



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

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

**2017/2018**

# **Master Degree**

# Program Specification

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## Program Specification

### A- Basic Information

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

### B- Professional Information

#### 1- Program aims:

**Analytical Chemistry master's program** is a program aimed for the enhancement of skills of the chemists employed either in Industry or Research.

The broad objectives of the Program are:

1. To provide training in modern analytical techniques to the learners.
2. To provide appropriate theoretical background and develop practical skills for analyzing materials even in trace amounts using modern analytical methods and instruments.
3. To enable students acquire the analytical data and interpret using statistical principles.
4. 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.

5. To enable the students to conduct professionally and independently analysis of pharmaceutical compounds by different qualitative and quantitative methods.

**The Analytical Chemistry master's program graduates** can work in different profession fields such as Research & Development Laboratories, Educational and Research institutes, Analytical and Bio-analytical laboratories, Medical Centers, Hospitals, Universities, National Quality Control & assurance Centers, Pharmaceutical Industry and Ministry of Health. **The Analytical Chemistry master's program** is useful for all those Pharmacy Graduates who are aspiring to get employment in these labs.

### **Graduate Attributes:**

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

1. Have the basic knowledge for practice of analytical and bio-analytical chemistry.
2. Apply the fundamental and advanced professional skills for appropriate applications in the field of pharmaceutical industry and pharmaceutical products development. .
3. Use modern analytical techniques and improve method development skills.
4. Analysis data, evaluate information, solve practiced problems and develop troubleshooting skills.
5. Conduct research, construct experimental plans and write scientific reports.
6. Appreciate scientific integrity and ethical principles for professional practice in the area of expertise.

7. Improve continuous and self learning abilities.
8. Cooperate and work effectively with other team members.

## **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 basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry, physical chemistry and chemical kinetics.
- A.2- Recognize good practice principles and environmental samples analysis.
- A.3- Identify the major impact and applications of analytical chemistry in science, industries and environment.
- A.4- Describe the most advanced Instrumental techniques in analytical chemistry and their applications.
- A.5- Outline principles of drug design and development.
- A.6- Figure out drug stability features and kinetics chemistry.
- A.7- Comprehend the ethical issues related to drug analysis and conduct research.
- A.8- Demonstrate full commitment to good laboratory practice (GLP), good manufacture practice (GMP) and quality assurance in pharmaceutical and industrial analysis.
- A.9- Demonstrate full awareness of ethics in all aspects of analytical techniques.

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

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

- B.1- Analyze and interpret both quantitative and qualitative data obtained from analytical chemistry research in a specific and suitable form.
- B.2- Suggest the most appropriate analytical technique for analyzing the pharmaceutical or biological samples.
- B.3- Integrate the gained knowledge of analytical chemistry, for analysis analytes of complex nature.
- B.4- Write concrete reports on the obtained results with conclusive significances.
- B.5- Recognize possible hazards during work and how to deal with.
- B.6- Propose laboratory safety and proper use of analytical instruments.
- B.7- Design a laboratory protocol for a requested analytical issue.
- B.8- Assess problems encountered during analytical assay and make professional decisions.

### **2-3 – Professional and practical Skills:**

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

- C.1- Recognize with personal command the recent laboratory techniques and advanced analytical procedures.
- C.2- Write with confidence reliable scientific reports.
- C.3- Develop and assess novel methods of analysis.
- C.4- Develop advantageous analytical method over the existing traditional techniques.

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

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

- D.1- Interact effectively with patients, researchers 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 of pharmaceutical analysis and drug stability.
- D.4- Retrieve information from various sources required for drug analysis and drug design.
- D.5- Set rules for judging others chemists performance in the team.
- D.6- Work effectively as a team member.
- D.7- Acquire team leader skills for the future work.
- D.8- Handle working hours appropriately.
- D.9- Study independently and plan research studies.

### 3- Academic Standards:

- ARS (National Academic Reference Standards)

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

|                             | ARS                                                                                           | Program ILOs                                                                                                                                                                                   |
|-----------------------------|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Knowledge and Understanding | 2.1.1- Theories and fundamentals related to the field of learning as well as in related areas | A.1- Illustrate the basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry , physical chemistry and chemical kinetics.      |
|                             | 2.1.2- Mutual influence between professional practice and its impact on the environment.      | A.2- Recognize good practice principles and environmental samples analysis.<br>A.3- Identify the major impact and applications of analytical chemistry in science, industries and environment. |



|                     |                                                                                                                |                                                                                                                                                                                                                                          |
|---------------------|----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     | 2.1.3- Scientific developments in the area of specialization.                                                  | A.4- Describe the most advanced Instrumental techniques in analytical chemistry and their applications.<br>A.5- Understand principles of drug design and development.<br>A.6- Figure out drug stability features and kinetics chemistry. |
|                     | 2.1.4- Moral and legal principles for professional practice in the area of specialization.                     | A.7- Comprehend the ethical issues related to drug analysis and conduct research.                                                                                                                                                        |
|                     | 2.1.5- Principles and the basics of quality in professional practice in the area of specialization.            | A.8- Demonstrate full commitment to good laboratory practice (GLP), good manufacture practice (GMP) and quality assurance in pharmaceutical and industrial analysis.                                                                     |
|                     | 2.1.6- The fundamentals and ethics of scientific research.                                                     | A.9- Demonstrate full awareness of ethics in all aspects of analytical techniques.                                                                                                                                                       |
| Intellectual Skills | 2.2.1- Analyze and evaluate information in the field of specialization and analogies to solve problems         | B.1- Analyze and interpret both quantitative and qualitative data obtained from analytical chemistry research in a specific and suitable form.                                                                                           |
|                     | 2.2.2- Solve specified problems in the lack or missing of some information.                                    | B.2- Suggest the most appropriate analytical technique for analyzing the pharmaceutical or biological samples.                                                                                                                           |
|                     | 2.2.3- Correlate and integrate different pharmaceutical knowledge to solve professional problems.              | B.3- Integrate the gained knowledge of analytical chemistry, for analysis analytes of complex nature.                                                                                                                                    |
|                     | 2.2.4- Conduct research and write scientific report on research specified topics.                              | B.4- Write concrete reports on the obtained results with conclusive significances.                                                                                                                                                       |
|                     | 2.2.5- Evaluate and manage risks and potential hazards in professional practices in the area of specialization | B.5- Recognize possible hazards during work and how to deal with.<br>B.6- Propose laboratory safety and proper use of analytical instruments.                                                                                            |

|                                   |                                                                                   |                                                                                                                                             |
|-----------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
|                                   | 2.2.6- Plan to improve performance in the field of specialization.                | B.7- Design a laboratory protocol for a requested analytical issue.                                                                         |
|                                   | 2.2.7- Professional decision-making in the contexts of diverse disciplines.       | B.8-Assess problems encountered during analytical assay and make professional decisions.                                                    |
| Professional and Practical Skills | 2.3.1- Master basic and modern professional skills in the area of specialization. | C.1- Recognize with personal command the recent laboratory techniques and advanced analytical procedures.                                   |
|                                   | 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.<br>C.4- Develop advantageous analytical method over the existing traditional techniques. |
| General and Transferable Skills   | 2.4.1- Communicate effectively.                                                   | D.1- Interact effectively with patients, researchers 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 of pharmaceutical analysis and drug stability.                             |
|                                   | 2.4.4- Use variable sources to get information and knowledge.                     | D.4- Retrieve information from various sources required for drug analysis and drug design.                                                  |
|                                   | 2.4.5- Set criteria and parameters to evaluate the performance of others          | D.5- Set rules for judging others chemists performance in the team.                                                                         |
|                                   | 2.4.6- Work in a team and lead teams carrying out various professional tasks.     | D.6- Work effectively as a team member.<br>D.7- Acquire team leader skills for the future work.                                             |
|                                   | 2.4.7- Manage time effectively.                                                   | D.8- Handle working hours appropriately.                                                                                                    |
|                                   | 2.4.8- Continuous and self learning.                                              | D.9- Study independently and plan research studies.                                                                                         |

## 4-Curriculum Structure and Contents:

**Program duration:** 3- 5 years

### Program structure:

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

#### 1- Courses: General (1 year) and Special

##### No. of credit hours for program courses:

Compulsory: 12

Elective: (2x4) 8

Special: (3x4) 12

#### 2- Thesis: 30 hours

The candidate must complete a research project on an approved topic 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            | A5, D2,D4            |
| M101        | Advanced Instrumental Analysis | 4            | A1, A2, B1,D4        |

|      |                                                                       |    |                                                                                                             |
|------|-----------------------------------------------------------------------|----|-------------------------------------------------------------------------------------------------------------|
|      | & chromatography I                                                    |    |                                                                                                             |
| M106 | Physical chemistry                                                    | 4  | A1, A4, A6, B1, B3, D2, D5, D6                                                                              |
| ME3  | Elective A<br>Good practice for analysis of drugs and quality control | 4  | A2,A8,D6                                                                                                    |
| ME2  | Elective B<br>Drug Stability                                          | 4  | A6,D6                                                                                                       |
|      | Special Courses:                                                      |    |                                                                                                             |
| Asp1 | Potentiometry, voltammetry and electrochemical sensors                | 4  | A1, A3, B7, B8, D2, D5, D6, D7.                                                                             |
| Asp2 | Kinetic methods of analysis                                           | 4  | A1, A2, A6, A8, A9, B1, B2, D4, D5, D9.                                                                     |
| Asp3 | Spectrophotometry                                                     | 4  | A1, A3, B7, D4, D5, D6, D7.                                                                                 |
|      | Thesis                                                                | 30 | A1, A3, A4, A7, A8, A9, B1, B2, B3, B4, B5, B6, B7, B8, C1, C2, C3, C4, D1, D2, D3, D4, D5, D6, D7 ,D8, D9. |

## **5-Program admission requirements:**

### **General Admission Conditions**

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

### **Admission Conditions for M.Sc. degree**

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

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

The Faculty council is allowed, on consent of the concerned Departmental Board as well as Graduate Studies and Research Committee, to accept student for registration of M.Sc. degree if he has got a diploma from one of the Egyptian Universities in one of the pharmaceutical sciences fields, Faculties, or Institutes that are

recognized by the Supreme Council of Universities with a general grade of Good regardless his grades in bachelor degree.

Students should fulfill all the admission requirements stated by the concerned Departmental Board (ICDL certificate, local TOEFL certificate with a grade at least 450).

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

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

### **Regulations to complete the program:**

Conditions of granting the degree

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

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

### **Cancellation of Registration**

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

- Student's failure to pass course examinations for two times.
- Student's nonattendance or unsatisfactory progress (at least two annual reports) in research work being reported by the advisors and chief supervisor to the Departmental Board and

forwarded to the Graduate Studies and Research Committee recommendation for approval of cancellation.

- Dissertation refusal by the Jury Committee.
- Incapability of student to graduate by the deadlines indicated.

## 6- Admission Policy:

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

## 7-Student assessment methods:

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

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

|    |     |           |
|----|-----|-----------|
| C  | 2.5 | 70- < 75% |
| D+ | 2   | 65- < 70% |
| D  | 1.5 | 60- < 65% |

### 8-Failure in Courses:

Students who fail to get 60% (1 point)

### 9-Methods of program evaluation

| Evaluator                                            | Method                                   | Sample                                         |
|------------------------------------------------------|------------------------------------------|------------------------------------------------|
| <b>Internal evaluator:</b><br>Prof. Dr. Hesham Ezzat | Program evaluation<br>Courses evaluation | Program report<br>Courses report               |
| <b>External evaluator:</b><br>Prof. Dr. Gamal Saleh  | Program evaluation<br>Courses evaluation | Program report<br>Courses report               |
| <b>Others methods</b>                                | Matrix with ARS<br>Questionnaires        | The Matrix<br>Results of the<br>questionnaires |

**Program coordinator**

**Head of Department**

**Prof. Dr. Hisham Ezzat**

**Prof. Dr. Magda El-Henawy**

تم اعتماد توصيف البرنامج في مجلس القسم بتاريخ 2017 / 10



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

# Physical Chemistry

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## 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:

