Detailed Course Description - Course Plan Development and Updating Procedures/ Pharmacy Department	QF02/0408-3.0E

Faculty	Pharmacy	Department	Pharmacy
Course number	0201318	Course title	Medicinal Chemistry I & Drug Design
Number of credit hours	3	Pre-requisite/co-requisite	0201335, 0201216

Brief course description
This course explores the role of organic chemistry in the design and action of drugs. It addresses principles of drug discovery, drug development, and drug/receptor interactions, types of chemical bonds involved in drug-receptor interactions, drug mechanism of action, and drug metabolism. Aspects of biochemistry and physical organic chemistry are covered as necessary to understand the chemistry of drug action and metabolism in the body. This course is designed to impart the knowledge in computational methods and drug design approaches.

	Course goals and learning outcomes
Goal 1	To introduce the knowledge of the relationship between different classes of pharmaceutical compounds and their physicochemical properties (relation to absorption, distribution, and elimination and metabolism).
Learning outcomes	1.1 Classify the functional groups into acidic, basic, and neutral moieties and their physicochemical properties that affect drug bioavailability. 1.2 Emphasize on the stereochemical background to understand the drugs activity: optical isomerism, geometric, and conformational and perceive isosterism and bioisosterism concept in drug modification. 1.3 Address the metabolic pathways and distinguish between the metabolic phases and their corresponding enzymes. And be able to predict and draw the chemical structures of the drug metabolites.
Goal 2	To be familiar with chemical modification and drug optimization, and explore drug/receptor interaction.
Learning outcomes	2.1 Optimize lead structure to enhance access to the target and understand the significance of prodrug and its aim. 2.1 Understand drug/receptor complex formation and differentiate between the bonding forces mediating complex formation. 2.3 Understand the mechanism of ligand as agonist, antagonist, partial agonist, activator, (reversible and irreversible) inhibitor, suicide inhibitor, transition-state analogue.
Goal 3	To explore computational chemistry and their application in drug design. To introduce the knowledge of hit discovery, lead identification, lead optimization, target selection, and molecular recognition employing computer-aided drug design software. To shed the light on computer-based methods, combinatorial chemistry, high-throughput screening, and database mining.

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Learning outcomes	3.1 Emphasize on the general principles of drug design and drug action from an organic chemical perspective rather than from the perspective of specific classes. 3.2 Be familiar in recent developments in key issues such as combinatorial chemistry, QSAR, recombinant technology, and molecular modeling. 3.3 Distinguish drug design approaches and recognize computational methods categories and their applications.
Textbook	1-An Introduction of Medicinal Chemistry, 4th edition, Graham Patrick, Oxford University Press, 2008. 2-Foye's Principles of Medicinal Chemistry, 6th edition, Thomas L. Lemke and David A. Williams, Lippincott Williams & Wilkins, 2008.
Supplementary references	1. Burger's Medicinal Chemistry and Drug Discovery, 6th edition, M. E. Wolff, 2003. 2. The Organic Chemistry of Drug Synthesis, Vol. 1-6, D. Lednicer and L. A. Mitscher, John Wiley and Sons.

Course timeline

Week	Number of hours	Course topics	Pages (textbook)	Notes
01	**1** **1** **1**	Physicochemical Properties in Relation to Biological Action - Solubility in water. - Partition coefficient. - Acid/ base partition. - Bonding forces. - Isosterism & Bioisosterism. - Geometric isomers. - Conformational Isomerism. - Optical isomerism.	**Textbooks 1-4/**	
02	**1** **1** **1**	Physicochemical Properties in Relation to Biological Action - Isosterism & Bioisosterism. - Geometric isomers. - Conformational Isomerism. - Optical isomerism	**Textbooks 1-4/**	

