>	Revision and open discussion	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>		
<b>15</b>	Revision and open discussion	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>	<b>x</b>		
<b>16</b>	Activity						<b>X</b>	<b>x</b>

<b>Matrix II of Chromatographic Analysis of Pharmaceuticals</b>										
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- Fundamental and in-depth knowledge and basic theories in the field of specialty and the closely related areas of pharmaceutical sciences	A.1- Illustrate the basis of analytical chemistry and related subjects including: Chemometry, Spectroscopy and Chromatography	a1	General aspects of chromatography---GC---HPLC-- -Ion Chromatography---TLC--- SFC---SEC---Capillary electrophoresis and electrochromatography---Planar Chromatography	Textbooks, Scientific papers and self learning	x	x	x	x	

	2.1.2- Fundamentals, methods, techniques, tools and ethics of scientific research	A.2- Describe the vast important applications of analytical chemistry.	a2	General aspects of chromatography---GC---HPLC-- -Ion Chromatography---TLC---- SEC---Capillary electrophoresis and electrochromatography--- Planar Chromatography <b>(Problems and Applications)</b>	Textbooks, Scientific papers and self learning	x	x	x	x	
2.2	2.2.2- Propose solutions to specified problems in the light of the available data (information).	B.2- Suggest the most appropriate analytical technique for assaying the pharmaceutical or biological samples.	b1	General aspects of chromatography---GC---HPLC-- -Ion Chromatography---TLC---- SEC---Capillary electrophoresis and electrochromatography--- Planar Chromatography <b>(Problems and Applications)</b>	Textbooks, Scientific papers and self learning	x	x	x	x	

2.2.5- Assess hazards and risks in professional practice in his / her area of specialization.	B.5- Recognize possible hazards during work and how to deal with	b2	Safety Measures all through analytical process						x	
2.2.6- Plan to improve performance in the pharmaceutical area of interest.	B.6- Integrate the gained knowledge of analytical chemistry, for assaying pharmaceuticals of complex nature.	b3	General aspects of chromatography---GC---HPLC-- -Ion Chromatography---TLC---- SEC---Capillary electrophoresis and electrochromatography--- Planar Chromatography <b>(Problems and Applications)</b>	Textbooks, Scientific papers and self learning	x	x	x	x		
<b>2.4.2- Efficiently use the information technologies ( IT) in</b>	D.2- Acquire computer skills such as internet, word processing, chemometric and	d1	Activity							x

	<b>improving the professional practices</b>	kinetic softwares.								
	<b>2.4.3- Help others to learn and evaluate their performance.</b>	D.3- Help your colleagues and coworkers to increase the quality of research.	d2	Activity						x



# Thesis Specification

## Thesis Specification of PhD Degree

### **A- Thesis specifications:**

- **Program on which the course is given:** PhD 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:** 2012/2013

### **1- Basic information:**

- Title: PhD 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 different techniques and methods used in the experimental work according to the designed protocol
- Derive and present 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 researcher

### 3- Intended learning outcome's (ILOs):

<b>Knowledge and Understanding</b>	
<b>a1</b>	Outline different principles of analytical chemistry and their possible application in the research study
<b>a2</b>	Demonstrate methods and techniques used during working in the area of specialization of research
<b>a3</b>	Understand the legal aspects of for professional and academic practices
<b>a4</b>	Illustrate the importance of quality assurance during the analysis of different drugs
<b>a5</b>	Define different practices that can be used in understanding the problem of the research and help in solving it
<b>Intellectual skills</b>	
<b>b1</b>	Solve problems related to practical work by obtained quantitative data from the practical work
<b>b2</b>	Discuss professional problems and suggest solutions rely on knowledge and recent information
<b>b3</b>	Plan a research in the research field
<b>b4</b>	Integrate scientific results and write report following conducting research
<b>b5</b>	Manage risks and hazards related to professional practical area
<b>b6</b>	Outline principles that should be followed in research to develop laboratory performance
<b>b7</b>	Decide what to do with full responsibility in scientific research
<b>b8</b>	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	Estimate laboratory techniques used in analytical chemistry. Develop methods of assay of various parameters
c4	Use IT skills in collecting information, presenting results and writing thesis
c5	Improve laboratory techniques.
General and Transferable skills	
d1	Interact with health care professional.
d2	Use information technology in review and thesis preparation
d3	Set rules for evaluation and judge others performance.
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
1 <sup>st</sup>	<p>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.</p> <p>Collect all available information about this subject by all possible means.</p> <p>Use internet, journals, books and others thesis to get previous and recent information about the subject understudy.</p>

