

1.	School	Pharmacy
2.	Department	Pharmaceutical Sciences
3.	Program title (Arabic)	دكتوراة في العلوم الصيدلانية
4.	Program title (English)	PhD in Pharmaceutical Sciences

	Specialization #	Degree	Dep #	Faculty #	Year	Track
Plan Number	041	PhD	01	12	2022	Thesis

First: General Rules & Conditions:

1. This plan conforms to valid regulations of the programs of graduate studies.
2. Specialties of Admission:
 - The First Priority: MSc in any field of Pharmacy.

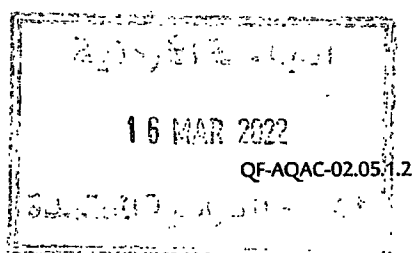
Second: Special Conditions:

- None.

Third: Study Plan: Studying (54) Credit Hours as following:

1. Obligatory Courses (21) credit hours:

Course No.	Course Title	Credit Hrs	Theory	Practical	Pre/Co-requisite
1201901	Pharmaceutical Organic Chemistry	3	3	-	-
1201902	Selected Topics in Drug Discovery (1)	2	2	-	-
1201904	Spectroscopy	3	3	-	-
1203905	Pharmacology Laboratory and Bioassay	2	-	6	-
1201907	Biotechnology and Drug Discovery	2	2	-	-
1201908	Medicinal Natural Products	3	3	-	-
1201925	Research Methodologies and Tools in Pharmacy	3	3	-	-
1201926	Advanced Pharmaceutical Statistics	3	3	-	-



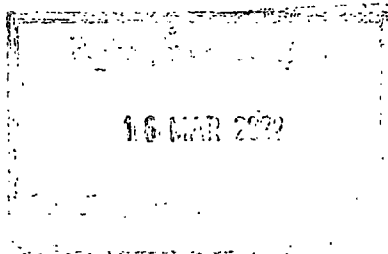
2. Elective Courses (15) Credit Hours: from the following:

Course No.	Course Title	Credit-Hrs	Theory	Practical	Pre/Co-requisite
1201910	Selected Topics in Drug Discovery (2)	3	3	-	-
1201911	Proteomics and Drug Discovery	3	3	-	-
1201912	-Quantification of Legend - Macromolecular Binding	3	3	-	-
1201914	Medicinal Chemistry of Anticancer Agents	3	3	-	-
1201915	Medicinal Chemistry of CNS Agents	2	2	-	-
1201916	Medicinal Chemistry of Respiratory and GIT Agents	2	2	-	-
1201917	Medicinal Chemistry of Anti-Inflammatories and Anti-Allergics	2	2	-	-
1201918	Medicinal Chemistry of Endocrine System Agents	2	2	-	-
1201919	Medicinal Chemistry of The Cardiovascular System Agents	2	2	-	-
1201927	Advanced Spectroscopy	3	3	-	-
1201928	Advanced Chromatographic Analysis	3	3	-	-
1201929	Quality Control and Standardization of Natural Products	2	2	-	-
1231930	Physicochemical Properties as a Tool in Drug Research	3	3	-	-
1201931	New Trends in Natural Products Drug Discovery	2	2	-	-
1201932	Seminar in Natural Products	1	1	-	-
1201933	Seminar in Medicinal Chemistry	1	1	-	-

3. Pass the qualifying exam (1201998).

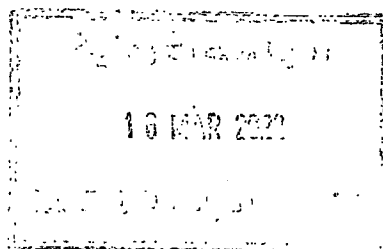
4. Thesis: (1201999) Credit hours (18).

