Jordan University of Science and Technology
Faculty of Graduate Studies

Course Curriculum for master's degree in Medicinal Chemistry and Pharmacognosy/ Non-thesis track

The master's degree in Medicinal Chemistry and Pharmacognosy/ Non-thesis track is awarded by the Faculty of Graduate Studies at Jordan University of Science and Technology (JUST) upon the Successful completion of (34) credit hours including compulsory and elective courses and passing the comprehensive exam.

1. Compulsory Requirements (25) credit hours as follows:

Course Code	Course Name	Credit Hours
PHAR 709	Seminar	1
PHAR 720	Research Methodology	3
PHAR 721	Advanced Pharmaceutical Organic Chemistry	3
PHAR 722	Organic Structure Determination	3
PHAR 723	Stereochemistry	2
PHAR 724	Advanced Drug Design	3

PHAR 725	Synthetic Medicinal Chemistry	2
PHAR 726	Analytical Techniques in Drug Discovery	2
PHAR 731	Drug Discovery from Nature	3
PHAR 735	Chromatography	3

2. Elective Requirements (9) credit hours as follows:

Course Code	Course Name	Credit Hours
PHAR 727	Organic Synthesis Research Laboratory	2
PHAR 728	Heterocyclic Chemistry	3
PHAR 729	Bioinformatics and Drug Discovery	3
PHAR 730	Artificial Intelligence in Drug Discovery	3
PHAR 732	Biosynthesis	3
PHAR 733	Biosensors	3
PHAR 734	Design of Cancer Immunotherapeutic Drugs	3
PHAR 780	Selected Topics in Medicinal Chemistry	3
PHAR 781	Molecular Modeling and Computer-Aided Drug Design	3
PHAR 782	Advances in Functional Foods and Nutraceuticals	3
PHAR 785	Enzymes and Drug Action	3
PHAR 799A	Special Topics A	2
PHAR 799B	Special Topics B	1

3. Elective Passing the Comprehensive Exam (PHAR 798): Zero Credit Hour.

Course Description

PHAR 709 Seminar (1 Credit Hour):

This course provides new graduate students the opportunity to practice speaking in front of audiences by presenting scientific topics. Topics related to seminar preparation and presentation will be covered.

PHAR 720 Research Methodology (3 Credit Hours):

This course provides new graduate students with a foundation to begin research in the fields of Medicinal Chemistry and Pharmacognosy. Topics relevant to graduate studies and research will be covered, including literature search, research ethics, scientific authorship, data management, research misconduct, scientific writing, human participants and animal subjects in research, and laboratory safety. Moreover, the basics of biostatistics pertinent to data collection, analysis, and presentation will be covered.

PHAR 721 Advanced Pharmaceutical Organic Chemistry (3 Credit Hours):

The aim of this course is to provide students with advanced knowledge of numerous aspects of organic chemistry, as it applies to modern medicinal chemistry. Topics include types and classification of reaction mechanisms with emphasis on some related reactions. Furthermore, the course covers various chemical reactions involving enolates and other carbon nucleophiles, organometallic compounds of group I and II metals as well as transition metals. The course also covers the fundamentals of heterocyclic compounds including properties, synthesis and reactions of aliphatic and aromatic heterocycles with emphasis on five-membered, six-membered, and fused heterocycles.

PHAR 722 Organic Structure Determination (3 Credit Hours):

The major focus of this course is organic structure determination via spectra. Concepts and applications of modern and advanced spectroscopic and spectrometric techniques in structural elucidation of organic compounds, including nuclear magnetic resonance spectroscopy (FT-NMR), mass spectrometry (MS), UV-Visible spectroscopy (UV-vis), and Infrared spectroscopy (FT-IR). The physical and chemical principles of each method will be discussed.

PHAR 723 Stereochemistry (2 Credit Hours):

This course covers the stereochemistry of organic compounds; chirality; resolution and analysis of enantiomers and diastereomers, conformational isomerism and geometrical isomerism. Introduction to stereoselective synthesis and drug design will be given. In addition, stereoselectivity in nature and spectroscopic determination of relative and absolute chirality will be discussed.

PHAR 724 Advanced Drug Design (3 Credit Hours):

The course discusses the concept of rational drug design and the conventional strategies applied in the lead-to-drug optimization process. It's also aimed to give students a foundation and hands-on experience with several computer-aided drug design methodologies. The course focuses on mastering the ability of students to critically analyze drug design literature and solving problems encountered during lead-to-drug optimization process.

PHAR 725 Synthetic Medicinal Chemistry (2 Credit Hours):

The aim of this course is to provide students with advanced knowledge of numerous aspects of synthetic organic chemistry, as it applies to modern medicinal chemistry. The course includes readings in and critical analysis of recent literature in synthetic and medicinal chemistry research. The course covers total synthesis and retrosynthetic analysis and strategies of a selection of natural products and pharmaceuticals. An understanding of reaction mechanisms will be emphasized throughout.

PHAR 726 Analytical Techniques in Drug Discovery (2 Credit Hours):

This course will introduce the student to analytical process and various analytical techniques used for pharmaceutical and drug discovery applications. The application of three key types of analysis: separation, identification and quantification, and process of selection of a valid method of analysis will be described. Spectroscopic techniques and their applications involving absorption, fluorescence, luminescence and emission will be discussed. Basic knowledge of separation techniques such HPLC, GC and electrophoresis will be also covered. The course will also introduce the student to various techniques used in bioanalysis.