	<p>Design the protocol including the steps of work following the suitable timetable.</p> <p>Increase the awareness of the recent biochemical and analytical techniques that will be used during practical work and determined by the protocol.</p> <p>Integrate different knowledge (analytical chemistry, pharmaceutical and organic chemistry knowledge, biostatistics, ..... ) to solve suggested problem.</p> <p>Continuous evaluation to the thesis outcome according to the schedule.</p>
2 <sup>nd</sup>	<p>Identify different practical techniques and methods to assess biochemical parameters related to the subject under study.</p> <p>Operate scientific instruments according to instructions.</p> <p>Evaluate and manage hazards (chemical) throughout the whole practical work.</p> <p>Organize the experimental work according to the designed protocol (either parallel or sequential experiments).</p> <p>Separation of samples for qualitative and quantitative determination and assay.</p> <p>Understand any legal aspects related to the thesis work.</p>
3 <sup>rd</sup>	<p>Collect raw data for the tested biochemical parameters.</p> <p>Interpret raw data to get valuable information.</p> <p>Perform statistical analysis and biological correlation for the results.</p> <p>Present and describe the results graphically.</p> <p>Suggest solution to the problem understudy based on this presented data.</p> <p>Modify methods for analysis of samples</p>

4 <sup>th</sup>	<ul style="list-style-type: none"><li>- Communicate with supervisors to discuss results</li><li>Work effectively as a member of a team (e.g. Supervisors, various professionals and Technicians).</li><li>Present the results periodically in seminars.</li><li>Write scientific reports on the obtained results with conclusive significance.</li><li>Discuss obtained results in comparison with pervious literatures.</li><li>Suggest possible recommendations based on the outcome of the thesis and decide future plans.</li><li>Summarize the thesis in an understandable Arabic language for non professionals.</li><li>Write references in the required form (Thesis, Paper.....).</li><li>Demonstrate the thesis in a final power point presentation.</li><li>Continue self-learning throughout the experimental work and writing scientific papers.</li></ul>
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### **5- Teaching and Learning Methods:**

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

### **6- References:**

- **Websites:** Pubmed, Sciencedirect, Weilyinterscience

### **Facilities required for:**

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

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**Head of Department: Prof. Dr. Mohamed Naguib El-Balkeny**

<b>Matrix of PhD Thesis in Analytical chemistry Program</b>				
	<b>NARS</b>	<b>Program ILOs</b>	<b>Thesis ILOs</b>	<b>Course contents</b>
<b>Knowledge and Understanding</b>	2.1.1- Fundamental and in-depth knowledge and basic theories in the field of specialty and the closely related areas of pharmaceutical sciences	A.1- Illustrate the basis of analytical chemistry and related subjects including: Chemometry, Spectroscopy and Chromatography	Outline different principles of analytical chemistry and their possible application in the research study	<ul style="list-style-type: none"> <li>• Collect all available information about this subject by all possible means.</li> </ul>
	2.1.2- Fundamentals, methods, techniques, tools and ethics of scientific research	A.2- Describe the vast important applications of analytical chemistry.	Demonstrate methods and techniques used during working in the area of specialization of research	<ul style="list-style-type: none"> <li>• Increase the awareness of the recent pharmaceutical techniques that will be used during practical work and determined by the protocol.</li> </ul>
	2.1.3- The ethical and legal principles in pharmacy and academic practices	A.3- Comprehend the ethical aspects required by professionals.	Understand the legal aspects of for professional and academic practices	Define ethics of scientific research.
	2.1.4- The principles and bases of quality assurance in professional practice in the field of specializations	A.4- Demonstrate full commitment to good laboratory practice and quality assurance.	Illustrate the importance of quality assurance during the analysis of different drugs	·Integrate different knowledge (analytical chemistry, pharmaceutical and organic chemistry knowledge, biostatistics, ..... ) to solve suggested problem.

	2.1.5- All relevant knowledge concerning the impact of professional practice on society and environment and the ways of their conservation and development	A.5- Identify the beneficial impact and applications of analytical chemistry towards a safe environment.	Define different practices that can be used in understanding the problem of the research and help in solving it	·Integrate different knowledge (analytical chemistry, pharmaceutical and organic chemistry knowledge, biostatistics, ..... ) to solve suggested problem.
Intellectual Skills	2.2.1- Analyze, evaluate the data in his / her specified area, and utilize them in logical inference processes (induction/deduction).	B.1- Apply the proper testing and calculations for data interpretation.	Solve problems related to practical work by obtained quantitative data from the practical work	<ul style="list-style-type: none"> <li>• Collect raw data for the tested samples.</li> <li>• Interpret raw data to get valuable information.</li> <li>• Perform statistical analysis for the results.</li> <li>• Present and describe the results graphically.</li> <li>• Suggest solution to the problem understudy based on this presented data.</li> </ul>
	2.2.2- Propose solutions to specified problems in the light of the available data (information).	B.2- Suggest the most appropriate analytical technique for assaying the pharmaceutical or biological samples.	Discuss professional problems and suggest solutions rely on knowledge and recent information	<ul style="list-style-type: none"> <li>• Separation of samples by qualitative and quantitative determination and assay by advanced instruments and techniques.</li> </ul>
	2.2.3- Conduct research studies that add to the current knowledge.	B.3- Apply proper research tools to establish novel facts and solve new or existing analytical problems using scientific methods.	Plan a research in the research field	<ul style="list-style-type: none"> <li>• Design the protocol including the steps of work following the suitable timetable.</li> </ul>



