Index

No	Data	Page number
1.	Basic Information	2
2.	Special Information	2
3.	Academic Standards of Program Specification	6
4.	External References for Standards (Benchmarks)	6
5.	Program Structure and Contents	6
6.	Program Duration	6
7.	Program Structure	7
8.	Program Course Levels	7
9.	Program Courses	9
10.	Program Courses Contents	10
11.	Program Admission Requirements	14
12.	Regulations for Program Course Completion	14
13.	Methods and Rules of Student's Evaluation	14
14.	Evaluation of Program Intended Learning Outcomes	16

University: **Pharos University in Alexandria.**
Faculty: **Pharmacy and Drug Manufacturing**

Program Specification

A- Basic Information:

1- Program Title: Master's Degree in Pharmaceutical Sciences (Pharmaceutical Chemistry, PC)

2- Program Type: **Single** [✓] **Double** [ ] **Multiple** [ ]

3- Department (s): Pharmaceutical Chemistry
Program Coordinator: Prof. Rasha Shaalan
4-Date of program specifications approval 8/10/2025

B- Special Information:

1- Program Aims: The program aims to cover up all the essential basis and principles underpinning research in Pharmaceutical Chemistry. It provides the researcher with fundamental background in instrumental analysis, QA/QC components, chemical reactions mechanism, stability study of new drug substances and products, various analytical techniques for drug discovery. It aims to give detailed knowledge about formulation chemistry and drug design. Generally, it offers the specialist a conceptual and intellectual foundation for further studies in pharmaceutical chemistry.

Graduate Attributes:

1. Demonstrate an up-to-date knowledge and understanding of general pharmaceutical sciences including physical chemistry, instrumental analysis, statistics & biostatistics as well as specialized pharmaceutical analytical sciences including advanced spectroscopic, chromatographic, electrochemical methods of analysis
2. Demonstrate knowledge and practical research skills of quality control of pharmaceutical products and validation of analytical methods
3. Apply appropriate analytical techniques in evaluating dosage forms, based on principles of analytical methodology in light of regional and international changes and employ available resources of chemicals and instruments to the greatest benefits.

4. Recognize multidisciplinary and progressive knowledge of key chemical concepts in the field of medicinal and pharmaceutical chemistry, underlying biological processes, aspects of medicinal sciences complementary to chemistry, knowledge necessary for the study of pharmaceutical products and awareness of advances at the forefront of the chemical science discipline.
5. Apply principles and methodologies involved in the production of new drugs.
6. Learn statistical methods necessary for deriving correct conclusions from generated experimental data and promote self-development and apply continuous self-education
7. Examine scientific evidence - both quantitative and qualitative - to arrive at evidence-based conclusions.
8. Critically analyze relevant published information.
9. Present experimental results for peer-evaluation and publication through written reports, thesis, journal articles and/or presentations at conferences.
10. Apply ethics of scientific research and information technology in different professional settings.
11. Demonstrate competency in professional and research skills set upon graduation (above average of those of other Egyptian universities).
12. Obtain self-learning ability needed for continuing professional development
13. Obtain skills of effective communication, teamwork, leadership, critical thinking, decision making, and problem solving.

2- Intended Learning Outcomes (ILOs):

2/1- Knowledge and Understanding:

A1: Demonstrate expertise in highly specialized and advanced research by the design, execution, and preparation of written and oral reports based on research investigation.

A2: Recognize bioinformatics software and web-based applications; that are required to search for, analyze and submit molecular biology and gene technology data to learn how to access new information in pharmaceutical research and development of new drugs.

A3: Identify principles and applications of biostatistics.

A4: Recognize the general functions and importance of different biological fluids for analysis & quantification.

A5: Identify terminology, basic rules and principles of chemical and enzymes Kinetics.

A6: Recall rules needed for the calculations to solve problems in different areas of analytical chemistry.

A7: Describe as well as the basic principles of UV, Visible, fluorescence spectroscopy and different types of chromatographic, spectroscopic and electrochemical techniques used in drug analysis

A8: Identify quality assurance (QA), quality control (QC), good analytical practice (GAP), good laboratory practice (GLP), good quality management (GQM) and biostatistics and its applications method development, validation and in sampling and sample preparation ready for analysis.

