

**Punjab University College of
Pharmacy Faculty of Pharmacy
University of the Punjab, Lahore
Course Outline**



Programme	Pharm.D 1 st Semester	Course Code	PHARM-103 (Theory), PHARM-104 (Lab)	Credit Hours	3+1
Course Title	Pharmaceutical Chemistry-IA (Organic Chemistry I)				
Course Introduction					
Pharmaceutical Chemistry-IA (Organic Chemistry I) course introduces the fundamental principles of organic chemistry with emphasis on concepts that are essential for understanding the chemical basis of drug molecules and pharmaceutical applications. The course covers the basic concepts of chemical bonding, hybridization, resonance, aromaticity, electronic effects, and tautomerism that influence the structure and reactivity of organic compounds. It also provides knowledge of the synthesis, nomenclature, structure, and properties of important functional groups commonly found in pharmaceutical compounds. Furthermore, the course explores different types of organic reaction mechanisms, including oxidation, reduction, substitution, elimination, and addition reactions, and highlights their relevance in drug synthesis and pharmaceutical transformations. Special attention is given to stereochemistry and conformational analysis, which are crucial for understanding the three-dimensional arrangement of drug molecules and their interaction with biological systems. Overall, the course aims to build a strong foundation in organic chemistry that supports the understanding of medicinal chemistry, pharmacology, and pharmaceutical sciences.					
Learning Outcomes					
On the completion of the course, the students will: • Understand the fundamental concepts of organic chemistry including chemical bonding, hybridization, resonance, aromaticity, electronic effects, hydrogen bonding, and tautomerism relevant to pharmaceutical compounds. • Understand the structure, nomenclature, properties, and apply knowledge of major functional groups such as alkanes, alkenes, alcohols, phenols, ethers, amines, aldehydes, ketones, carboxylic acids, esters, amides, and aromatic compounds used in drug synthesis. • Apply the principles of organic reaction mechanisms to interpret and predict common reactions such as oxidation, reduction, acylation, esterification, nucleophilic substitution (SN1 and SN2), elimination, and addition reactions. • Analyze the mechanisms of organic reactions occurring in aliphatic and aromatic systems and evaluate their significance in pharmaceutical synthesis and drug development.					
• Differentiate between various types of stereoisomerism including optical and geometrical isomerism and explain their importance in drug activity and pharmacological response. • Interpret stereochemical representations such as Fischer projections and perspective formulas, and perform conformational analysis of organic molecules with pharmaceutical relevance.					

Course Content (Theory)		Assignments/Readings
Week 1	Unit I: Basic concepts Introduction to science, chemistry, organic chemistry and pharmaceutical chemistry	Chapter 1. Bhupinder Mehta and Manju Mehta. Organic Chemistry. 2 nd Ed. PHI Learning Private Ltd. 2015.
	Role of pharmaceutical chemistry in pharmacy and medicine	
	Structure of atom and subatomic particles, and chemical bonding	Chapter 1. Review of General Chemistry: Electrons, Bonds, and Molecular Properties. Organic Chemistry. David Klein. John Wiley and Sons, Inc. Assignment: Prepare a comparison chart between different types of bonding and hybridization
Week 2	Concept of hybridization	
	Electronegativity	Chapter 3. Electron shift. D. N. Singh. Basic Concepts of Organic Chemistry. Pearson India Education Services Pvt. Ltd. Assignment: Make a comparison chart of permanent and temporary electronic effects.
	Inductive effect	
Week 3	Electromeric effect	
	Mesomeric effect	Chapter 21 & 27. Catherine E. Housecroft and Edwin C. Constable. Chemistry. Pearson Education Limited, England. Assignment: Write a detail note on significance of hydrogen bonding.
	Resonance	
Week 4	Steric effect	
	Conjugation	Chapter 4. Fundamentals of organic reactions. Bhupinder Mehta and Manju Mehta. Organic Chemistry. 2 nd Ed. PHI Learning Private Ltd. 2015.
	Hyperconjugation	
Week 5	Dipole moment	
	Hydrogen bonding	Chapter 4. Fundamentals of organic reactions. Bhupinder Mehta and Manju Mehta. Organic Chemistry. 2 nd Ed. PHI Learning Private Ltd. 2015. Assignment: On an A4 size paper, write criteria of aromaticity and types of aromatic rings.
	Tautomerism (keto-enol in tetracyclines and lactam-lactim)	
Week 6	Aromaticity	Chapter 4. Fundamentals of organic reactions. Bhupinder Mehta and Manju Mehta. Organic Chemistry. 2 nd Ed. PHI Learning Private Ltd. 2015. Assignment: On an A4 size paper, write criteria of aromaticity and types of aromatic rings.