	2.2.4- Formulate scientific papers.	B.4- Establish a good knowledge in writing and publishing research papers.	Integrate scientific results and write report following conducting research	Write scientific reports on the obtained results with conclusive significance.
	2.2.5- Assess hazards and risks in professional practice in his / her area of specialization.	B.5- Recognize possible hazards during work and how to deal with	Manage risks and hazards related to professional practical area	<ul style="list-style-type: none"> <li>Evaluate and manage hazards (chemical) throughout the whole practical work.</li> </ul>
	2.2.6- Plan to improve performance in the pharmaceutical area of interest.	B.6- Integrate the gained knowledge of analytical chemistry for assaying pharmaceuticals of complex nature and Design a laboratory protocol for a requested analytical issue .	Outline principles that should be followed in research to develop laboratory performance	Design the protocol including the steps of work following the suitable timetable.
	2.2.7- Take professional decisions and bears responsibility in wide array of pharmaceutical fields	B.7- Take professional decisions in the area of specialization.	Decide what to do with full responsibility in scientific research	<p>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.</p> <ul style="list-style-type: none"> <li>Suggest possible recommendations based on the outcome of the thesis and decide future plans.</li> </ul>

	2.2.8- Be creative and innovative	B.8- Show creativity in solving analytical problems.	Demonstrate creativity and innovation in modifying techniques and in utilization of various therapy.	<ul style="list-style-type: none"> <li>• Separation of samples by qualitative and quantitative determination and assay by advanced instruments and techniques.</li> </ul>
	2.2.9- Manage discussions and arguments based on evidence and logic.	B.9- Discuss different logical solutions for a given analytical problem	Outline principles that was used to solve different problems	<ul style="list-style-type: none"> <li>• Present the results periodically in seminars.</li> </ul>
Professional and Practical Skills	2.3.1- Master basic and modern professional skills in the area of specialization.	C.1- Recognize with personal command the recent laboratory techniques in Analytical Chemistry research.	Apply different techniques related to practical thesis work.	Identify different analytical techniques and methods used to assess parameters related to the subject under study.
	2.3.2- Write and critically evaluate professional reports.	C.2- Write with confidence reliable scientific reports in analytical chemistry field.	Use and evaluate practical data to write report	Summarize the thesis in an understandable Arabic language for non professionals. Write references in the required form (Thesis, Paper.....).
	2.3.3- Evaluate and develop methods and tools existing in the area of specialization.	C.3- Develop and assess novel methods of analysis.	Estimate laboratory techniques used in analytical chemistry. Develop methods of assay of various parameters.	Operate scientific instruments according to instructions. <ul style="list-style-type: none"> <li>• Separation of samples by qualitative and quantitative determination and assay by advanced instruments and techniques.</li> </ul>

	2.3.4- Properly use technological means in a better professional practice	C.4- Implement sophisticated analytical instruments for assay of analytes of complex nature.	Use IT skills in collecting information, presenting results and writing thesis	Use internet, journals, books and others thesis to get previous and recent information about the subject understudy. • Perform statistical analysis for the results. Present and describe the results graphically. Present the results periodically in seminars.
	2.3.5- Plan to improve professional practices and to improve the performance of other scholars	C.5- Set a plan for the improvement of professionals and researchers.	Improve laboratory techniques.	Modify methods for analysis of samples
General and Transferable Skills	2.4.1- Effective communication in its different forms	D.1- Interact effectively with patient and professionals.	Interact with health care professional.	Communicate with supervisors to discuss results.
	2.4.2- Efficiently use the information technologies ( IT) in improving the professional practices	D.2- Acquire computer skills such as internet, word processing, chemometric and kinetic softwares.	Use information technology in review and thesis preparation	Present the results periodically in seminars Demonstrate the thesis in a final power point presentation.
	2.4.3- Help others to learn and evaluate their performance.	D.3- Help your colleagues and coworkers to increase the quality of research.	Set rules for evaluation and judge others performance.	Discuss obtained results in comparison with pervious literatures.
	2.4.4- Self-assessment and continuous working.	D.4- Practice self assessment and continuous working in the field analytical chemistry.	Study independently and evaluate learning needs in analytical chemistry.	Continue self-learning throughout the experimental work and writing scientific papers.
	2.4.5- Use various sources to get information and knowledge.	D.5- Retrieve information from various sources in the field of analytical chemistry.	Use up-to-date information in analytical chemistry.	Use internet, journals, books and others thesis to get previous and recent information about the

				subject understudy.
	2.4.6- Work as a member and lead a team of workers	D.6- Work effectively as a member of team, and improve leadership skills.	Implement tasks as a member of a team.	Work effectively as a member of a team (e.g. Supervisors, various professionals and Technicians).
	2.4.7-Direct scientific meetings and to manage time effectively	D.7- Optimize work hours, and call for periodical scientific meetings.	Utilize time effectively to achieve goals	Organize the experimental work according to the designed protocol.