A9: Recognize basic principles and major synthetic pathways in Organic Chemistry and medicinal chemistry, involving tautomerism, organic reactions energetics and kinetics, and acidity and basicity, and approach the pharmacokinetic and pharmacodynamics studies of drugs inside the body.

A10: Outline factors affecting chemical stability of drugs and structural elucidation of the degradation products using different techniques.

2/2- Intellectual Skills:

B1: Plan a research protocol to conduct independent and effective study.

B2: Evaluate information data from a variety of sources for planning different work strategies.

B3: Criticize published evidence-based information and problem solving of relevance to Organic, Analytical and Medicinal Chemistry by the aid of computer technology.

B4: Discover the scope of computational biology and bioinformatics software and web-based applications to analyze molecular biology and gene technology data for pharmaceutical research and drug design.

B5: Illustrate how to effectively present scientific data based on knowledge of biostatistics.

B6: Distinguish between the different orders of reactions and the calculations of the half-life time of drugs.

B7: Explain the interaction between electromagnetic radiation and matter on atomic and molecular levels.

B8: Apply validation concept whenever needed

B9: Select the proper different HPLC conditions for separation and quantification

B10: Select the most appropriate conditions for storing and distributing different pharmaceutical products and the appropriate method of analysis for appropriate interpretation of data.

2/3- Professional and Practical skills:

C1: Develop research skills, including knowledge of general principles and procedures of research methodology, statistical analysis, and scientific writing in the fields of pharmacy.

C2: Demonstrate ethical and professional conduct in handling patient or experimental data and following research ethics guidelines.

C3: Apply modern computational and digital tools (e.g., bioinformatics and data analysis software) in biomedical research.

C4: Develop competence, confidence and an enquiring investigative approach.

C5: Create comments on reports for situations related to the field of pharmacy including critical reviews of scientific articles and peer evaluation.

C6: Compile reviews and essays discussion competently for effective information management.

C7: Develop proper chemical formulas of different chemical compounds and skills of using calculations in different tasks.

C8: Apply spectrophotometry in qualitative and quantitative determination of drugs, as well as advanced analytical methods and operating related instruments in laboratory.

C9: Classify pharmacopoeial qualification, calibration & standardization and parameters for working safely in laboratory

C10: Discuss physical and chemical properties or changes taking place in a drug.

C11: Develop the correct reporting of spectrophotometric and different analytical data as used in pharmaceutical analysis.

C12: Evaluate standard methods for quantitative analysis of concentration-time profile

2/4 - General and Transferable Skills:

D1 : Develop the ability of working in a team through group presentation and group discussion with appreciation of leadership and innovation skills.
D2 : Use reference books, internet, and previous knowledge for getting information, demonstrating competency in managing a research project, writing a manuscript, making conclusions and selecting an appropriate pharmaceutical journal for publication.
D3: show good communication skills of others, to transfer knowledge and information provided by the course both verbally and written.
D4: Demonstrate various skills of self-learning, self- and peer evaluation, data processing, time management, using information technology and ethics in scientific research.

3- Academic Standards of program specification:

Academic Reference Standards (ARS) for Master's Degree in Pharmaceutical Sciences (Pharmaceutical Chemistry, PC)

4- External references for standards (Benchmarks):

NA

5- Program Structure and Contents:

a- Program duration: Minimum of Two years

b- Program structure:

Subject Areas	Percentage
Basic sciences courses	**11.11%**
Specialized courses	**38.88%**
Thesis	**50.00%**

c- Program course Levels (in credit-hours system):

أولا: (الفصل الدراسي الأول) 4 ساعات معتمدة مقررات عامة و4 ساعات معتمدة مقررات تخصصية.

First Semester:

No.	Course Code	Course Title	Credit Hours	إسم المقرر
1	PP 601	Research Methods & Scientific Writing	2	طرق البحث والكتابة العلمية
2	PL 601	Statistics & Biostatistics	1	الإحصاء والإحصاء الحيوي
3	PM 602	Bioinformatics	1	المعلوماتية الحيوية
4	PC 701	Chemical Kinetics & Drug Stability	2	الحركية الكيميائية وثبات الأدوية
5	PC 702	Analytical & Instrumental Methods	2	طرق تحليلية وآلية

ثانيا: (الفصل الدراسي الثاني) 10 ساعات معتمدة مقررات تخصصية.