PHAR 731 Drug Discovery from Nature (3 Credit Hours):

The focus of this course is to highlight the impact of natural products in the drug discovery and development process. Topics related to the different methods, approaches, and strategies utilized in the discovery of new drug leads from nature will be covered, including biochemistry- and molecular biology-based methods. A number of unique drugs of natural origin will be highlighted during the course.

PHAR 735 Chromatography (3 Credit Hours):

The objective of this course is to familiarise the student with the theory and practice of the state of the art of analytical and preparative chromatographic separation processes. Topics include: Theory of chromatography, chromatographic techniques and LC method selection and development (e.g. choice of sample preparation, columns, mobile phase and detector). An emphasis on development and optimising chromatographic methods coupled to MS will be made. Tutorials, critical reviews of the current literature and laboratory demonstrations in the lab will be employed throughout the course to illustrate important concepts and familiarise students with instrumentation.

PHAR 727 Organic Synthesis Research Laboratory (2 Credit Hours):

Practical organic chemistry course that aims to teach students the necessary skills of synthesis, purification, and systematic identification of organic compounds based on their physical, chemical, and spectral properties using namely NMR and IR spectra. The techniques of separating organic mixtures using column chromatography, flash chromatography, and HPLC will also be covered.

PHAR 726 Heterocyclic Chemistry: (2 Credit Hours)

This course will cover the fundamentals of heterocyclic compounds; Structure, nomenclature and physical properties. This course will also discuss synthesis and reactions of both aliphatic and aromatic heterocycles with emphasis on five-membered six-membered and fused heterocycles. Selected examples on the synthesis of medicinally important heterocyclic compounds will be given.

Artificial Intelligence in Drug Discovery (3 credit hours)

The course aims to provide students with a comprehensive understanding of the role of artificial intelligence in accelerating and enhancing drug design and development processes. It covers the theoretical foundations and advanced techniques of artificial intelligence, including deep learning, artificial neural networks, machine learning, big data analysis, and their applications in drug design. The course illustrates how these techniques are utilized to analyze biological data, guide drug discovery, improve drug design processes, predict drug effects, and evaluate drug safety.

PHAR 732 Biosynthesis (3 Credit Hours):

This course deals with natural products from a biosynthetic perspective. Emphasis will be on biosynthetic techniques, mechanism, and pathways leading to the major natural products classes. Enzyme chemistry will also be studied.

Phar 733 Biosensors (3 credit hours):

This course focuses on non-standard techniques for biomarker capture. It covers the fundamental theoretical and practical aspects of electrochemical and optical detection, as well as biosensing, with an emphasis on nanopore detection and its applications in drug discovery. Additionally, the course provides both practical and theoretical overviews of biochemical sensing, bio-capture techniques, diagnostic approaches, and drug monitoring using electrochemical and nanopore-based biosensors.

Phar 734 Design of Cancer Immunotherapeutic Drugs (3 credit hours):

The course provides a comprehensive overview of the principles, strategies, and techniques involved in designing effective immunotherapeutic approaches for cancer treatment. This course explores various facets of cancer immunotherapy, covering fundamental concepts in immunology as well as the latest therapeutic interventions.

PHAR 780 Selected Topics in Medicinal Chemistry (2 Credit Hours)

This course is designed to cover the up-to-date aspects of medicinal chemistry.

PHAR 781 Molecular Modeling and Computer-Aided Drug Design (3 Credit Hours):

This course covers the theory of molecular modeling, including force fields, energy minimization, molecular dynamics, homology modelling and their applications in drug design. In addition, it covers theory and practice of most currently used computational techniques in the field of computer-aided drug design, including approaches for both ligand and target drug design such as similarity searching, pharmacophore modeling, QSAR, docking and scoring, virtual screening, and ADMET property prediction.

The course will explore the latest research and innovations in the field of functional foods and nutraceuticals. Regulatory, ethical, and marketing aspects of functional food and nutraceutical will be critically examined.

PHAR 783 Bioinformatics and Drug Discovery (3 Credit Hours):

This course focus on the use of bioinformatics on drug discovery. Topics related to genomics, transcriptomics, proteomics, population genetics, and molecular phylogenetics will be covered.

PHAR 785 Enzymes and Drug Action (3 Credit Hours):

This course covers subjects related to mechanisms of enzyme inhibition such as transition state analogs, noncompetitive enzyme inhibition, and irreversible mechanism-based inhibition. Besides, there will be a coverage of enzyme kinetics and their application in enzyme inhibition. Moreover, there will be a study of drug metabolic processes. Phases, reactions, and reaction mechanisms of metabolic pathways will be discussed in details. In addition, factors affecting drug metabolism, drug-metabolizing enzyme systems, and drug metabolism in drug design will be discussed.

PHAR 779A Special Topics A: (2 Credit Hours)

Special topics in advanced pharmaceutical sciences are discussed.

PHAR 779B Special Topics B: (1 Credit Hour)

Special topics in advanced pharmaceutical sciences are discussed.