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

Title: **Physical Chemistry**

Code: M106

Lectures: 4 hrs/week

Credit hours: 4 hrs/week

Total: 4 hrs/week

### **2- Overall aim of the course:**

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

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

| <b>A- Knowledge and Understanding</b>     |                                                                                                                           |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <b>a1</b>                                 | Outline the principles of kinetics, catalysis, solutions and photochemistry                                               |
| <b>a2</b>                                 | Demonstrate the behavior and laws governing, photochemistry, solutions and chemical reactions and their applications.     |
| <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 chemistry principles in determining rates 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 of kinetics and rate of reactions</li></ul>           |
| 2                  | <ul style="list-style-type: none"><li>• Molecular and order of reaction.</li></ul>                         |
| 3                  | <ul style="list-style-type: none"><li>• Parallel and consecutive reactions.</li></ul>                      |
| 4                  | <ul style="list-style-type: none"><li>• Methods used for determination of the order of reactions</li></ul> |
| 5                  | <ul style="list-style-type: none"><li>• Theories of reaction rates and chain reaction</li></ul>            |
| 6                  | <ul style="list-style-type: none"><li>• Criteria of catalysis.</li></ul>                                   |
| 7                  | <ul style="list-style-type: none"><li>• Homogenous and enzyme catalysis</li></ul>                          |
| 8                  | <ul style="list-style-type: none"><li>• Heterogeneous catalysis</li></ul>                                  |

|    |                                                                                                                                                                                                        |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9  | <ul style="list-style-type: none"><li>• Nature of electrolytes in solution.</li></ul>                                                                                                                  |
| 10 | <ul style="list-style-type: none"><li>• Photochemistry and properties of electromagnetic radiations.</li></ul>                                                                                         |
| 11 | <ul style="list-style-type: none"><li>• Laws of photochemical process, quantum yield and chain reaction.</li></ul>                                                                                     |
| 12 | <ul style="list-style-type: none"><li>• Solutions:</li><li>• Principles and concentration and solubility.</li></ul>                                                                                    |
| 13 | <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> |
| 14 | <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>                                       |
| 15 | <ul style="list-style-type: none"><li>• Open discussion and revision</li></ul>                                                                                                                         |

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

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

### **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:**

| 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:**

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

**D- Websites/Journal:**

- Analytical Chemistry
- www.sciencedirect.com
- www.rsc.org

**Facilities required for teaching and learning:**

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

- **Course Coordinator: Prof Dr/ Wafaa Hassan**

**Prof Dr/ Mervat Hosny**

- **Head of Department: Prof. Dr. Magda El Henawee**

تم اعتماد توصيف المقرر في مجلس القسم بتاريخ 10 / 2017

| Matrix I of Physical Chemistry |                                                                |                             |    |                     |    |                                 |                |                |
|--------------------------------|----------------------------------------------------------------|-----------------------------|----|---------------------|----|---------------------------------|----------------|----------------|
| Course Contents                |                                                                | ILOs                        |    |                     |    |                                 |                |                |
|                                |                                                                | 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> |
| 1                              | • Introduction of kinetics and rate of reactions               | x                           |    |                     |    |                                 |                |                |
| 2                              | • Molecular and order of reaction.                             |                             |    | x                   |    |                                 |                |                |
| 3                              | • Parallel and consecutive reactions.                          |                             |    | x                   | x  |                                 |                |                |
| 4                              | • Methods used for determination of the order of reactions     | x                           |    |                     |    |                                 |                |                |
| 5                              | • Theories of reaction rates and chain reaction                |                             | x  |                     |    |                                 |                |                |
| 6                              | • Criteria of catalysis.                                       |                             | x  |                     |    |                                 |                |                |
| 7                              | • Homogenous and enzyme catalysis                              | x                           |    |                     |    |                                 |                |                |
| 8                              | • Heterogeneous catalysis                                      | x                           |    |                     |    | x                               | x              | x              |
| 9                              | • Nature of electrolytes in solution.                          | x                           |    |                     |    |                                 |                |                |
| 10                             | • Photochemistry and properties of electromagnetic radiations. |                             | x  |                     |    |                                 |                |                |

|    |                                                                                                                                                                                                     |   |   |  |  |   |   |   |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|--|--|---|---|---|
| 11 | <ul style="list-style-type: none"> <li>Laws of photochemical process, quantum yield and chain reaction.</li> </ul>                                                                                  |   | x |  |  |   |   |   |
| 12 | <ul style="list-style-type: none"> <li>Solutions:</li> <li>Principles and concentration and solubility.</li> </ul>                                                                                  |   | x |  |  |   |   |   |
| 13 | <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> |   | x |  |  |   |   |   |
| 14 | <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>                                     |   | x |  |  |   |   |   |
| 15 | <ul style="list-style-type: none"> <li>Open discussion and revision</li> </ul>                                                                                                                      | X |   |  |  | x | x | x |



## Matrix II of Physical Chemistry

| Matrix II of Physical Chemistry |                                                                                                |                                                                                                                                                                                          |             |                                                                                                                                                                                                                                                                                                                   |                                                |                               |               |                      |           |          |
|---------------------------------|------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------|---------------|----------------------|-----------|----------|
| ARS                             |                                                                                                | Program ILOs                                                                                                                                                                             | Course ILOs | Course contents                                                                                                                                                                                                                                                                                                   | Sources                                        | Teaching and learning methods |               | Method of assessment |           |          |
|                                 |                                                                                                |                                                                                                                                                                                          |             |                                                                                                                                                                                                                                                                                                                   |                                                | Lecture                       | Self learning | Written exam         | Oral Exam | Activity |
| 2.1                             | 2.1.1- Theories and fundamentals related to the field of learning as well as in related areas. | A.1- Illustrate the basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry, physical chemistry and chemical kinetics. | a1          | <ul style="list-style-type: none"> <li>• Introduction of kinetics and rate of reactions.</li> <li>• Methods used for determination of the order of reactions</li> <li>• Homogenous and enzyme catalysis</li> <li>• Heterogeneous catalysis</li> <li>• Nature of electrolytes in solution.</li> </ul>              | Textbooks, Scientific papers and self learning | x                             | X             | x                    | x         |          |
|                                 | 2.1.3- Scientific developments in the area of specialization.                                  | A.4- Describe the most advanced Instrumental techniques in analytical chemistry and their applications.<br><br>A.6- Figure out drug stability features and kinetics chemistry.           | a2          | <ul style="list-style-type: none"> <li>• Theories of reaction rates and chain reaction</li> <li>• Criteria of catalysis. Photochemistry and properties of electromagnetic radiations.</li> <li>• Laws of photochemical process, quantum yield and chain reaction. Solutions:</li> <li>• Principles and</li> </ul> |                                                |                               |               |                      |           |          |

|     |                                                                                                        |                                                                                                                                                |    |                                                                                                                                                                                                                                                                                                                                                           |                                                |   |   |   |   |  |
|-----|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---|---|---|---|--|
|     |                                                                                                        |                                                                                                                                                |    | concentration and solubility. Factors affecting solubility <ul style="list-style-type: none"> <li>• Solute-solvent interaction.</li> <li>• Solubility and temperature.</li> <li>• Effect of pressure on solubility.</li> <li>• Solutions of liquids in liquids</li> <li>• Solutions of solid in liquids (Colligative properties of solutions.)</li> </ul> |                                                |   |   |   |   |  |
| 2.2 | 2.2.1- Analyze and evaluate information in the field of specialization and analogies to solve problems | B.1- Analyze and interpret both quantitative and qualitative data obtained from analytical chemistry research in a specific and suitable form. | b1 | Units of measurements and dimensional analysis---Calculations with chemical formulas and equations.                                                                                                                                                                                                                                                       | Textbooks, Scientific papers and self learning | x | X | x | x |  |
|     | 2.2.3- Correlate and integrate different pharmaceutical knowledge to solve professional problems.      | B.3- Integrate the gained knowledge of analytical chemistry, for analysis analytes of complex nature.                                          | b2 | Calculations with chemical formulas and equations.                                                                                                                                                                                                                                                                                                        | Textbooks, Scientific papers and self learning | x | x | x | x |  |

|     |                                                                               |                                                                                                    |    |          |  |  |  |  |  |   |
|-----|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|----|----------|--|--|--|--|--|---|
| 2.4 | 2.4.2- Effectively use information technology in professional practices       | D.2- Acquire computer skills such as internet, word processing, chemometric and kinetic softwares. | d1 | Activity |  |  |  |  |  | X |
|     | 2.4.6- Work in a team and lead teams carrying out various professional tasks. | D.6- Work effectively as a team member.                                                            | d2 | Activity |  |  |  |  |  | x |
|     | 2.4.5- Set criteria and parameters to evaluate the performance of others      | D.5- Set rules for judging others chemists performance in the team.                                | d3 | Activity |  |  |  |  |  | x |

# Courses offered by other departments

# Drug Design

## Course specification of Drug Design

### Course specifications:

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

### 1- Basic information:

Title: **Drug Design**

Code: M109

Lectures: 4 hrs/week

Credit hours: 4 hrs/week

Total: 4 hrs/week

### 2- Overall aim of the course:

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

- outline principles of drug design, docking
- utilize combinatorial chemistry in synthesis of drugs.

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

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

### 4. Course Content of Drug Design

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

|    |                                                                     |
|----|---------------------------------------------------------------------|
| 12 | <b>Activity( Reports)</b>                                           |
| 13 | Applications of drug design ( self destruct drugs, peptidomimetics) |
| 14 | Applications of drug design ( targeting drugs)                      |
| 15 | Revision & Open Discussion                                          |

### **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 6-12 |
| <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> |
|--------------------------|--------------|-------------------|
| • 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:**

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:**

- **Head of Department:**

- **Date**

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| Matrix I of Drug Design |                                                                                                                             |                             |    |    |                     |                                 |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------|----|----|---------------------|---------------------------------|
| Course Contents         |                                                                                                                             | ILOs of Drug Design course  |    |    |                     |                                 |
|                         |                                                                                                                             | Knowledge and understanding |    |    | Intellectual skills | General and Transferable skills |
|                         |                                                                                                                             | a1                          | a2 | a3 | b1                  | d1                              |
| 1                       | Principles of drug design                                                                                                   | x                           |    |    |                     |                                 |
| 2                       | Combinatorial chemistry (combinatorial and parallel synthesis in medicinal chemistry projects)                              | x                           |    |    |                     |                                 |
| 3                       | Combinatorial chemistry (solid phase techniques)                                                                            | x                           |    |    |                     |                                 |
| 4                       | QSAR (hydrophobicity, electronic effects)                                                                                   |                             | x  |    |                     |                                 |
| 5                       | QSAR( steric factors, other physicochemical parameters)                                                                     |                             | x  |    |                     |                                 |
| 6                       | <b>Activity(Reports)</b>                                                                                                    |                             |    |    |                     | x                               |
| 7                       | Drug design and relationship of functional groups to biological activity (hydrophilic/ hydrophobic properties)              |                             | x  | x  |                     |                                 |
| 8                       | Drug design and relationship of functional groups to biological activity (resistance to chemical and enzymatic degradation) |                             | x  | x  |                     |                                 |
| 9                       | Relationship between molecular structure and biological activity                                                            |                             | x  | x  |                     |                                 |
| 10                      | Docking (Introduction)                                                                                                      |                             |    | x  |                     |                                 |
| 11                      | Docking (procedures)                                                                                                        |                             |    | x  |                     |                                 |
| 12                      | <b>Activity( Reports)</b>                                                                                                   |                             |    |    |                     | x                               |
| 13                      | Applications of drug design (self destruct drugs, peptidomimetics)                                                          |                             |    |    | x                   |                                 |
| 14                      | Applications of drug design (targeting drugs)                                                                               |                             |    |    | x                   |                                 |
| 15                      | Revision & Open Discussion                                                                                                  | x                           | x  | x  | x                   | x                               |

## Matrix II of Drug Design

| Matrix II of Drug Design |                                                                                                |                                                                                                                |             |                                                                                                                                                                    |                                                |                               |               |                       |           |            |
|--------------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------|---------------|-----------------------|-----------|------------|
| ARS                      |                                                                                                | Program ILOs                                                                                                   | Course ILOs | Course contents                                                                                                                                                    | Sources                                        | Teaching and learning methods |               | Methods of assessment |           |            |
|                          |                                                                                                |                                                                                                                |             |                                                                                                                                                                    |                                                | Lecture                       | Self learning | Written exam          | Oral exam | Activities |
| 2.1                      | 2.1.1- Theories and fundamentals related to the field of learning as well as in related areas. | A.1- Outline principles of drug design, docking and combinatorial chemistry.                                   | a1          | Principles of drug design.<br><br>Combinatorial chemistry                                                                                                          | Textbooks, Scientific papers and self learning | x                             | x             | x                     | x         |            |
|                          | 2.1.2- Mutual influence between professional practice and its impact on the environment.       | A.3- Describe applications of drug design and QSAR                                                             | a2          | QSAR<br>Drug design and relationship of functional groups to biological activity.<br>Relationship between molecular structure and biological activity.             | Textbooks, Scientific papers and self learning | x                             | x             | x                     | x         |            |
|                          | 2.1.3- Scientific developments in the area of specialization.                                  | A.5- Record the recent advances in the field of instrumental analysis, CADD, and advanced medicinal chemistry. | a3          | Drug design and relationship of functional groups to biological activity.<br>Relationship between molecular structure and biological activity.<br>Docking Activity | Textbooks, Scientific papers and self learning | x                             | x             | x                     | x         |            |

|     |                                                                                                  |                                                                                                                                     |    |                              |                                                |   |   |   |   |   |
|-----|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----|------------------------------|------------------------------------------------|---|---|---|---|---|
| 2.2 | 2.2.3-Correlate and integrate different pharmaceutical knowledge to solve professional problems. | B.3- Apply learnt knowledge to solve professional problems associated with drug design and synthesis.                               | b1 | Applications of drug design. | Textbooks, Scientific papers and self learning | x | x | x | x |   |
| 2.4 | 2.4.4- Use variable sources to get information and knowledge.                                    | D.4- Find information from a range of sources in the field of Drug synthesis and analysis and recent topics in medicinal chemistry. | d1 | Activity (Reports)           | Internet Textbooks                             |   | x |   |   | x |

# Advanced Instrumental Analysis & chromatography I

## **Course specification of Advanced Instrumental Analysis & chromatography I**

### **Course specifications:**

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

### **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
- describe new aspects of (HPLC), HPLC/Mass, Gas Chromatography (GC) and GC/Mass and their medicinal applications.