Second Semester:

No.	Course Code	Course Title	Credit Hours	إسم المقرر
1	PC 703	Advanced Analytical Quality Assurance of Drugs	3	مقرر متقدم في تأكيد جودة تحليل الدواء
2	PC 704	Advanced Organic Pharmaceutical Chemistry	2	كيمياء عضوية صيدلية متقدمة
3	PC 705	Advanced Pharmaceutical Analysis	2	التحليل الصيدلى المتقدم
4	PC 706	Advanced Medicinal Chemistry	2	الكيمياء الطبية المتقدمة
5		Elective Course	1	مقرر اختيارى

المقررات الاختيارية المتاحة لدرجة ماجستير الكيمياء الصيدلية:

No.	Course Code	Course Title	Credit Hours	إسم المقرر
1	PC L07	Formulation Chemistry	1	كيمياء صواغات الدواء
2	PC L08	Drug Synthesis	1	تخليق الأدوية
3	PL L13	Analysis of Body Fluids	1	تحليل سوائل الجسم

- بحث رسالة الماجستير

- **Thesis Research**

No.	Course Code	Course Title	Credit Hours	إسم المقرر
1	PC 800	Thesis Research	18	بحث رسالة الماجستير

d- Program Courses:

a. Compulsory (17 h):

Course Code	Course Title	No. of Units	Hours per Week			Level	Semester
			Lect.	Lab.	Tut.		
PP 601	Research Methods & Scientific Writing	2	2	0	0	General	First
PL 601	Statistics & Biostatistics	1	1	0	0	General	First
PM 602	Bioinformatics	1	1	0	0	General	First
PC 701	Chemical Kinetics & Drug Stability	2	2	0	0	Special	First
PC 702	Analytical & Instrumental Methods	2	2	0	0	Special	First
PC 703	Advanced Analytical Quality Assurance of Drugs	3	3	0	0	Special	Second
PC 704	Advanced Organic Pharmaceutical Chemistry	2	2	0	0	Special	Second
PC 705	Advanced Pharmaceutical Analysis	2	2	0	0	Special	Second
PC 706	Advanced Medicinal Chemistry	2	2	0	0	Special	Second
PC 800	Thesis Research	18	0	0	0	thesis	---

b. Elective (1 h):

Course Code	Course Title	No. of Units	Hours per Week			Level	Semester
			Lect.	Lab.	Tut.		
PC L07	Formulation Chemistry	1	1	—	—	Special	
PC L08	Drug Synthesis	1	1	—	—	Special	
PL L13	Analysis of Body Fluids	1	1	—	—	Special	

- **Required courses offered by any department could be mutually accepted as elective courses in other departments.**

Courses may be offered in the summer semester to meet the needs of the graduate students.

6- Program Courses Contents:

Course Code or Number: PP 601
Course Title: Research Methods & Scientific Writing
Contents:

- Research areas in various pharmacy disciplines.
- Drug literature retrieval and evaluation.
- Experimental design and methodology to optimize the in-vitro and in–vivo experiments.
- Design of single and multiple factors experiments (e.g. factorial design or others).
- Response surface design.
- Sampling techniques.
- Data collection, reliability, validity and analysis.
- Thesis preparation.
- Ethical conduct in research

Course Code or Number: PL 601
Course Title: Statistics & Biostatistics
Contents:

- Data collection, presentation & distribution.
- Basic probability.
- Statistical building blocks.
- Confidence intervals.
- Regression analysis (parametric and non-parametric).
- Tests of statistical significance: Paired, pooled t tests & analysis of variance.
- Epidemiology.
- Statistical quality control.
- Robust statistics.

Course Code or Number: PM 602
Course Title Bioinformatics
Contents:

- Definition, aims and components of bioinformatics.
- Biological archives and public organizations.
- Searching for drug side effects, interactions and publications.
- Comparative analysis of sequences.
- Protein structure and function and annotation of sequences.
- Bioinformatics tools for gene technology.
- Bioinformatics-based drug design.
- Genomics, proteomics and metabolomics.