*notes



Course Description

- 1201901 Pharmaceutical Organic Chemistry: (3cr.)**
Detailed elaboration of recent synthetic literature examples, including retro-synthetic planning, chemical reactions, conditions, reagents and mechanism. of reactions.
- 1201902 Selected Topics In Drug Discovery (1): (2cr.)**
Detailed discussions of various aspects of computer aided drug discovery techniques including: molecular modeling using molecular mechanics, quantum mechanics, semi-empirical quantum mechanics, and molecular dynamics. Furthermore, different conformation search methodologies will be also considered such as systemic searches, Monte Carlo techniques, and Genetic Algorithm.
Furthermore, ligand-based and receptor-based drug discovery methodologies will be covered. Ligand-based methods include various QSAR techniques (such as, classical, COMFA, COMSIA, 3D-QSAR, and COMMA) and pharmacophor-based searches. On the other hand, receptor-based methods include various de novo ligand building approaches. The discussion will cover the relevant software with some hands-on experiences.
- 1201904 Spectroscopy: (3cr.)**
Theories of spectroscopic transitions and their applications in structural elucidation and quantitative analyses. Topics include infrared, Raman, nuclear magnetic resonance spectroscopy and mass spectrometry. Advanced application of these techniques in structural elucidation will be given great focusing.
- 1203905 Pharmacology Laboratory and Bloassay: (2cr.)**
Measurement of the effects of drugs on isolated tissues and cells and their use in the study of drug / receptor interactions and drug toxicity, and analytical techniques in the measurement of drug absorption and metabolism. Conducting simple experiments on *in vitro* preparations and present their findings in a written account, which includes details of the background of the experiment (introduction), methods, results and discussion.
- 1201907 Biotechnology and Drug Discovery: (2cr.)**



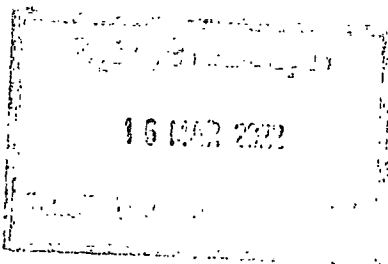
Concept of introducing useful agents through the manipulation of biosystems and its associated fields to Pharmacy students. Advanced concepts and application of biotechnology and its techniques. Topics involved deal with cloning, recombinant DNA (rDNA), Genetic engineering and protein production, tissue culture (plants and animals). Moreover, many techniques related to DNA will be discussed such as isolation and purification, gene splicing, enzyme systems, types of mutation and techniques related to DNA hybridization and mutation detection, Finger printing, polymerase Chain Reaction PCR, Enzyme linked immuno sorbent assay ELISA, Capillary electrophoresis CE, mutation detection methods and its correction, the management and treatment of DNA errors, and Gene therapy. DNA as a receptor and target for drug action as part of Drug Discovery will be covered .

1201908 Medicinal Natural Products: (3cr.)

Selected plants which form bases for some medicinal product discovery, or synthetic. Some families and species from different natural sources as a lead for drug discovery. Further elaboration will deal with the biosynthesis of these natural agents and the stress mechanism that leads to their existence such as environment, chemical treatment, and climate. Marine animals and plants as new and rich sources for medical agents will be covered .

1201926 Advanced Pharmaceutical Statistics (3cr.)

The course covers the most common tests used in inferential statistics, particularly T-test and ANOVA, including training examples on appropriate software (e.g. MINITAB). Moreover, the course introduces the multivariate analyses as the most powerful tool in chemometrics, The course will deal in brief with different search methodologies implemented in pattern recognition problems such as Genetic Algorithm, Monti Carlo search, systematic search and stepwise regression analysis. Appropriate training examples will be discussed by using appropriate software (e.g. MATLAB, SIMCA-P).



1201925 Research methodologies and tools in Pharmacy (3cr.)

This course will provide the students with the theoretical and practical research skills needed for their research program. The academic staff members will transfer their research experience skills to the students with practical examples of actual research cases.

Research skills include text books and encyclopaedias readings, literature analysis and retrieval methodologies and tools focusing on electronic data bases such as scopus, pubmed, scifinder, elsiver, web of knowledge, science citation index, etc.

Students will be also provided with all the necessary information to understand the Ideality of research problem solving and literature gaps applying all these techniques.

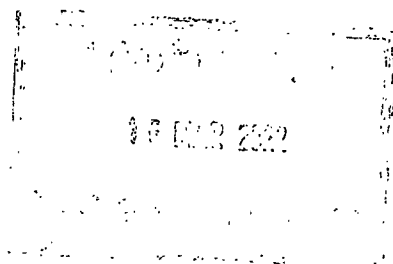
The course shall also include academic skills required for proposal writing specially those needed for projects and research grants. Other essential writing skills offered are oral presenters, poster preparations, article and review writing. The practical part shall expose the students to the experience of transformation of raw data into scientific form such as dissertation, abstract, short paper and full manuscript, with real examples related to different fields of pharmaceutical research.

1201910 Selected Topics in Drug Discovery(2): (3cr.)

Detailed in-depth discussions covering various aspects of combinatorial chemistry such as, solid supports, linker moieties, protective groups, cleavage conditions. Furthermore, collective review of classical, as well as, recently introduced chemical transformations that applied in combinatorial synthesis combined with some recent relevant examples. Concise discussions of the physical and chemical methods utilized in the characterization and follow up of reaction progress on the solid supports.