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

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

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

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

|    |                                                                                                |
|----|------------------------------------------------------------------------------------------------|
| 8  | HPLC & its medicinal and pharmaceutical application                                            |
| 9  | High performance thin layer chromatography (HPTLC).                                            |
| 10 | Advanced Gas chromatography.                                                                   |
| 11 | GC & its medicinal and pharmaceutical application                                              |
| 12 | New aspects of Supercritical fluid chromatography (SFC) and ion exchange chromatography (IEC). |
| 13 | Capillary electrophoresis(CE)                                                                  |
| 14 | Analytical application of dimeric and polymeric molecules.<br><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  |
|-------------------|------------|-------------|
| • 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.

• **Head of Department:**

• **Date:** تم اعتماد التوصيف بمجلس القسم بتاريخ

## Matrix I of Advanced Instrumental Analysis & chromatography I

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

### Matrix II of Advanced Instrumental Analysis & chromatography I

| ARS |                                                                                                | Program ILOs                                                                                  | Course ILOs | Course contents                                                                                                                                                                                                                                                                                                                                                                                              | Sources                                        | Teaching and learning methods |               | Method of assessment |           |            |
|-----|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------|---------------|----------------------|-----------|------------|
|     |                                                                                                |                                                                                               |             |                                                                                                                                                                                                                                                                                                                                                                                                              |                                                | Lecture                       | Self learning | Written exam         | Oral exam | Activities |
| 2.1 | 2.1.1- Theories and fundamentals related to the field of learning as well as in related areas. | A.2- Illustrate theories of Qualitative and Quantitative estimation of different formulations | a1          | Advanced Ultra-violet spectroscopy<br>New aspects of Vibrational spectroscopy (IR spectroscopy)<br>Application of Nuclear magnetic resonance (NMR)<br>Application of Mass spectrometry(MS)<br>Raman spectroscopy<br>Advanced HPLC<br>High performance liquid chromatography HPTLC<br>Advanced Gas chromatography<br>New aspects of Supercritical fluid chromatography (SFC)<br>Capillary electrophoresis(CE) | 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.4- Demonstrate applications of Quality control and Quality assurance that serves the community and patients. | a2 | Advanced Ultra-violet spectroscopy<br>New aspects of Vibrational spectroscopy (IR spectroscopy)<br>Application of Nuclear magnetic resonance (NMR)<br>Application of Mass spectrometry(MS)<br>Medicinal application of spectroscopy in diagnosis of diseases<br>Advanced HPLC & its medicinal and pharmaceutical application<br>Advanced GC & its medicinal and pharmaceutical application<br>New aspects of Supercritical fluid chromatography (SFC)<br>Capillary electrophoresis(CE)<br>Analytical application of dimeric and polymeric molecules. | Textbooks, Scientific papers and self learning | X | x | x | X |  |
|--|------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---|---|---|---|--|

|     |                                                                                                        |                                                                                                                                     |    |                                                                                                                                                                                                                                                                                                                                                                                            |                                                |   |   |   |   |   |
|-----|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---|---|---|---|---|
| 2.2 | 2.2.1- Analyze and evaluate information in the field of specialization and analogies to solve problems | B.1- Analyze and interpret data obtained from Instrumental analysis of different drugs in a specific and suitable form.             | b1 | Advanced Ultra-violet spectroscopy<br>New aspects of Vibrational spectroscopy (IR spectroscopy)<br>Application of Nuclear magnetic resonance (NMR)<br>Application of Mass spectrometry(MS)<br>Medicinal application of spectroscopy in diagnosis of diseases<br>Advanced HPLC & its medicinal and pharmaceutical application<br>Advanced GC & its medicinal and pharmaceutical application | 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- Find information from a range of sources in the field of Drug synthesis and analysis and recent topics in medicinal chemistry. | d1 | Activity (Reports)                                                                                                                                                                                                                                                                                                                                                                         | Internet Textbooks                             |   | x |   |   | x |

# Good practice for analysis of drugs and quality control

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

### **Course specifications:**

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

### **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

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

### 4. Course Content :

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



|    |                                             |
|----|---------------------------------------------|
| 10 | Radioimmune Assay                           |
| 11 | Electrophoresis                             |
| 12 | Advanced GC-MS chemistry<br><b>Activity</b> |
| 13 | Spectrodenistometric (TLC scanner)          |
| 14 | Forensic chemistry                          |
| 15 | Revision & Open Discussion                  |

### 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:**

| 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:**

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:**

- **Head of Department**

- **Date**

تم اعتماد توصيف المقرر بمجلس القسم بتاريخ

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

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

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

| ARS |                                                                                                | Program ILOs                                                                                                  | Course ILOs | Course contents                                                                                                                                                                                                                                                                   | Sources                                        | Teaching and learning methods |               | Method of assessment |           |            |
|-----|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------|---------------|----------------------|-----------|------------|
|     |                                                                                                |                                                                                                               |             |                                                                                                                                                                                                                                                                                   |                                                | Lecture                       | Self learning | Written exam         | Oral exam | Activities |
| 2.1 | 2.1.1- Theories and fundamentals related to the field of learning as well as in related areas. | A.2- Illustrate theories of Qualitative and Quantitative estimation of different formulations.                | a1          | Validation parameters in analysis<br>Application of quantitative analysis for different drugs<br>H <sup>1</sup> ,C <sup>13</sup> ,N <sup>15</sup> ,F <sup>19</sup> - NMR<br>Forensic chemistry<br>Spectrodenistometric (TLC scanner)<br>Advanced GC-MS Techniques                 | Textbooks, Scientific papers and self learning | X                             | x             | X                    | X         |            |
|     | 2.1.3- Scientific developments in the area of specialization                                   | A.5- Record the recent advances in the field of Instrumental analysis, CADD, and advanced medicinal chemistry | a2          | Application of quantitative analysis for different drugs<br>Applications of Spectrophotometric analysis for dosage forms<br>H1,C13,N15,F19 NMR<br>Advanced techniques in mass spectroscopy<br>Fluorimetric analysis<br>Radioimmune Assay<br>Electrophoresis<br>Forensic chemistry | 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.7- Identify the principles to ensure quality and Validation of analysis results.                                      | a3 | Spectrodenistometric (TLC scanner)<br>Atomic absorption<br>GC-MS Techniques<br>Validation parameters in analysis<br>Application of quantitative analysis<br>Quality control and how to minimize systemic errors.<br>Quality assurance and basic requirements of GMP | 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 data obtained from Instrumental analysis of different drugs in a specific and suitable form. | b1 | Quality control and how to minimize systemic error<br>Applications of Spectrophotometric analysis for dosage forms<br>Spectrodenistometric (TLC scanner)                                                                                                            | Textbooks, Scientific papers and self learning | X | x | X | X |  |
|     | 2.2.5- Evaluate and manage risks and potential hazards in professional practices in the area of specialization | B.6-Evaluate risks in experiments and techniques used during handling chemicals and deal with them effectively.         | b2 | Applications of Spectrophotometric analysis for dosage forms<br>Advanced techniques in mass spectroscopy<br>Atomic absorption<br>Fluorimetric analysis<br>$H^1, C^{13}, N^{15}, F^{19}$ - NMR                                                                       | Textbooks, Scientific papers and self learning | X | x | X | X |  |

|     |                                                                         |                                                                                                                                                                                       |    |                    |                    |  |   |  |  |  |   |
|-----|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|--------------------|--------------------|--|---|--|--|--|---|
| 2.4 | 2.4.2- Effectively use information technology in professional practices | D.2- Demonstrate appropriate information technology skills especially in the areas of word processing, internet communication , information retrieval and online literature searching | d1 | Activity (Reports) | Internet Textbooks |  | x |  |  |  | x |
|     | 2.4.4- Use variable sources to get information and knowledge.           | D.4- Find information from a range of sources in the field of Drug synthesis and analysis and recent topics in medicinal chemistry.                                                   | d2 | Activity (Reports) | Internet Textbooks |  | x |  |  |  | X |

# Drug Stability

## Course specification of Drug stability

### Course specifications:

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

### 1- Basic information:

Title: **Drug stability**  
Lectures: 4 hrs/week  
Total: 4 hrs/week

Code: Esp2  
Credit hours: 4 hrs/week

### 2- Overall aim of the course:

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



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

| <b>Knowledge and Understanding</b>     |                                                                                                                            |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| <b>a1</b>                              | Illustrate the principles drug stability                                                                                   |
| <b>a2</b>                              | Describe the regulations for drug stability program                                                                        |
| <b>a3</b>                              | Describe the methodologies for drug stability program                                                                      |
| <b>Intellectual skills</b>             |                                                                                                                            |
| <b>b1</b>                              | Suggest suitable stability 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>                              | Use computer skills to present information                                                                                 |
| <b>d2</b>                              | Collect information from a variety of sources                                                                              |

**4. Course Content of Drug stability (Master degree):**

| <b>Week number</b> | <b>Lecture content (4 hr/w)</b>                                                                                                  |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------|
| 1                  | <ul style="list-style-type: none"> <li>• Drug stability (Overview – importance)</li> </ul>                                       |
| 2                  | <ul style="list-style-type: none"> <li>• Stability regulations (overview)</li> </ul>                                             |
| 3                  | <ul style="list-style-type: none"> <li>• Critical regulatory requirements for a stability program</li> </ul>                     |
| 4                  | <ul style="list-style-type: none"> <li>• Global stability practices</li> </ul>                                                   |
| 5                  | <ul style="list-style-type: none"> <li>• Understanding and predicting pharmaceutical product shelf life</li> </ul>               |
| 6                  | <ul style="list-style-type: none"> <li>• Stability methodologies (overview)</li> </ul>                                           |
| 7                  | <ul style="list-style-type: none"> <li>• Development of stability indicating methods</li> <li>• <b>(Presentation)</b></li> </ul> |
| 8                  | <ul style="list-style-type: none"> <li>• Overview of USP-NF requirements for stability</li> </ul>                                |
| 9                  | <ul style="list-style-type: none"> <li>• Non chromatographic methods for stability program</li> </ul>                            |
| 10                 | <ul style="list-style-type: none"> <li>• Vibrational spectroscopic methods for quantitative analysis</li> </ul>                  |
| 11                 | <ul style="list-style-type: none"> <li>• Evaluation of stability data</li> </ul>                                                 |
| 12                 | <ul style="list-style-type: none"> <li>• Qualification, calibration and maintenance of stability chambers</li> </ul>             |
| 13                 | <ul style="list-style-type: none"> <li>• <b>Stability operation practices</b></li> </ul>                                         |
| 14                 | <ul style="list-style-type: none"> <li>• Stability studies in biologics</li> </ul>                                               |
| 15                 | <ul style="list-style-type: none"> <li>• Open discussion</li> <li>• <b>(Final Presentation)</b></li> </ul>                       |

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

- Lectures
- Self learning
- Open discussion
- Problem solving

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

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

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

Activities to assess: d1, d2

### **Assessment schedule:**

|                                     |           |
|-------------------------------------|-----------|
| <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:**

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

### **B- Suggested books:**

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

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

**Facilities required for teaching and learning:**

1. **For lectures:** Black (white) boards, data show.
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- **Course Coordinators:**
- **Head of Department:**
- **Date:** تم اعتماد التوصيف بمجلس القسم