Course Code or Number: PC 701
Course Title: Chemical Kinetics & Drug Stability
Contents:

- Chemical kinetics and enzyme kinetics, factors affecting reaction rates, rate laws, half-life and determining rate equation.
- Mathematical treatment of zero-order, first –order & second-order reaction rates.
- Determination of expiry time of pharmaceutical preparations.
- Decomposition of medicinal agents (hydrolysis & oxidation).
- Accelerated stability analysis of drug substances.
- Guidelines for drug stability and stability testing.

Course Code or Number: PC 702
Course Title: Analytical & Instrumental Methods
Contents:
In depth knowledge and update information in the following areas with emphasis on research relevant issues:

- Chemical composition of aqueous solutions.
- Effect of electrolytes on chemical equilibria.
- Equilibrium calculations for simple and complex systems.
- Chemical calculations to determine concentrations of species of interest.
- Basics of Chromatographic separation methods.
- Basic properties of electromagnetic radiation & interaction between radiation and matter.
- Basic principles of molecular absorption & molecular fluorescence spectroscopy.
- Development of spectrophotometric methods for the quantitation of drug combination using ΔA, D_1 & D_2 techniques & for determination of K_a & K_b of medicinal agents.
- Fundamental principles of electro-chemistry in terms of oxidation-reduction reactions.
- Electro-chemical calculations.
- Potentiometry, pH measurements and electrolysis in analysis of drug substance.

Course Code or Number: PC 703
Course Title: Advanced Analytical Quality Assurance of Drugs
Contents
In depth knowledge and update information in the following areas with emphasis on research relevant issues:

- Introduction to QA/QC.
- Key elements of QA/QC program.
- Sampling operation and plans.
- Validation of analytical procedures.
- Qualification and calibration of instruments.
- System suitability testing.
- QC checks.
- Stability testing of new drug substances & products.
- Forced degradation study.
- Documentation in QA/QC.

Course Code or Number: PC 704
Course Title: Advanced Organic Pharmaceutical Chemistry
Contents
In depth knowledge and update information in the following areas with emphasis on research relevant issues:

- Nomenclature of organic compounds including heterocycles.
- Aliphatic and aromatic nucleophilic substitutions, aliphatic and aromatic electrophilic substitutions, addition to C-C and C-hetero multiple bonds, elimination reaction, rearrangement and tautomerism.
- Naming of reactions.
- Acidity and basicity of organic compounds.
- Investigation of reaction mechanism.
- Reaction of some functional groups: phenolic, acidic, ketonic, carbanions and carbocations.

Course Code or Number: PC 705
Course Title: Advanced Pharmaceutical Analysis
Contents
In depth knowledge and update information in the following areas with emphasis on research relevant issues:

- Electrogravimetric & coulometric methods.
- Molecular ultraviolet/visible absorption spectroscopy.
- Molecular-fluorescence spectroscopy.
- Atomic spectroscopy based upon flames.
- Infrared and Raman spectroscopy.
- Emission spectroscopy.

- Nuclear Magnetic Resonance spectroscopy: Theory and instrumentation, the chemical shift, time-dependence of NMR phenomena, spin-spin coupling, NMR spectroscopy of nuclei other than protons & analytical application.
- Mass spectrometry.
- Analytical separations: Separation by extraction & separation by ion exchange.
- Chromatographic methods: Migration rates of solutes, the efficiency of chromatographic columns, column resolution, application of chromatography, gas-liquid chromatography & high- performance liquid chromatography.

Course Code or Number: PC 706
Course Title: Advanced Medicinal Chemistry
Contents
In depth knowledge and update information in the following areas with emphasis on research relevant issues:

- Enzyme inhibitors as therapeutic agents.
- Protein pharmaceuticals & the use of biotechnology in their production.
- Gene therapy.
- Selective estrogen receptor modulators (SERM).
- Novel targets for the design of anticancer agents.
- Prodrugs (Drug latentiations).
- Radiopharmaceutical.
- Nitric oxide & its role in physiological & pathophysiological states.
- Drug metabolism of some of the commonly used drugs.