Some attention will be directed towards library design methodologies including focused and diverse designs.

In depth discussion will be focused on recent advances in the area of high throughput bioassay technologies utilized to screen combinatorial libraries.



1201911 Proteomics and Drug Discovery:

(3cr.)

Study of organism proteins and their role in organism's structure, growth, health, disease (and/or the organism's resistance to disease, etc.). Those roles are predominantly due to each protein molecule's tertiary structure/conformation, therefore, the effect of drugs on 3D structure will be discussed as part of Drug Discovery Sciences. Some methods utilized to determine which impact results from which protein, such as: *chemical genetics*, to compare two same-species organisms, *gene expression analysis*, to determine the protein(s) produced when a given gene is "switched on", by measuring fluorescence of individual messenger RNA (mRNA) molecules when that mRNA hybridizes. Gene expression analysis, to determine impact when a given gene is "knocked out"/"turned off" and *protein interaction analysis*, to determine if a newly-discovered protein molecule interacts with a protein molecule whose function is already known. In silico biology (modeling), to compare computer-predicted events with actual or *in vitro* outcomes will be covered.

1201912 Quantification of Legend-Macromolecular Binding:

(3cr.)

Theoretical aspects of various methods used in the quantitative determination of ligand-receptor affinities (traditional methods such as radio-immuno assay, and more recent methodologies such as Capillary Electrophoresis, Enzyme-linked immuno-sorbent assay (ELISA), and Plasmon Surface Resonance techniques (PSR) . Future plans include hands-on experience on the respective instruments, however, upon their acquisition.

1201914 Medicinal Chemistry of Anticancer Agents:

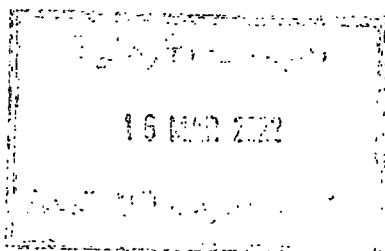
(3cr.)

Detailed discussions of the recent developments in carcinogenesis and anticancer chemotherapy. The involvement of various cell signaling routes. Such as receptor and non-receptor tyrosine kinases, ras-raf system, MAPK and phosphoinositol 3 kinase, etc...,the involvement of other cellular targets in the carcinogenesis, such as topoisomerases, tubulin polymerization, telomerases, MDR factors, and the involvement of extracellular factors in carcinogenesis, such as angiogenic factors, cytokines and related others. Examples on the development of recently introduced anticancer agents may be discussed.

1201915 Medicinal Chemistry of CNS Agents:

(2cr.)

Discussion regarding the recent advances in psychotropic, stimulants, depressants, analgesics, analeptics, and psychedelics, as well as , some recently identified characterized receptor macromolecules involved in the normal and abnormal functioning of the central nervous system, such as, opiate receptors, histamine receptors, serotonin receptors, serotonin reuptake receptors, adrenergic receptors and reuptake mechanisms and dopamine receptors. Other recently introduced relevant subjects will be adequately discussed.



1201916 Medicinal Chemistry of the Respiratory and GIT Agents: (2cr.)

Discussions related to recent advances in broncho-modulators, such as broncho-smooth muscle contractors and relaxants, anti-asthmatic drugs, related inflammatory endogenous compounds (bradykinines, prostaglandines). Furthermore, medicinal compounds related to the management of peptic and duodenal ulcers including histamine receptor (Peptic acid secretion) inhibitors. Other topics related to spasmolytics, anticholinergic agents, locally acting dopamine antagonists. Recently isolated and characterized receptors and endogenous mediators related to the GIT and respiratory tract will be also discussed.

1201917 Medicinal Chemistry of Anti-Inflammatories, Ant-Allergenic: (2cr.)

Recent advances in the areas of steroidal and non-steroidal anti inflammatory agents, including issues such as selective cox2 inhibition, eicosanoids, prostalagndins, thromboxans, cyokines, and leukotrienes and their respective inhibitors. Furthermore, focus will be also directed towards steroidal anti-inflammatories including their intriguing SAR properties. Moreover, recent advances in antiallergenic anti-histamines and various histamine receptors will also be coverd.

1201918 Medicinal Chemistry of Endocrine System Agents: (2cr.)

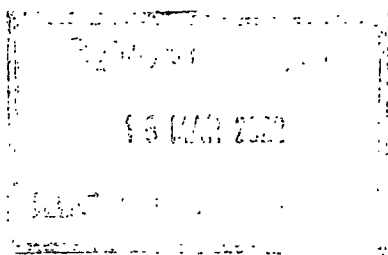
It deals with recent advances in sex hormones, gonadotropins, thyroid hormones, hormones involved in calcium balance, growth hormones, contraceptive hormones and hormonal analogues. Hormones involved in sugar balance. Particular interest is to be given the involvement of some hormones in the development of certain cancers.