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

| Matrix II of Drug stability |                                                                                                     |                                                                                                                                                                                                                                                  |             |                                                                                                                                                                                              |                                                |                               |               |                      |           |          |
|-----------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------|---------------|----------------------|-----------|----------|
| ARS                         |                                                                                                     | Program ILOs                                                                                                                                                                                                                                     | Course ILOs | Course contents                                                                                                                                                                              | Sources                                        | Teaching and learning methods |               | Method of assessment |           |          |
|                             |                                                                                                     |                                                                                                                                                                                                                                                  |             |                                                                                                                                                                                              |                                                | Lecture                       | Self learning | Written exam         | Oral Exam | Activity |
| 2.1                         | 2.1.3- Scientific developments in the area of specialization.                                       | A.8- Demonstrate the stability programs for pharmaceutical products and the latest regulations for stability testing and ability to predict the degradation pathways of a drug design a stabilization protocol and predict a product shelf-life. | a1          | Drug stability (Overview – importance)                                                                                                                                                       | Textbooks, Scientific papers and self learning | x                             | xx            | x                    | x         |          |
|                             |                                                                                                     |                                                                                                                                                                                                                                                  | a2          | Stability regulations (overview)<br>Critical regulatory requirements for a stability program<br>Global stability practices<br>Understanding and predicting pharmaceutical product shelf life | 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.11- Mention the legal aspects for professional practices.                                                                                                                                                                                      | a3          | Stability methodologies (overview)<br>Development of stability indicating methods<br>Overview of USP-NF requirements for stability                                                           | Textbooks, Scientific papers and self learning | x                             | X             | X                    | x         |          |

|     |                                                                                                        |                                                                                                                       |    |                                                                                                                                                                                                                                                                                                                                                             |                                                |   |   |   |   |  |
|-----|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---|---|---|---|--|
|     |                                                                                                        |                                                                                                                       |    | Non chromatographic methods for stability program<br>Vibrational spectroscopic methods for quantitative analysis<br>Evaluation of stability data<br>Qualification, calibration and maintenance of stability chambers<br>Qualification, calibration and maintenance of stability chambers<br>Stability operation practices<br>Stability studies in biologics |                                                |   |   |   |   |  |
|     | 2.2.1- Analyze and evaluate information in the field of specialization and analogies to solve problems | B.1- Analyze and interpret quantitative data obtained from pharmaceutical research in a specific and suitable form.   | b1 | Understanding and predicting pharmaceutical product shelf life                                                                                                                                                                                                                                                                                              | Textbooks, Scientific papers and self learning | x | x | x | x |  |
| 2.2 | 2.2.2- Solve specified problems in the lack or missing of some information.                            | B.2- Suggest significant solutions for pharmaceutical results and outcome errors based on a wide academic background. | b2 | Non chromatographic methods for stability program<br>Vibrational spectroscopic methods for quantitative analysis<br>Evaluation of stability data                                                                                                                                                                                                            | Textbooks, Scientific papers and self learning | x | x | x | x |  |

|     |                                                                         |                                                                                                                 |    |          |                                                 |  |   |  |  |   |
|-----|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|----|----------|-------------------------------------------------|--|---|--|--|---|
| 2.4 | 2.4.2- Effectively use information technology in professional practices | D.2- Acquire computer skills in analyzing results and presenting them.                                          | d1 | Activity | Textbooks , Scientific papers and self learning |  | x |  |  | X |
|     | 2.4.4- Use variable sources to get information and knowledge.           | D.4-Practice how to retrieve information from a variety of sources including libraries, databases and internet. | d2 | Activity | Textbooks , Scientific papers and self learning |  | x |  |  | x |

# Special Courses



# Potentiometry, Voltammetry and Electrochemical sensors

## Course specification of Potentiometry, Voltammetry and Electrochemical sensors

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

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

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

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

Code: Asp1

Lectures: 4 hrs/week

Credit hours: 4 hrs/week

Total: 4 hrs/week

### **2- Overall aim of the course:**

On completion of the course, the students should be able to outline principles and procedures of different potentiometric, ion selective and voltammetric methods of analysis, describe different types of electrochemical sensors and apply these techniques to analyze different analytes. Method development and validation will be covered as well.

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

| <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 in a team                                                                                    |
| <b>d<sub>3</sub></b>                      | Improve scientific brain storming and problem solving skills                                                  |

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

| <b>Week number</b> | <b>Content</b>                                                                |
|--------------------|-------------------------------------------------------------------------------|
| 1                  | Introduction to electrochemistry.                                             |
| 2                  | Potentionmetry:<br>Introduction<br>Principles of potentiometric measurements. |
| 3                  | Reference electrodes and Metallic indicator electrodes.                       |

|    |                                                                                      |
|----|--------------------------------------------------------------------------------------|
| 4  | Ion Selective Electrodes<br>Theory<br>Glass electrodes                               |
| 5  | Ion Selective Electrodes<br>Liquid membrane electrodes<br>Applications               |
| 6  | Ion Selective Electrodes<br>Solid state electrodes<br>Coated wire electrodes         |
| 7  | Applications of Potentiometry.                                                       |
| 8  | Voltammetry:<br>Introduction<br>Principles of voltammetric measurements.<br>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
- Assignments

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

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

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

Activity to assess: d1, d2 and d3

### **Assessment schedule:**

|                                     |         |
|-------------------------------------|---------|
| <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/Journals:**

Electrochemistry

Drug Testing and Analysis

Analytical Letters

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

تم اعتماد توصيف المقرر في مجلس القسم بتاريخ 10 / 2017

## Matrix I of Potentiometry, Voltammetry and Electrochemical sensors

| Course Contents |                                                                                         | ILOs                        |    |    |                     |    |                                 |                |                |
|-----------------|-----------------------------------------------------------------------------------------|-----------------------------|----|----|---------------------|----|---------------------------------|----------------|----------------|
|                 |                                                                                         | Knowledge and understanding |    |    | Intellectual skills |    | General and Transferable skills |                |                |
|                 |                                                                                         | a1                          | a2 | a3 | b1                  | b2 | d <sub>1</sub>                  | d <sub>2</sub> | d <sub>3</sub> |
| 1               | Introduction to electrochemistry                                                        | x                           |    |    |                     |    |                                 |                |                |
| 2               | Potentiometry:<br>*Introduction<br>*Principles of potentiometric measurements.          | x                           |    |    |                     |    |                                 |                |                |
| 3               | Reference electrodes and Metallic indicator electrodes.                                 |                             | x  |    |                     |    |                                 |                |                |
| 4               | Ion Selective Electrodes<br>*Theory<br>*Glass electrodes                                | x                           | x  |    |                     |    |                                 |                |                |
| 5               | Ion Selective Electrodes<br>*Liquid membrane electrodes<br>*Applications                |                             | x  | x  | x                   | x  |                                 |                |                |
| 6               | Ion Selective Electrodes<br>*Solid state electrodes<br>*Coated wire electrodes          |                             | x  |    |                     |    |                                 |                |                |
| 7               | Applications of Potentiometry .                                                         |                             |    | x  | x                   | x  |                                 |                |                |
| 8               | Voltammetry:<br>*Introduction<br>* Principles of voltammetric measurements.<br>Activity | x                           |    |    |                     |    | x                               | x              | x              |
| 9               | Voltammograms                                                                           | x                           |    |    |                     |    |                                 |                |                |
| 10              | Quantitative and Qualitative aspects of voltammetry                                     |                             |    | x  | x                   | x  |                                 |                |                |
| 11              | Voltammetric 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

| ARS |                                                                                                | Program ILOs                                                                                                                                                          | Course ILOs | Course contents                                                                                                                                                                                                                                                                 | Sources                                        | Teaching and learning methods |               | Method of assessment |           |          |
|-----|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------|---------------|----------------------|-----------|----------|
|     |                                                                                                |                                                                                                                                                                       |             |                                                                                                                                                                                                                                                                                 |                                                | lecture                       | self learning | written exam         | Oral Exam | Activity |
| 2.1 | 2.1.1- Theories and fundamentals related to the field of learning as well as in related areas. | A.1- Illustrate the basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry and physical chemistry. | a1          | Introduction to electrochemistry--<br>Potentionmetry:<br>Introduction and Principles of potentiometric measurements.--Ion Selective Electrodes:<br>Theory--Voltammetry:<br>Introduction and Principles of voltammetric measurements--<br>Voltammograms---Voltametric Techniques | Textbooks, Scientific papers and self learning | x                             | x             | x                    | x         |          |

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

|  |                                                                                      |                                                                                                    |    |                                                                                                                                                                                                                     |                                                |   |   |   |   |   |
|--|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---|---|---|---|---|
|  | 2.2.7- Professional decision-making in the contexts of diverse disciplines.          | B.8- Assess problems encountered during analytical assay and make professional decisions.          | b2 | Ion Selective Electrode: Applications---Applications of Potentiometry---Quantitative and Qualitative aspects of voltammetry----Quantitative voltammetric applications--- Characterization voltammetric applications | Textbooks, Scientific papers and self learning | x | x | x | x |   |
|  | <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 team member.<br>D.7- Acquire team leader skills for the future work.    | 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 chemists performance in the team.                                | d3 | Activity                                                                                                                                                                                                            |                                                |   |   |   |   | x |

# Kinetic methods of analysis

## Course specification of Kinetic methods of analysis

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

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

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

Title: **Kinetic methods of analysis**

Code: Asp2

Lectures: 4 hrs/week

Credit hours: 4 hrs/week

Total: 4 hrs/week

### **2- Overall aim of the course:**

On completion of the course, the students should be able to outline the principles of kinetics, reaction rates and factors affecting them, apply studied kinetic methods for determination of different pharmaceutical compounds and describe the analysis of kinetic results.

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

| <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>                                 | Enumerate different types of reaction order and the corresponding half-life law. Enumerate different types of reaction order and the corresponding half-life law. |
| <b>a4</b>                                 | Explain reaction mechanism according to different theories.                                                                                                       |
| <b>a5</b>                                 | Outline kinetic methods of analysis used in spectrophotometric analysis.                                                                                          |
| <b>B- Intellectual skills</b>             |                                                                                                                                                                   |
| <b>b<sub>1</sub></b>                      | Manipulate data, calculate reaction order and activation energy ,determine rate law and interpret kinetic results.                                                |
| <b>b<sub>2</sub></b>                      | Prove the rate law using different reaction mechanisms.                                                                                                           |
| <b>b<sub>3</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>○ Monitoring the progress of a reaction</li><li>○ Techniques for monitoring concentrations as a</li></ul> |

|   |                                                                                                                                                                                                                                                                                |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | function of time                                                                                                                                                                                                                                                               |
| 2 | <ul style="list-style-type: none"><li>○ Monitoring the progress of a reaction</li><li>○ Techniques for monitoring concentrations as a function of time</li></ul>                                                                                                               |
| 3 | <ul style="list-style-type: none"><li>○ Rate Law and its types</li></ul>                                                                                                                                                                                                       |
| 4 | <ul style="list-style-type: none"><li>○ Reaction order</li><li>○ zero and first order</li><li>○ second and third order</li><li>○ Pseudo-order reactions</li></ul>                                                                                                              |
| 5 | <ul style="list-style-type: none"><li>● Determination of rate law<ul style="list-style-type: none"><li>○ Isolation method</li><li>○ Initial rate method</li><li>○ Integrated rate law ( graphical plot)</li><li>○ Half-lives (equi-fractional part) method</li></ul></li></ul> |
| 6 | <ul style="list-style-type: none"><li>● Half-life time of different orders of reaction</li><li>○ Activity</li></ul>                                                                                                                                                            |
| 7 | <ul style="list-style-type: none"><li>● Molecularity of a reaction</li><li>● Reaction mechanisms</li><li>○ Steady state approximation “SSA”</li></ul>                                                                                                                          |
| 8 | <ul style="list-style-type: none"><li>○ The Lindemann-Hinshelwood mechanism for unimolecular reactions</li><li>○ Experimental deviation of Lindemann-Hinshelwood model</li></ul>                                                                                               |
| 9 | <ul style="list-style-type: none"><li>● Theories of reaction rate:<ul style="list-style-type: none"><li>○ Transition state theory</li><li>○ Collision theory</li></ul></li></ul>                                                                                               |

|    |                                                                                                                                                                                                                                                                                                       |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10 | <ul style="list-style-type: none"><li>• Catalysis type and mechanism<ul style="list-style-type: none"><li>○ Homogenous catalysts</li><li>○ Heterogenous catalysts</li></ul></li></ul>                                                                                                                 |
| 11 | <ul style="list-style-type: none"><li>• Activation energy (Ea)<ul style="list-style-type: none"><li>○ Maxwell–Boltzmann Distributions</li></ul></li></ul>                                                                                                                                             |
| 12 | <ul style="list-style-type: none"><li>• Relation between rate constant and Ea<ul style="list-style-type: none"><li>○ Arrhenius plot and calculation of Ea.</li></ul></li></ul>                                                                                                                        |
| 13 | <ul style="list-style-type: none"><li>• Kinetic spectrophotometric methods of analysis<ul style="list-style-type: none"><li>○ determination of reaction order</li></ul></li></ul>                                                                                                                     |
| 14 | <ul style="list-style-type: none"><li>○ Determination of drug concentration and the interpretation of kinetic results.<ul style="list-style-type: none"><li>✓ Initial rate method</li><li>✓ Rate constant method</li><li>✓ Fixed concentration method</li><li>✓ Fixed time method</li></ul></li></ul> |
| 15 | <ul style="list-style-type: none"><li>○ Open discussion and revision</li></ul>                                                                                                                                                                                                                        |