II. Elective Courses:

Course Code or Number: PC L07
Course Title: Formulation Chemistry
Contents:

- Classification of formulation excipients, these include: carbohydrates, polysaccharides, lipids, thickeners, lubricants, humectants, preservatives, organoleptic and synthetic polymer excipients.
- Physical and structural chemistry of the major classes of formulation excipients.
- General use of excipients in different classes of products.
- Use of standard methods for quantitative analysis of concentration- time profiles to obtain degradation rate constants, half-lives and shelf-lives.
- Mechanism of chemical degradation of typical organic drugs & excipients with emphasis on nucleophilic & free- radical reactions.
- Methods for minimizing the extent of degradation reactions to increase life-times of products.
- Complex kinetics in oxidation, photochemical and solid state degradation.

Course Code or Number: PC L08
Course Title: Drug Synthesis
Contents:

- Synthesis of amino acids, peptides and nucleotides.
- Synthesis of some selected drugs including heterocyclic drugs.
- Functional group interconversion and protection of functional groups are illustrated.
- Separation of organic compounds using different chromatographic techniques.
- Retrosynthesis of some drugs.

7- Program Admission Requirements:

Admission Requirements include:

1. **Holders of bachelor's degree in Pharmaceutical Sciences – minimum general grade Good (C+), or the equivalent of this grade from one of the universities recognized by the Supreme Council in the field of specialty, or from an equivalent foreign university.**
2. **In case the applicant is granted a Pass in his bachelor's degree and wants to register for a master's degree, he must obtain a specialty diploma with general grade (C +) at least, or pass the complementary courses determined by the department, with a general grade no less than (C+) and these courses are not part of the hours of the program.**
3. **The student gets the approval of the department council if he fulfills the terms set by the scientific department (if any) and then the approval of the faculty's Council.**

8- Regulations rules for program course completion:

To obtain a master's degree, 18 credit hours must be studied, in addition to 18 credit hours for the thesis, so that the total number of hours to obtain the degree is no less than 36 credit hours.

9- Methods and Rules of Student's Evaluation:

Methods	Program Intended Learning Outcomes
Written exams (Midterm & Final)	Knowledge & Understanding, and Intellectual Skills (and Professional Skills If course contains case studies)
Continuous assessment (Research projects/ Reports/ Assignments	Knowledge & Understanding, Intellectual Skills, Professional Skills and General Skills

- **Examinations Procedure:**

1. **The final grade awarded to students in a course are distributed as follows:**
   - **30% for the continuous assessment.**
   - **10% for the mid-semester exam.**
   - **60% for the final written exam.**

2. **Each credit hour is allotted a total of 100 points.**

- **Grading System:**

وصف التقدير	النسبة المئوية	رمز التقدير	نقاط التقدير
ممتـاز	100 - 97	A+	4.0
	97 - أقل من 90	A	3.85
	90 - أقل من 85	A-	3.7
جيد جدا	85 - أقل من 80	B+	3.3
	80 - أقل من 75	B	3.0
جـيد	75 - أقل من 70	C+	2.7
	70 - أقل من 65	C	2.3
مـقبول	65 - أقل من 60	D	2.0
راسب	أقل من 60	F	0.0
راسب لائحة	أقل من 30% في الامتحان التحريري النهائي	BL	0.0
مرضى (خاص بالبحث)	-	NP	-
غير مرضى (خاص بالبحث)	-	NF	-
جارى حساب التقدير	-	IP	-
منسحب	-	W	-
منسحب للتجنيد	-	MW	-
غير مكتمل	-	I	-
غائب بعذر	-	E	-
غائب بدون عذر	0.0	NE	0.0
محروم	0.0	DN	0.0

X = Percentage Grade.

$$\text{Cumulative GPA} = \frac{\sum \text{Grade points x N° Cr. Hrs}}{\sum \text{Cr. Hrs}}$$

10- Evaluation of Program Intended Learning Outcomes:

Evaluator	Tool	Sample	% Contribution in Total Marks of Program Evaluation
5th Year Students	Questionnaires and Periodic Meetings	Questionnaires (20%)	25%
Graduate students	Questionnaires and Periodic Meetings	Questionnaires (20%)	25%
Stakeholders (Employers)	Questionnaires and Periodic Meetings	One meeting / year	25%
External Evaluator	Reviewing of the specifications of the program and the courses according to the bylaw	At least one reviewer professor in the specialty	25%

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