1201919 Medicinal Chemistry of The Cardiovascular System Agent: (2cr.)

Discussions covering recent advances in the areas of antianginal agents, vasodilators, mediators involved in hypertension and antihypertensive agents. Furthermore, this course also covers antihyperlipidemics, anticoagulants, and diuretics. Particular interest will be directed towards recent developments concerning various ion-channels and ion-pumps and their relation to cardiac arrhythmias, such as K-channels, Na-channels, Na-channels, Cl-channels, Na/K pumps, etc.....

1201927 Advanced Spectroscopy (3cr.)

The course is intended to cover the structural elucidation by using 1D NMR spectroscopy, namely H^1 NMR, C^{13} NMR, J-mod. The modern two dimensional techniques will also be discussed through the application on real NMR cases. These techniques include COSY, HMBC, HMQC, INADEQUITE, 1D NOE, NOSEY and TOCSY. Furthermore, single X-ray crystallography will be discussed as a tool of structure elucidation, particularly for the large molecules such as proteins.



1201928 Advanced Chromatographic Analysis (3cr.)

This course provides an in-depth examination of techniques used to separate and analyze mixtures and presents a variety of advanced applications in chromatographic analysis. Topics to be covered include preparative column chromatography (CC), analytical and preparative liquid chromatography (HPLC), gas chromatography (GC), solid-phase extraction (SPE), capillary electrophoresis (CE) and electrochromatography (EC). In addition to provide a comprehensive knowledge of the instrumentation and operation of chromatographic equipments, the course also discusses the essential sample preparation requirements for trace analytes in complex matrices prior to chromatographic analysis.

1201929 Quality Control and Standardization of Natural Products (2cr.)

This course will cover various topics related the standardization of natural products (crude drugs, extracts, and finished products), which will emphasize a better understanding of the subject. This will include definitions and implications, current techniques and methodologies, and validation protocols.

1231930 Physicochemical properties as a tool in drug research (3cr.)

Development of advanced instruments explored new horizons in drug research and made it possible to results of higher quality and accuracy in shorter time in both diagnostic and therapeutic research areas. During this course, the students will be introduced to some of the new trends in drug research like the application of advanced light sources (Synchrotrons) in the characterization of the physicochemical properties of different pharmaceutical dosage forms like microemulsions, liquid crystals and nanoparticles. Also the students will be introduced to some medical applications of advanced light source like tracing drug diffusion and delivery based on the interaction of drug molecules with the electromagnetic radiation in the infrared region.

The knowledge of the relation between nature of the research tool and the physicochemical properties of the drug molecule (interaction with light, magnetic properties, ..) and the properties of the formula (size, surface properties,..) are the key factors for optimum utilization of these advanced techniques. This area will be discussed in details during the course. The basics of each technology (X-ray bases, Neutr- based, FTIR- based,..) will be introduced followed by discussion of selected newly published related articles.

1201931 New Trends in Natural Products Drug Discovery (2cr.)

The course will highlight the historical background of drug discovery from plant and animal kingdoms. The impact of using compounds isolated from natural sources as templates or as starting molecules for semi synthetic modification on modern pharmaceutical industry. Examples of clinically used compounds based on molecules isolated from natural sources will be presented.

Identification available sources of diversity for lead compound(s) and its pharmacological targets. Application of compound libraries and its relation to identify lead compound diversity. Understand the concept of high-throughput screening (HTS) from source selection, pilot-scale screening, assay design and implementation. Practical aspects of cell-based in vitro and in vivo testing will be discussed. Chemo- and bio-informatic analysis for optimization of lead compound from HTS for quantitative approaches to model development efficacy. Scaling up successful candidates for optimization of lead compound(s) through pre-clinical pharmacological and toxicological studies. The concepts will be supported by examples of successful and failed candidates for anticancer, antimicrobial, anti-inflammatory, immunostimulant, anticoagulant and cardioactive compounds using techniques discussed throughout the course.

1201932 Seminar in Natural products (1cr.)

Graduate students present a seminar based on their research endeavors or research topics assigned and selected by the instructor.

1201933 Seminar in Medicinal Chemistry (1cr.)

Graduate students present an in depth seminar in the field of medicinal chemistry, usually related to their research endeavours. The student can also chose any research topics assigned and selected by the instructor.