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

- Lectures
- Self learning
- Problem solving and brain storming
- Open discussion

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

Written exams to assess: a1, a2, a3, a4,a5, b1, b2,b3

Oral exam to assess: a1, a2, a3, a4,a5, b<sub>1</sub>, b<sub>2</sub>,b<sub>3</sub>

Activity to assess: d1,d2 and d3



**Assessment schedule:**

|                                     |         |
|-------------------------------------|---------|
| <b>Assessment (1):</b> Activity     | Week 6  |
| <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-Scientific papers****B- Essential books:**

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

**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: Prof. Dr. Magda El-Maamli**  
**Dr. Heba El-Sayed**
- **Head of Department: Prof. Dr. Magda El Henawee**
- **Date:**  
**تم اعتماد توصيف المقرر في مجلس القسم بتاريخ 2017 / 10**

| Matrix I of Kinetic methods of analysis |                                                                                                                                                                         |                             |    |    |    |    |                     |    |                                 |    |    |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----|----|----|----|---------------------|----|---------------------------------|----|----|
| Course Contents                         |                                                                                                                                                                         | ILOs                        |    |    |    |    |                     |    |                                 |    |    |
|                                         |                                                                                                                                                                         | Knowledge and understanding |    |    |    |    | Intellectual skills |    | General and Transferable Skills |    |    |
|                                         |                                                                                                                                                                         | a1                          | a2 | a3 | a4 | a5 | b1                  | b2 | d1                              | d2 | d3 |
| 1                                       | Mechanisms of chemical reactions                                                                                                                                        | X                           |    |    |    |    |                     |    |                                 |    |    |
| 2                                       | Rates of the reaction and their measurement                                                                                                                             | X                           |    |    |    |    |                     |    |                                 |    |    |
| 3                                       | zero and first order Reactions                                                                                                                                          | X                           |    |    |    |    |                     |    |                                 |    |    |
| 4                                       | second and third order reactions                                                                                                                                        | X                           |    |    |    |    |                     |    |                                 |    |    |
| 5                                       | Methods for the determination of the order of the reaction                                                                                                              | X                           |    |    |    |    |                     |    |                                 |    |    |
| 6                                       | Concentrations and Time: Half-Lives                                                                                                                                     | X                           |    |    |    |    |                     |    |                                 |    |    |
| 7                                       | Pseudo-order reactions                                                                                                                                                  | X                           |    |    |    |    |                     |    |                                 |    |    |
| 8                                       | Molecularity of a reaction<br>Activity                                                                                                                                  | X                           |    |    |    |    |                     |    | X                               | X  | X  |
| 9                                       | Collision theory                                                                                                                                                        | X                           |    |    |    |    |                     |    |                                 |    |    |
| 10                                      | Transition state theory                                                                                                                                                 | X                           |    |    |    |    |                     |    |                                 |    |    |
| 11                                      | Catalysis                                                                                                                                                               | X                           |    |    |    |    |                     |    |                                 |    |    |
| 12                                      | Kinetic methods of analysis and interpretation of kinetic results.                                                                                                      |                             | x  |    |    |    | x                   | X  |                                 |    |    |
| 13                                      | Activation energy (Ea),<br>Determination of rate constant and Ea (Arrhenius plot)                                                                                       |                             |    |    |    |    | x                   |    |                                 |    |    |
| 14                                      | The Quality of Analytical Measurements<br>Average run length: cusum charts<br>Proficiency testing schemes<br>Collaborative trials<br>Uncertainty<br>Acceptable sampling |                             |    | x  | x  | x  |                     |    |                                 |    |    |
| 15                                      | Open discussion and revision                                                                                                                                            | X                           | x  | x  | x  | x  | x                   | X  |                                 |    |    |

## Matrix II of Kinetic methods of analysis

| Matrix II of Kinetic methods of analysis |                                                                                                |                                                                                                                                                                                          |             |                                                                                                                                                                                                                                                                                                         |                                                |                               |               |                      |           |          |
|------------------------------------------|------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------|---------------|----------------------|-----------|----------|
| ARS                                      |                                                                                                | Program ILOs                                                                                                                                                                             | Course ILOs | Course contents                                                                                                                                                                                                                                                                                         | Sources                                        | Teaching and learning methods |               | Method of assessment |           |          |
|                                          |                                                                                                |                                                                                                                                                                                          |             |                                                                                                                                                                                                                                                                                                         |                                                | Lecture                       | Self learning | Written exam         | Oral Exam | Activity |
| 2.1                                      | 2.1.1- Theories and fundamentals related to the field of learning as well as in related areas. | A.1- Illustrate the basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry, physical chemistry and chemical kinetics. | a1          | Mechanisms of chemical reactions---Rates of the reaction and their measurement--Zero, First, Second and Third order of reaction---Methods for determining reaction order--- Conc. And Time---Pseudo order reaction---Molecularity of Reaction ---Collision Theory---Transition state theory---Catalysis | Textbooks, Scientific papers and self learning | x                             | x             | x                    | x         |          |
|                                          | 2.1.2- Mutual influence between professional practice and its impact on the environment.       | A.2- Recognize good practice principles and environmental samples analysis.                                                                                                              | 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.6- Figure out drug stability features and kinetics chemistry.                                                                                                      | a3 | Proficiency testing schemes<br>Collaborative trials<br>Uncertainty<br>Acceptable sampling                                                          | Textbooks,<br>Scientific papers and self learning | x | x | x | x |  |
|     | 2.1.5- Principles and the basics of quality in professional practice in the area of specialization.    | A.8- Demonstrate full commitment to good laboratory practice (GLP), good manufacture practice (GMP) and quality assurance in pharmaceutical and industrial analysis. | a4 | The Quality of Analytical Measurements                                                                                                             | Textbooks,<br>Scientific papers and self learning | x | x | x | x |  |
|     | 2.1.6- The fundamentals and ethics of scientific research.                                             | A.9- Demonstrate full awareness of ethics in all aspects of analytical techniques.                                                                                   | a5 | the Quality of Analytical Measurements                                                                                                             | Textbooks,<br>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,<br>Scientific papers and self learning | x | x | x | x |  |

|     |                                                                             |                                                                                                               |    |                                                                   |                                                |   |   |   |   |   |
|-----|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|----|-------------------------------------------------------------------|------------------------------------------------|---|---|---|---|---|
|     | 2.2.2- Solve specified problems in the lack or missing of some information. | B.2- Suggest the most appropriate analytical technique for assaying the pharmaceutical or biological samples. | b2 | Kinetic methods of analysis and interpretation of kinetic results | Textbooks, Scientific papers and self learning | x | x | x | x |   |
|     | 2.4.4- Use variable sources to get information and knowledge.               | D.4- Retrieve information from various sources in the field of analytical chemistry.                          | d1 | Activity                                                          |                                                |   |   |   |   | X |
| 2.4 | 2.4.7- Manage time effectively.                                             | D.8- Handle working hours appropriately.                                                                      | d2 | Activity                                                          |                                                |   |   |   |   | X |
|     | 2.4.8- Continuous and self learning.                                        | D.9- Study independently and plan research studies.                                                           | d3 | Activity                                                          |                                                |   |   |   |   | X |

# 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:

### 1- Basic information:

Title: **Spectrophotometry**

Code: Asp3

Lectures: 4 hrs/week

Credit hours: 4 hrs/week

Total: 4hrs/week

### 2- Overall aim of the course:

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



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

| <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.                                                                                   |
| <b>d<sub>2</sub></b>                      | Work effectively with other researchers and judge their work.                                                                                                     |
| <b>d<sub>3</sub></b>                      | Carry out responsibilities of either team leader or member.                                                                                                       |

### 4. Course Contents of Spectrophotometry:

| <b>Week number</b> | <b>Contents</b>                                                                                                                                            |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                  | Introduction to light absorption<br>Electromagnetic spectrum<br>Visible and ultraviolet spectra<br>The Beer-Lambert law<br>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<br>Baseline<br>Isosbestic points<br>Wavelength and absorbance calibration<br>Choice and use of cuvettes<br>Detailed examples                                                                                                                                               |
| 6  | Derivative spectrophotometry <ul style="list-style-type: none"><li>○ Introduction</li><li>○ Instrumentation</li><li>○ Practical Aspects</li><li>○ Applications</li></ul>                                                                                                                            |
| 7  | Recent spectrophotometric methods for multicomponent analysis <ul style="list-style-type: none"><li>○ Ratio subtraction method</li><li>○ Ratio difference method</li><li>○ Mean center method</li><li>○ Constant centering method</li><li>○ H-point method</li><li>○ Isoabsorptive method</li></ul> |
| 8  | Spectrophotometric assays<br>Introduction<br>Assay Design<br>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
- Critical thinking
- Cooperative assignments

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

Written exams to assess: a1, a2, b1

Oral exam to assess: a1, a2, b1

Activity to assess: d1, d2, d3

#### **Assessment schedule:**

|                                     |         |
|-------------------------------------|---------|
| <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/Journals:**

Spectrochemica Acta

Spectroscopy

Analytical Chemistry

[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-Henawee  
**Head of Department:** Prof. Dr. Magda El-Henawee
- **Date:**  
تم اعتماد توصيف المقرر في مجلس القسم بتاريخ 10 / 10 / 2017

| Matrix I of Spectrophotometry |                                                                         |                             |    |                     |                                 |    |    |
|-------------------------------|-------------------------------------------------------------------------|-----------------------------|----|---------------------|---------------------------------|----|----|
| Course Contents               |                                                                         | ILOs                        |    |                     |                                 |    |    |
|                               |                                                                         | Knowledge and Understanding |    | Intellectual skills | General and Transferable Skills |    |    |
|                               |                                                                         | a1                          | a2 | b1                  | d1                              | d2 | d3 |
| 1                             | Introduction to light absorption                                        | x                           |    |                     |                                 |    |    |
| 2                             | Spectra of some important naturally occurring chromophores              | x                           |    |                     |                                 |    |    |
| 3                             | Spectrophotometer configuration                                         | x                           |    |                     |                                 |    |    |
| 4                             | Choice of spectrophotometer operating conditions                        | x                           |    |                     |                                 |    |    |
| 5                             | Use of spectrophotometer                                                | x                           |    |                     |                                 |    |    |
| 6                             | Derivative spectrophotometry<br>*Introduction<br>*Instrumentation       | x                           |    |                     |                                 |    |    |
| 7                             | Derivative spectrophotometry<br>*Practical Aspects<br>*Applications     |                             | x  | x                   |                                 |    |    |
| 8                             | Spectrophotometric assays<br>*Introduction<br>*Assay Design<br>Activity |                             | x  | x                   | x                               |    |    |
| 9                             | Spectrophotometric assay of protein                                     |                             | x  | x                   |                                 |    |    |
| 10                            | Enzyme based spectrophotometric assay                                   |                             | x  | x                   |                                 |    |    |
| 11                            | Luminescence based assay                                                |                             | x  | x                   |                                 |    |    |
| 12                            | Flow-injection spectrophotometry                                        | x                           | x  | x                   |                                 |    |    |
| 13                            | Pharmaceutical and biological applications of spectrophotometry         |                             | x  | x                   |                                 |    |    |
| 14                            | Revision                                                                | x                           | x  | x                   |                                 |    |    |
| 15                            | Open discussion                                                         | x                           | x  | x                   |                                 | x  | x  |

| Matrix II of Spectrophotometry |                                                                                                |                                                                                                                                                                                          |             |                                                                                                                                                                                                                                                                                                                                      |                                                |                               |               |                      |           |          |
|--------------------------------|------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------|---------------|----------------------|-----------|----------|
| ARS                            |                                                                                                | Program ILOs                                                                                                                                                                             | Course ILOs | Course contents                                                                                                                                                                                                                                                                                                                      | Sources                                        | Teaching and learning methods |               | Method of assessment |           |          |
|                                |                                                                                                |                                                                                                                                                                                          |             |                                                                                                                                                                                                                                                                                                                                      |                                                | Lecture                       | Self learning | Written exam         | Oral Exam | Activity |
| 2.1                            | 2.1.1- Theories and fundamentals related to the field of learning as well as in related areas. | A.1- Illustrate the basics of analytical chemistry and related subjects including: instrumental analysis, spectrophotometry, electrochemistry, physical chemistry and kinetic chemistry. | a1          | Introduction to light absorption---Spectra of some important naturally occurring chromophores--<br>-Spectrophotometer configuration----Choice of spectrophotometer operating conditions---<br>Use of spectrophotometer--<br>--Derivative spectrophotometry<br>*Introduction and Instrumentation ----Flow-injection spectrophotometry | Textbooks, Scientific papers and self learning | x                             | x             | x                    | x         |          |