03	**1** **1** **1**	Prodrugs - Basic concepts. - Prodrugs of functional groups. - Chemical delivery systems.	**Textbooks 1-4/**	
04	**1** **1** **1**	Metabolic Changes of Drugs and Related Organic Compounds - General pathways of drug metabolism. - Sites of drug biotransformation. - Factors affecting drug metabolism.	**Textbooks 1-4/**	
05	**1** **1** **1**	Metabolic Changes of Drugs and Related Organic Compounds - Phase I metabolic pathways. - Phase II metabolic pathways	**Textbooks 1-4/**	
06	**1** **1** **1**	Making Drugs More or Less Resistant to Enzymatic and Chemical Hydrolysis - Steric Shield - Electronic Effects of Bioisostere - Stereoelectronic Modification - Metabolic Blockers - Removal or Replacement of Susceptible Groups - Self- destructive Drugs	**Textbooks 1-4/**	
07	**1** **1** **1**	Optimizing Hydrophilic/Hydrophobic Properties - Variation of Alkyl or Acyl Substituents to vary polarity - Variation of Polar Substituents to vary polarity - Variation of *N*-alkyl to vary pKa - Variation of aromatic to vary pKa - Bioisosteres of Polar Groups	**Textbooks 1-4/**	

08	**1** **1** **1**	Receptors as Drug Targets - Design of Agonists: - Binding Groups - Position of the Binding Groups - Size and Shape - Allosteric Modulators - Design of Antagonists: - Antagonists acting at the binding site - Antagonists acting out with the binding site - Antagonists as Molecular Labels - Partial Agonist - Inverse Agonist	**Textbooks 1-4/**	
9	**1** **1** **1**	Enzyme as Drug Targets - Inhibitors acting at the active site of an enzyme - Reversible Inhibitors - Irreversible Inhibitors - Inhibitors acting at the allosteric binding site - Competitive and Non-competitive Inhibitors - Transition-state Analogues - Suicide Substrates - Isozyme selectivity of inhibitors - Medical Uses of Enzyme Inhibitors	**Textbooks 1-4/**	
10	**1** **1** **1**	Molecular Modeling - Computational Methods. - Potential energy. - Molecular mechanics - Quantum Mechanics - Conformational analysis - Molecular Dynamic Simulation (MD) - X-ray crystallography - Superposing	**Textbooks 1-4/**	
11	**1** **1** **1**	Structure-Based Drug Design (SBDD) - Molecular Docking	**Textbooks 1-4/**	

12	1 1 1	**Combinatorial Chemistry** - **General Aspects.** - **Parallel Synthesis.** - **Solid Phase Technique.** - **Split synthesis: peptide libraries.** - **Anchors.** - **Protecting Groups.**	**Textbooks 1-4/**	
13	1 1 1	**Ligand-Based Drug Design (LBDD)** - **Pharmacophore modeling** - **Quantitative Structure-Activity Relationships (QSAR)** - **Methods to correlate physicochemical parameters with biological activity.** - **Equations and Graphs**	**Textbooks 1-4/**	
14	1 1 1	**Ligand-Based Drug Design (LBDD)** - **Physicochemical Parameters** - **Hydrophobicity** - **Electronic Property** - **Steric Property** - **Hansch Analysis.** - **De Novo Method.** - **Enhancement Factor.** - **Topliss Schemes.** - **COMFA**	**Textbooks 1-4/**	
15	1 1 1	**Case Study I:** **Design of ACE Inhibitors**	**Textbook 1/**	
16	1 1 1	**Case Study II:** **Current Research into Antidepressant Agents**	**Textbook 1/**	

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Theoretical course evaluation methods and weight	First exam 25% Second exam 25% Final exam 50%	**Practical (clinical) course evaluation methods**	

Approved by head of department		**Date of approval**	

Extra information (to be updated every semester by corresponding faculty member)

Name of teacher	Dr. Buthaina Hussein Dr. Ali Ibrahim	Office Number Office Number	**404** **405**
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Office hours(Dr.Buthaina	Sunday, Tuesday11-12 pm Wednesday, Monday 11-12 pm Thursday 2-5pm		
Office hours(Dr.Ali)	Sunday, Tuesday, Thursday 10-11 am Wednesday, Monday 11-1 pm		