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

|     |                                                                    |                                                                                            |    |                                                                                                                                                                                                                                                                                                                            |                                                |   |   |   |   |   |
|-----|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---|---|---|---|---|
| 2.2 | 2.2.6- Plan to improve performance in the field of specialization. | B.7- Design a laboratory protocol for a requested analytical issue.                        | b1 | Derivative spectrophotometry<br>*Practical Aspects<br>*Applications----<br>Spectrophotometric assays---<br>Spectrophotometric assay of protein---Enzyme based spectrophotometric assay---Luminescence based assay---Flow-injection spectrophotometry---<br>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 required for drug analysis and drug design. | d1 | Activity                                                                                                                                                                                                                                                                                                                   |                                                |   |   |   |   | x |



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

# Thesis Specification

## Thesis of Master Degree

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

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

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

- Title: Master Thesis in Analytical chemistry
- Credit hours: 30 hrs

### **2- Overall aim of the thesis:**

**On completion of the thesis;** the students will be able to design a robust study to answer the research questions, identify and perform different analytical techniques and methods used for the experimental work according to the designed protocol, analyze results of the study in the light of prior knowledge and also draw conclusions about the contribution to knowledge by the study

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

| Knowledge and Understanding       |                                                                                                                        |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------|
| a1                                | Outline theoretical and advanced bases of analytical chemistry related to main objectives of the thesis                |
| a2                                | Determine the problem the thesis will handle in correlation with the community and surrounding environment             |
| a3                                | Explain clearly the principles of different and advanced qualitative and quantitative analytical techniques            |
| a4                                | Understand any legal aspects related to the thesis work.                                                               |
| a5                                | Demonstrate GLP and quality assurance related to practical work of the thesis                                          |
| a6                                | Identify and apply scientific experimental ethics.                                                                     |
| Intellectual skills               |                                                                                                                        |
| b1                                | Solve problems related to practical work by obtained quantitative data from the practical work                         |
| b2                                | Discuss professional problems and suggest solutions relay on different pharmaceutical knowledge and recent information |
| b3                                | Combine required specialties to manage the subject under study                                                         |
| b4                                | Integrate scientific results and write report following conducting research                                            |
| b5                                | Manage risks and hazards related to professional practical area                                                        |
| b6                                | Design a laboratory protocol for the work                                                                              |
| b7                                | Decide what to do with full responsibility in scientific research                                                      |
| Professional and practical skills |                                                                                                                        |
| c1                                | Apply different techniques related to practical thesis work.                                                           |
| c2                                | Use and evaluate practical data to write report                                                                        |

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

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

| Steps           | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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</p> |

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 | <p>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> |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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

- Self learning (Activities, Research....)
- Research group meetings
- Departmental seminars
- Critical thinking
- Problem solving

### **6- References:**

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

**Websites:** Pubmed, Sciencedirect, Wileyinterscience

**Other resources:** Faculty and University libraries

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

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

- 
- **Head of Department: Prof. Dr. Magda El-Henawee**

تم اعتماد توصيف الرسالة في مجلس القسم بتاريخ 2017 / 10

# **PhD Degree**



# Program Specification

## Program Specification

### A- Basic Information

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

### B- Professional Information

#### 1- Program aims:

The aim of the Ph.D. program in Analytical chemistry is to develop the skills of researchers to become professionals and leaders in scientific research, drug analysis and also educational field. Ph.D. students will be capable of making original contributions to the advancement of Analytical chemistry and related disciplines. Few formal courses are required for the Ph.D. degree. The purpose of advanced course work is to build on the foundation gained in undergraduate study to give additional depth in specialty areas of interest to individual students. Students select courses that will equip them for research of high quality, broaden their general background, and aid them in preparing for doctoral exams.

#### The broad objectives of the Program are:

1. To prepare training of trainers (TOT) team in advanced analytical and bioanalytical techniques.

2. To provide students with updated theories and practical skills for analyzing problematic pharmaceutical compounds.
3. To enable researchers to acquire, process and interpret the analytical data using recent and advanced softwares.
4. To advance the experience of students in the area quality by design and step by step industry troubleshooting.
5. To achieve good experience in the area of in analytical interferences such as drug degradation products, impurities and biological fluids endogenous components.
6. To enable students to recognize importance and rule of analytical chemistry in the field of pharmacokinetic studies.
7. To investigate new approaches in drug analysis such as green analytical chemistry.
8. To correlate actual pharmaceutical industry problems with drug analysis and characterization.
9. To teach Ph.D students how to apply for governmental and private grants, write updating reports for clients and pharmaceutical companies and negotiate with

**The Analytical Chemistry Ph.D. graduates** can work in a multidisciplinary profession fields such as Research & Development Laboratories, Educational and Research institutes, Analytical and Bio-analytical laboratories, Medical Centers, Hospitals, Universities, National Quality Control Centers, Pharmaceutical Industry, Ministry of Health, Drug Bioequivalence and Drug Bioavailability centers. Graduate students have an excellent chance to catch advanced positions such as group leaders and managers in these places.

## **Graduate Attributes:**

**Ph.D. graduates** should gain the mandatory attributes & cleverness in variety of Analytical Chemistry and related disciplines including the following:

1. Investigative skills and elevate analytical techniques to a high level.
2. Learn to use advanced analytical instrumentation.
3. Be prepared for industry-based learning.
4. Inculcate a problem solving approach by coordinating different analytical techniques.
5. Contribute to scientific heritage by publishing research in specialized journals for pharmaceutical analysis.
6. Perseverance and working under changing circumstances and with different team works.
7. Be able to manage a team of chemists and researchers.
8. Contribute in the future as a supervisor or co-advisor for graduate students.
9. Study the theoretical basis and areas of application for the most commonly used areas of high-sensitivity; highly selective instrumental separation science (chromatography) and the most widely used but diverse methods of detection of chemicals (spectroscopy).

## **2-Intended Learning Outcomes (ILOs):**

The Program provides outstanding opportunities for Ph.D students to reveal knowledge and understanding skills and successfully develop requirements for Advanced degree in Analytical chemistry.

## **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 with additional depth in advanced spectroscopic and chromatographic.

A.2- Have comprehensive knowledge and clear understanding of the theories and advancements in the field of analytical chemistry and related fields

A.3- Collaborate with different specializations needed to integrate the research approach used in the plan using chemometric analysis principles.

A.4- Describe the scientific research methodologies, ethics, and professional practice especially in the areas of Chemometry, Spectroscopy and Chromatography.

A.5- Provide proposals for research assumptions for the chromatographic analysis of pharmaceutical mixtures

A.6- Comprehend the ethical aspects required by professionals.

A.7- Demonstrate full commitment to good laboratory practice (GLP) , good manufacture practice (GMP), quality control, quality assurance, and quality by design.

A.8- Recognize the concepts and basics of laboratory safety and waste disposal.

A.9- Identify the beneficial impact and applications of analytical chemistry towards a safe environment.

A.10- Provide research ideas to solve problems for the environment.

A.11- Link the different parts to produce a general knowledge serve the research assumptions.

## **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- Evaluate the results and statistical analysis of the result with commitment to objectivity.
- B.3- Suggest the most appropriate analytical technique for assaying the pharmaceutical or biological samples.
- B.4- Solve the problems which obstacle to research plan and research results
- B.5- Apply proper research tools to establish novel facts and solve new or existing analytical problems using scientific methods.
- B.6- Establish a good knowledge in writing and publishing research articles.
- B.7- Recognize possible hazards and biohazards during conducting research and routine work and how to deal with them safely.
- B.8- Integrate the gained knowledge of analytical chemistry for assaying pharmaceuticals of complex nature and Design a laboratory protocol for a requested analytical issues.
- B.9- Take professional decisions in the area of specialization.
- B.10- Show creativity in solving analytical problems.
- B.11- Discuss different practical solutions for a given analytical problem.
- B.12-Justify the conclusions by providing the scientific evidences.

## **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- Accomplish advanced techniques and basic concepts of scientific research in pharmaceutical analytical chemistry.
- C.3- Write with confidence reliable scientific reports and conclusions in pharmaceutical analysis.
- C.4- Summarize and display the scientific research without compromising rigorous scientific content.
- C.5- Develop and assess novel methods of analysis of target analytes either in trace amounts.
- C.6- Implement sophisticated analytical instruments for assay of analytes in complex matrices and biological fluids.
- C.7- 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- Communicate with the groups participating in the research project.
- D.2- Acquire advanced computer skills and train on new softwares used for instrumentation and data processing.
- D.3- Help your colleagues and coworkers to increase the quality of research.
- D.4- Commit to scientific security and disseminate information and provide counsel and advice.
- D.5- Practice self assessment and continues working in the field analytical chemistry.
- D.6- Retrieve information from various sources in the field of analytical chemistry.

D.7- Work effectively as a member of team, and improve leadership skills.

Acquire the capacity to lead the team work

D.8- Arrange for periodical meetings and scientific talks.

D.9-Use work hours effectively and put different work plans for different circumstances.

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

- ARS (Academic Reference Standards)

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

|                             | ARS                                                                                                                                             | 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 with additional depth in advanced spectroscopic and chromatographic.<br>A.2- Have comprehensive knowledge and clear understanding of the theories and advancements in the field of analytical chemistry and related fields<br>A.3- Collaborate with different specializations needed to integrate the research approach used in the plan using chemometric analysis principles. |
|                             | 2.1.2- Fundamentals, methods, techniques, tools and ethics of scientific research                                                               | A.4- Describe the scientific research methodologies, ethics, and professional practice especially in the areas of Chemometry, Spectroscopy and Chromatography.<br>A.5- Provide proposals for research assumptions for the chromatographic analysis of pharmaceutical mixtures                                                                                                                                                                          |



|                     |                                                                                                                                                            |                                                                                                                                                                                                                                                                                 |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     | 2.1.3- The ethical and legal principles in pharmacy and academic practices                                                                                 | A.6- 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.7- Demonstrate full commitment to good laboratory practice (GLP) , good manufacture practice (GMP), quality control, quality assurance, and quality by design.<br>A.8- Recognize the concepts and basics of laboratory safety and waste disposal.                             |
|                     | 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.9- Identify the beneficial impact and applications of analytical chemistry towards a safe environment.<br>A.10- Provide research ideas to solve problems for the environment.<br>A.11-Link the different parts to produce a general knowledge serve the research assumptions. |
| 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.<br>B.2- Evaluate the results and statistical analysis of the result with commitment to objectivity.                                                                                                     |
|                     | 2.2.2- Propose solutions to specified problems in the light of the available data (information).                                                           | B.3- Suggest the most appropriate analytical technique for assaying the pharmaceutical or biological samples.<br>B.4- Solve the problems which obstacle to research plan and research results                                                                                   |
|                     | 2.2.3- Conduct research studies that add to the current knowledge.                                                                                         | B.5- 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.6- Establish a good knowledge in writing and publishing research articles.                                                                                                                                                                                                    |

|                                   |                                                                                                    |                                                                                                                                                                                                                                  |
|-----------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                   | 2.2.5- Assess hazards and risks in professional practice in his / her area of specialization.      | B.7- Recognize possible hazards and biohazards during conducting research and routine work and how to deal with them safely.                                                                                                     |
|                                   | 2.2.6- Plan to improve performance in the pharmaceutical area of interest.                         | B.8- Integrate the gained knowledge of analytical chemistry for assaying pharmaceuticals of complex nature and Design a laboratory protocol for a requested analytical issues.                                                   |
|                                   | 2.2.7- Take professional decisions and bears responsibility in wide array of pharmaceutical fields | B.9- Make professional decisions in the area of specialization.                                                                                                                                                                  |
|                                   | 2.2.8- Be creative and innovative                                                                  | B.10- Show creativity in solving analytical problems.                                                                                                                                                                            |
|                                   | 2.2.9- Manage discussions and arguments based on evidence and logic.                               | B.11- Discuss different practical solutions for a given analytical problem.<br>B.12-Justify the conclusions by providing the scientific evidences.                                                                               |
| 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.<br>C.2- Accomplish advanced techniques and basic concepts of scientific research in pharmaceutical analytical chemistry. |
|                                   | 2.3.2- Write and critically evaluate professional reports.                                         | C.3- Write with confidence reliable scientific reports and conclusions in pharmaceutical analysis.<br>C.4- Summarize and display the scientific research without compromising rigorous scientific content.                       |

|                                 |                                                                                                   |                                                                                                                                                                                |
|---------------------------------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| General and Transferable Skills | 2.3.3- Evaluate and develop methods and tools existing in the area of specialization.             | C.5- Develop and assess novel methods of analysis of target analytes either in trace amounts.                                                                                  |
|                                 | 2.3.4- Properly use technological means in a better professional practice                         | C.6- Implement sophisticated analytical instruments for assay of analytes in complex matrices and biological fluids.                                                           |
|                                 | 2.3.5- Plan to improve professional practices and to improve the performance of other scholars    | C.7- Set a plan for the improvement of professionals and researchers.                                                                                                          |
|                                 | 2.4.1- Effective communication in its different forms                                             | D.1- Communicate with the groups participating in the research project.                                                                                                        |
|                                 | 2.4.2- Efficiently use the information technologies ( IT) in improving the professional practices | D.2- Acquire advanced computer skills and train on new softwares used for instrumentation and data processing. .                                                               |
|                                 | 2.4.3- Help others to learn and evaluate their performance.                                       | D.3- Help your colleagues and coworkers to increase the quality of research.<br>D.4- Commit to scientific security and disseminate information and provide counsel and advice. |
|                                 | 2.4.4- Self-assessment and continuous working.                                                    | D.5- Practice self assessment and continues working in the field analytical chemistry.                                                                                         |
|                                 | 2.4.5- Use various sources to get information and knowledge.                                      | D.6- 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.7- Work effectively as a member of team, and improve leadership skills.<br>Acquire the capacity to lead the team work                                                        |

|  |                                                                 |                                                                                                                                                        |
|--|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | 2.4.7-Direct scientific meetings and to manage time effectively | D.8- Arrange for periodical meetings and scientific talks.<br>D.9-Use work hours effectively and put different work plans for different circumstances. |
|--|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|

#### 4-Curriculum Structure and Contents:

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

**b- Program structure:**

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

##### 1- Courses:

###### No. of credit hours for program courses:

Special: (3x4) 12

##### 2- Thesis: 30 hours

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

##### 3- General University Requirements: 10 credit hours

including:

a- TOEFL (500 units)

b- Computer course

### c-Program Curriculum:

| Course Code | Course Title                                  | Credit hours | Program ILOs Covered                                                                                                                        |
|-------------|-----------------------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------|
|             | Special Courses:                              |              |                                                                                                                                             |
| Asp4        | Chemometric Analysis                          | 4            | A2, A3, A6, A8, B1, B3, B9, B11, D2, D3, D5.                                                                                                |
| Asp5        | Advanced spectroscopy of Analytical chemistry | 4            | A1, A4, A9, A11, B3, B4, B8, B10, D6, D7, D8, D9.                                                                                           |
| Asp6        | Chromatographic Analysis of Pharmaceuticals   | 4            | A1, A2, A4, B3, B4, B7, B8, D2, D3, D4.                                                                                                     |
|             | Thesis                                        | 30           | A1, A4, A5, A6, A7, A8, A9, A10. B1, B2, B4, B5, B6, B7, B8, B9, B10, B11, B12, C1, C2, C3, C4, C5, C6, C7, D1, D2, D3, D5, D6, D7, D8, D9. |

### 5-Program admission requirements:

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

1. The applicants should be holders of Bachelor in Pharmaceutical Sciences from any Faculty of Pharmacy and also finish M.Sc. degree

affiliated to the Egyptian Universities affiliated to the Egyptian Supreme Council of Universities (ESCU).

2. Students should fulfill all the admission requirements stated by the concerned Departmental Board.

### **Regulations to complete the program:**

#### **Conditions of granting the degree**

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

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

#### **Cancellation of Registration**

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

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

Incapability of the student to graduate by the deadlines indicated

## 6- Admission Policy:

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

## 7-Student assessment methods:

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

| Grade Scale | Grade point average value (GPA) | Numerical scale |
|-------------|---------------------------------|-----------------|
| A+          | 5                               | ≥ 95%           |
| A           | 4.5                             | 90- < 95%       |
| B+          | 4                               | 85- < 90%       |
| B           | 3.5                             | 80- < 85%       |
| C+          | 3                               | 75- < 80%       |
| C           | 2.5                             | 70- < 75%       |
| D+          | 2                               | 65- < 70%       |
| D           | 1.5                             | 60- < 65%       |

**8-Failure in Courses:**

Students who fail to get 60% ( 1 point)

**9-Methods of program evaluation**

| <b>Evaluator</b>                                     | <b>Method</b>                            | <b>Sample</b>                                  |
|------------------------------------------------------|------------------------------------------|------------------------------------------------|
| <b>Internal evaluator:</b><br>Prof. Dr. Hisham Ezzat | Program evaluation<br>Courses evaluation | Program report<br>Courses report               |
| <b>External evaluator:</b><br>Prof. Dr. Gamal Saleh  | Program evaluation<br>Courses evaluation | Program report<br>Courses report               |
| <b>Others methods</b>                                | Matrix with ARS<br>Questionnaires        | The Matrix<br>Results of the<br>questionnaires |

**Program coordinator**

**Head of Department**

**Prof. Dr. Hisham Ezzat**

**Prof. Dr. Magda El-Henawee**

تم اعتماد توصيف البرنامج في مجلس القسم بتاريخ 2017 / 10



## Matrix of PhD program of Analytical chemistry

| Program Courses |                                             | Program intended learning outcomes |    |    |    |    |    |    |    |    |     |                     |    |    |    |    |    |    |    |    |    |     |     |                                   |    |    |    |    |    |    |                                 |    |    |    |    |    |    |    |    |    |
|-----------------|---------------------------------------------|------------------------------------|----|----|----|----|----|----|----|----|-----|---------------------|----|----|----|----|----|----|----|----|----|-----|-----|-----------------------------------|----|----|----|----|----|----|---------------------------------|----|----|----|----|----|----|----|----|----|
|                 |                                             | Knowledge and understanding        |    |    |    |    |    |    |    |    |     | Intellectual skills |    |    |    |    |    |    |    |    |    |     |     | Professional and practical skills |    |    |    |    |    |    | General and transferable skills |    |    |    |    |    |    |    |    |    |
|                 |                                             | A1                                 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | A11                 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 | B11 | B12                               | C1 | C2 | C3 | C4 | C5 | C6 | C7                              | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 |
| Special courses | Chemometric analysis                        |                                    | x  | x  |    |    | x  |    | x  |    |     | x                   |    | x  |    |    |    |    |    | x  |    | x   |     |                                   |    |    |    |    |    |    |                                 |    | x  | x  |    | x  |    |    |    |    |
|                 | advanced Spectroscopy                       | x                                  |    |    | x  |    |    |    | x  |    | x   |                     |    | x  | x  |    |    |    | x  |    | x  |     |     |                                   |    |    |    |    |    |    |                                 |    |    |    |    | X  | x  | x  | X  |    |
|                 | Chromatographic analysis of pharmaceuticals | x                                  | x  |    | x  |    |    |    |    |    |     |                     |    |    | x  | x  |    |    | x  | x  |    |     |     |                                   |    |    |    |    |    |    |                                 |    | x  | x  | x  |    |    |    |    |    |
| Thesis          |                                             | x                                  |    |    | x  | x  | x  | x  | x  | x  |     | x                   | x  |    | x  | x  | x  | x  | x  | x  | x  | x   | x   | x                                 | x  | x  | x  | x  | x  | x  | x                               | x  | x  | x  | x  | X  | x  | x  | x  | X  |

# Chemometric Analysis

## Course specification of Chemometric Analysis

### A- Course specifications:

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

### 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><br>Randomization and blocking<br>Two-way ANOVA<br>Latin squares and other designs<br>Interactions |

|   |                                                                                                                                                                                                                                                                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <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> <p>Curve fitting</p> <p>Outliers in regression</p>                                                                                         |

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

|    | Activity                                                                                                                                                                                                                                                                                                                                        |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9  | <b>Errors in quantitative analysis</b>                                                                                                                                                                                                                                                                                                          |
| 10 | <b>Statistics of Repeated Measurements</b><br>Mean and standard deviation<br>The distribution of repeated measurements<br>The sampling distribution of the mean<br>Confidence limits of the mean for large samples<br>Presentation of results<br>Confidence limits of the geometric mean for a log-normal distribution<br>Propagation of errors |
| 11 | <b>Significance Tests</b><br>Comparison of an experimental mean with a known value<br>Comparison of two experimental means<br>Paired t-test<br>One-sided and two-sided tests<br>F-test for the comparison of standard deviations<br>Outliers<br>Analysis of variance                                                                            |
| 12 | <b>Significance Tests</b><br>Comparison of several means<br>The arithmetic of ANOVA calculations<br>The chi-squared test<br>Testing for normality of distribution                                                                                                                                                                               |
| 13 | <b>The Quality of Analytical Measurements</b><br>Sampling<br>Separation and estimation of variances using ANOVA                                                                                                                                                                                                                                 |

|    |                                                                                                                                                                                |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | Quality control methods<br>Stewhart charts<br>Establishing the process capability                                                                                              |
| 14 | <b>The Quality of Analytical Measurements</b><br>Average run length: cusum charts<br>Proficiency testing schemes<br>Collaborative trials<br>Uncertainty<br>Acceptable sampling |
| 15 | <b>Revision and open discussion</b>                                                                                                                                            |

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

- Lectures
- Self learning
- Open discussion
- Cooperative learning
- Problem solving

### **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 |
| <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-Scientific papers**

**B: Books:** Statistics for the Quality Control Laboratory, Mullins, E., (RSC, 2003).

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

### **C- Websites:**

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

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

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

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

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

- 
- **Course Coordinators: Prof Dr. Hanaa Salah**

**Prof. Dr. Hisham Ezzat**

- **Head of Department: Prof. Dr. Magda El-Henawee**
- **Date:**

تم اعتماد توصيف المقرر في مجلس القسم بتاريخ 10 / 2017

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

## Matrix II of Chemometric Analysis

| ARS |                                                                                                                                                 | Program ILOs                                                                                                                                                                                                                                                                                           | Course ILOs | Course contents                      | Sources                                        | Teaching and learning methods |               | Method of assessment |           |          |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------------------|------------------------------------------------|-------------------------------|---------------|----------------------|-----------|----------|
|     |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                        |             |                                      |                                                | Lecture                       | Self learning | Written exam         | Oral Exam | Activity |
| 2.1 | 2.1.1- Fundamental and in-depth knowledge and basic theories in the field of specialty and the closely related areas of pharmaceutical sciences | A.2-Have comprehensive knowledge and clear understanding of the theories and advancements in the field of analytical chemistry and related fields<br>A.3- Collaborate with different specializations needed to integrate the research approach used in the plan using chemometric analysis principles. | a1          | Experimental Design and Optimization | Textbooks, Scientific papers and self learning | x                             | x             | x                    | x         |          |

|     |                                                                                                                                       |                                                                                 |    |                                                                                             |                                                |   |   |   |   |  |
|-----|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----|---------------------------------------------------------------------------------------------|------------------------------------------------|---|---|---|---|--|
| 2.2 | 2.1.3- The ethical and legal principles in pharmacy and academic practices                                                            | A.6- 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.8- Recognize the concepts and basics of laboratory safety and waste disposal. | a3 | The Quality of Analytical Measurements                                                      | Textbooks, Scientific papers and self learning | x | x | x | x |  |
|     | 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.3- 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.9- Make 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.11- Discuss different practical 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                         | D.2- Acquire advanced computer skills and train on new softwares used                                         | d1 | Activity                                                                           |                                                |   |   |   |   | x |

|  |                                                             |                                                                                        |    |          |  |  |  |  |  |   |
|--|-------------------------------------------------------------|----------------------------------------------------------------------------------------|----|----------|--|--|--|--|--|---|
|  | professional practices                                      | for instrumentation and data processing.                                               |    |          |  |  |  |  |  |   |
|  | 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.5- 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:

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

Title: **Advanced Spectroscopy of Analytical Chemistry**

Code: Asp5

Lectures: 4 hrs/week

Credit hours: 4 hrs/week

Total: 4 hrs/week

### **2- Overall aim of the course:**

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



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

| <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 based on previous published and gained information.                      |
| <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><br>Introduction<br>Theory     |
| 2                  | <b>Classification of spectroscopic techniques</b> |

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

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

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

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

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

Written exams to assess: a1, a2, a3, b1, b2, 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> |
|--------------------------|--------------|-------------------|
| • 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/Journals:**

Rapid Communications in Mass Spectrometry

Spectrochimica Acta

Pharmaceutical and Biomedical Analysis

[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. Mervat Hosny
- **Head of Department:** Prof. Dr. Magda El-Henawee
- **Date:**

تم اعتماد توصيف المقرر في مجلس القسم بتاريخ 2017 / 10

## Matrix I of Advanced Spectroscopy of Analytical Chemistry

| Course Contents |                                                                                         | ILOs                        |    |    |                     |    |    |                                 |    |    |
|-----------------|-----------------------------------------------------------------------------------------|-----------------------------|----|----|---------------------|----|----|---------------------------------|----|----|
|                 |                                                                                         | Knowledge and understanding |    |    | Intellectual skills |    |    | General and Transferable Skills |    |    |
|                 |                                                                                         | a1                          | a2 | a3 | b1                  | b2 | 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<br>*Absorption of Energy *Resonance | x                           |    |    |                     |    |    |                                 |    |    |
| 5               | NMR: *Chemical shift *Local diamagnetic shielding *Spin-spin splitting                  | x                           |    |    |                     |    |    |                                 |    |    |
| 6               | Typical <sup>1</sup> H NMR absorptions by type of compound                              | x                           |    |    |                     |    |    |                                 |    |    |
| 7               | Carbon – <sup>13</sup> C 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<br>*Detection and Quantification                      |                             | x  |    | x                   |    |    |                                 |    |    |
| 11              | MS/MS: *Introduction *Scan modes<br>*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

| ARS |                                                                                                                                                    | Program ILOs                                                                                                                                | Course ILOs | Course contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Sources                                        | Teaching and learning methods |               | Method of assessment |           |          |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------|---------------|----------------------|-----------|----------|
|     |                                                                                                                                                    |                                                                                                                                             |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                | Lecture                       | Self learning | Written exam         | Oral Exam | Activity |
| 2.1 | 2.1.1-<br>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 with additional depth in advanced spectroscopic and chromatographic. | a1          | Spectroscopy *Introduction<br>*Theory<br>Classification of spectroscopic techniques<br>NMR : *Principals *Vector Model *Nuclear spin states<br>*Nuclear magnetic moments<br>*Absorption of Energy<br>*Resonance *Chemical shift<br>*Local diamagnetic shielding<br>*Spin-spin splitting<br>Typical <sup>1</sup> H NMR absorptions by type of compound --Carbon – <sup>13</sup> C spectra, including heteronuclear coupling with other nuclei--<br>Mass Spectrometry: *Principle<br>*Mass spectrometer *Sample introduction *Ionization methods | Textbooks, Scientific papers and self learning | X                             | x             | x                    | x         |          |

|  |                                                                                                                                                            |                                                                                                                                                                                                          |    |                                                                                                                              |                                                |   |   |   |   |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---|---|---|---|--|
|  | 2.1.2- Fundamentals, methods, techniques, tools and ethics of scientific research                                                                          | A.4- Describe the scientific research methodologies, ethics, and professional practice especially in the areas of Chemometry, Spectroscopy and Chromatography.                                           | a2 | *Mass Spectrometry: Detection and Quantification<br>*MS/MS: Reactions studied<br>*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 conservation and development | A.9- Identify the beneficial impact and applications of analytical chemistry towards a safe environment.<br>A.11-Link the different parts to produce a general knowledge serve the research assumptions. | a3 | MS/MS: Applications<br>*Mass spectrometry/ Chromatography coupling                                                           | 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.3- Suggest the most appropriate analytical technique for assaying the pharmaceutical or biological<br>B.4- Solve the problems which obstacle to research plan and results    | b1 | *Mass Spectrometry: Detection and Quantification<br>*MS/MS: Reactions studied<br>*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.8- Integrate the gained knowledge of analytical chemistry for assaying pharmaceuticals of complex nature and Design a laboratory protocol for a requested analytical issues. | b2 | MS/MS: Applications<br>*Mass spectrometry/ Chromatography coupling                                                           | Textbooks, Scientific papers and self learning | X | x | x | x |  |
|     | 2.2.8- Be creative and innovative                                                                | B.10- Show creativity in solving analytical problems.                                                                                                                          | b3 | MS/MS: Applications<br>*Mass spectrometry/ Chromatography coupling                                                           | Textbooks, Scientific papers and               | X | x | x | x |  |

|     |                                                                 |                                                                                                                                                        |    |          | self learning |  |  |  |  |   |
|-----|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|---------------|--|--|--|--|---|
| 2.4 | 2.4.5- Use various sources to get information and knowledge.    | D.6- 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.7- Work effectively as a member of team, and improve leadership skills.<br>Acquire the capacity to lead the team work                                | d2 | Activity |               |  |  |  |  | X |
|     | 2.4.7-Direct scientific meetings and to manage time effectively | D.8- Arrange for periodical meetings and scientific talks.<br>D.9-Use work hours effectively and put different work plans for different circumstances. | 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:

### **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>b<sub>1</sub></b>                      | Assess the problems encountered during analytical procedures.                                                                                                                          |
| <b>b<sub>2</sub></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.                                                                                               |
| <b>d3</b>                                 | Successfully work with other team members and other research group.                                                                                                                    |

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

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

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

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

|    |                                                                                                                          |
|----|--------------------------------------------------------------------------------------------------------------------------|
|    | Problems and applications                                                                                                |
| 13 | <b>Planar chromatography</b><br>Introduction<br>Materials and techniques<br>Detection<br>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
- Practical problem solving
- Troubleshooting

### 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:**

| 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-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/Journals:**

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

Journal of Chromatography A and B

Chromatographia

Journal of Liquid Chromatography

[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.

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

**Date:**

تم اعتماد توصيف المقرر في مجلس القسم بتاريخ 10 / 10 / 2017

| Matrix I of Chromatographic Analysis of Pharmaceuticals |                                                                                                                                                                                               |                             |    |                     |    |    |                                 |    |    |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----|---------------------|----|----|---------------------------------|----|----|
| Course Contents                                         |                                                                                                                                                                                               | ILOs                        |    |                     |    |    |                                 |    |    |
|                                                         |                                                                                                                                                                                               | Knowledge and understanding |    | Intellectual skills |    |    | General and transferable Skills |    |    |
|                                                         |                                                                                                                                                                                               | a1                          | a2 | b1                  | b2 | b3 | d1                              | d2 | d3 |
| 1                                                       | General aspects of chromatography:*General concept of analytical chromatography *The chromatogram *Column efficiency *Retention parameters                                                    | x                           |    |                     |    |    |                                 |    |    |
| 2                                                       | General aspects of chromatography:<br>*Optimization of chromatographic analysis<br>*Classification of analytical techniques.<br>*Problems *Safety Measures all through the analytical process | x                           | X  | x                   | x  | x  |                                 |    |    |
| 3                                                       | GC *Components of GC installation *Carrier gas and flow regulation. *Sample introduction and the injection chamber<br>*Thermostatically controlled oven *Columns<br>*Stationary Phases        | x                           |    |                     |    |    |                                 |    |    |
| 4                                                       | GC: *Principal gas chromatographic detectors. *Retention indexes and stationary phase constants *problems and applications                                                                    | x                           | X  | x                   |    | x  |                                 |    |    |
| 5                                                       | HPLC: *The beginnings of HPLC *General concept of HPLC system *Pumps and gradient elution *Injectors *Columns                                                                                 | x                           |    |                     |    |    |                                 |    |    |
| 6                                                       | HPLC: *Stationary phases *Mobile phases<br>*Paired ion chromatography *Principal detectors *Applications and problems                                                                         | x                           | X  | x                   |    | x  |                                 |    |    |
| 7                                                       | Ion chromatography *Basics of ion chromatography *Stationary phases *Mobile phases *Conductivity detectors                                                                                    | x                           |    |                     |    |    |                                 |    |    |
| 8                                                       | Ion Chromatography: * Areas of the peaks and data treatment *External standard method *Internal standard method<br>*Problems and applications<br>Activity                                     | x                           | x  | X                   |    | x  | x                               | x  | x  |

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

| Matrix II of Chromatographic Analysis of Pharmaceuticals |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                  |             |                                                                                                                                                                            |                                                |                               |               |                      |           |          |
|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------|---------------|----------------------|-----------|----------|
| ARS                                                      |                                                                                                                                                 | Program ILOs                                                                                                                                                                                                                                                                                     | Course ILOs | Course contents                                                                                                                                                            | Sources                                        | Teaching and learning methods |               | Method of assessment |           |          |
|                                                          |                                                                                                                                                 |                                                                                                                                                                                                                                                                                                  |             |                                                                                                                                                                            |                                                | Lecture                       | Self learning | Written exam         | Oral Exam | Activity |
| 2.1                                                      | 2.1.1- 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 with additional depth in advanced spectroscopic and chromatographic.<br>A.2-Have comprehensive knowledge and clear understanding of the theories and advancements in the field of analytical chemistry and related fields | a1          | General aspects of chromatography---GC---HPLC--<br>-Ion Chromatography---TLC---<br>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.4- Describe the scientific research methodologies, ethics, and professional practice especially in the areas of Chemometry, Spectroscopy and Chromatography.                                | a2 | General aspects of chromatography---GC---HPLC--<br>-Ion Chromatography---TLC----<br>SEC---Capillary electrophoresis and electrochromatography---<br>Planar Chromatography<br><b>(Problems and Applications)</b> | Textbooks,<br>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.3- Suggest the most appropriate analytical technique for assaying the pharmaceutical or biological samples.<br>B.4- Solve the problems which obstacle to research plan and research results | b1 | General aspects of chromatography---GC---HPLC--<br>-Ion Chromatography---TLC----<br>SEC---Capillary electrophoresis and electrochromatography---<br>Planar Chromatography<br><b>(Problems and Applications)</b> | Textbooks,<br>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.7- Recognize possible hazards and biohazards during conducting research and routine work and how to deal with them safely.                                                   | b2 | Safety Measures all through analytical process                                                                                                                                                                  |                                                   |   |   |   | x |  |
|  | 2.2.6- Plan to improve performance in the pharmaceutical area of interest.                    | B.8- Integrate the gained knowledge of analytical chemistry for assaying pharmaceuticals of complex nature and Design a laboratory protocol for a requested analytical issues. | b3 | General aspects of chromatography---GC---HPLC--<br>-Ion Chromatography---TLC----<br>SEC---Capillary electrophoresis and electrochromatography---<br>Planar Chromatography<br><b>(Problems and Applications)</b> | Textbooks,<br>Scientific papers and self learning | x | x | x | x |  |

|     |                                                                                                          |                                                                                                                                                                                |    |          |  |  |  |  |  |   |
|-----|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----------|--|--|--|--|--|---|
|     | 2.4<br>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 |
|     | 2.4.3- Help others to learn and evaluate their performance.                                              | D.3- Help your colleagues and coworkers to increase the quality of research.<br>D.4- Commit to scientific security and disseminate information and provide counsel and advice. | d2 | Activity |  |  |  |  |  | X |
| 2.4 | 2.4.1- Effective communication in its different forms                                                    | D.1- Communicate with the groups participating in the research project.                                                                                                        | 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:**

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

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

| Knowledge and Understanding       |                                                                                                                 |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------|
| a1                                | Outline different principles of analytical chemistry and their possible application in the research study       |
| a2                                | Demonstrate methods and techniques used during working in the area of specialization of research                |
| a3                                | Understand the legal aspects of for professional and academic practices                                         |
| a4                                | Illustrate the importance of quality assurance during the analysis of different drugs                           |
| a5                                | Define different practices that can be used in understanding the problem of the research and help in solving it |
| Intellectual skills               |                                                                                                                 |
| b1                                | Solve problems related to practical work by obtained quantitative data from the practical work                  |
| b2                                | Discuss professional problems and suggest solutions rely on knowledge and recent information                    |
| b3                                | Plan a research in the research field                                                                           |
| b4                                | Integrate scientific results and write report following conducting research                                     |
| b5                                | Manage risks and hazards related to professional practical area                                                 |
| b6                                | Outline principles that should be followed in research to develop laboratory performance                        |
| b7                                | Decide what to do with full responsibility in scientific research                                               |
| b8                                | Demonstrate creativity and innovation in modifying techniques and in utilization of various therapy.            |
| Professional and practical skills |                                                                                                                 |

|                                        |                                                                                                                |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------|
| c1                                     | Apply different techniques related to practical thesis work.                                                   |
| c2                                     | Use and evaluate practical data to write report                                                                |
| c3                                     | Estimate laboratory techniques used in analytical chemistry.<br>Develop methods of assay of various parameters |
| c4                                     | Use IT skills in collecting information, presenting results and writing thesis                                 |
| c5                                     | Improve laboratory techniques.                                                                                 |
| <b>General and Transferable skills</b> |                                                                                                                |
| 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> | <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> |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### 5- Teaching and Learning Methods:

- Self learning (Activities, Research....)
- Research group meetings
- Departmental seminars
- Instrumental troubleshooting
- Investigation and problem solving

### 6- References:

**Websites:** Pubmed, Sciencedirect, Weilyinterscience

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

**Books:**

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

**Facilities required:**

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

**Head of Department: Prof. Dr. Magda El-Henawee**

تم اعتماد توصيف المقرر في مجلس القسم بتاريخ 10 / 2017