	Unit II: Synthesis, structure, nomenclature, properties, and pharmaceutical applications of functional organic compounds in drug synthesis: Introduction to functional groups and functionality Role of functional groups in a drug's action and synthesis	Chapter 4. Thomas, G. (2013). Medicinal chemistry: A molecular and biochemical approach. Oxford University Press.
Week 7	Alkanes	Chapter 4-7. Rajesh Agarwal. Organic Chemistry-I (Module IV) for JEE (Main and Advanced). McGraw Hill Education, India Private Limited. Assignment: Compare hydrocarbons (acyclic and cyclic)
	Alkenes	
	Alkynes	
Week 8	Aromatic compounds (arenes)	Chapter 2. Rajesh Agarwal. Organic Chemistry-II (Module V) for JEE (Main and Advanced). McGraw Hill Education, India Private Limited. Assignment: Compare alcohols and ethers
	Alcohols	
	Phenols	
Week 9	Ethers	Chapter 3. Rajesh Agarwal. Organic Chemistry-II (Module V) for JEE (Main and Advanced). McGraw Hill Education, India Private Limited. Assignment: Compare aldehydes and ketones
	Aldehydes	
	Ketones	
Week 10	Carboxylic acids	Chapter 4. Rajesh Agarwal. Organic Chemistry-II (Module V) for JEE (Main and Advanced). McGraw Hill Education, India Private Limited. Assignment: Write a detail note on carboxylic acid and its derivatives
	Esters	
	Amides	Chapter 12. Thomas M. Lemke. Review of organic functional groups. Lippincott Williams and Wilkins.

Week 11	Amines	Chapter 5. Rajesh Agarwal. Organic Chemistry-II (Module V) for JEE (Main and Advanced). McGraw Hill Education, India Private Limited. Assignment: Compare amines and amides
	Alkyl halides	Chapter 1. Rajesh Agarwal. Organic Chemistry-II (Module V) for JEE (Main and Advanced). McGraw Hill Education, India Private Limited. Assignment: Compare reactivity of alkanes with alkyl halides
	Unit III. Stereochemistry and conformational analysis Stereoisomerism	Chapter 3. Lutfun Nahar and Satyajit Sarker. Chemistry for Pharmacy students. John Wiley & Sons, Inc. Publication.
Week 12	Molecule with more than one chiral center	Chapter 7. Bahl, A., & Bahl, B. A Textbook of Organic Chemistry, 22nd Edition. Assignment: Construct a concept map on types of stereoisomers
	Optical isomerism	
	Dextrorotatory and levorotatory systems	
Week 13	RS system	
	Geometrical isomerism	
	EZ isomers	
Week 14	Resolution of a racemic mixture	
	Conformational analysis	
	Applications in Pharmacy	
Week 15	Unit IV: Types of Reactions and Aromatic systems and their applications Oxidation, reduction	Chapter 5. Lutfun Nahar and Satyajit Sarker. Chemistry for Pharmacy
	Acylation, esterification	
	Nucleophilic substitution reactions	students. John Wiley & Sons, Inc. Publication.
Week 16	Elimination reactions	Assignment: Define a chemical reaction. Classify different types of chemical reactions involved in organic synthesis and explain each type with suitable examples.
	Addition reactions	
	Rearrangements and Polymerization reactions	

Textbooks and Reading Material				
Main source: Bhupinder Mehta and Manju Mehta. Organic Chemistry. 2 nd Ed. PHI Learning Private Ltd. 2015.				
Other sources: Lemke, T. L., & Williams, D. A. (2013). <i>Foye's principles of medicinal chemistry</i> (7th ed.). Lippincott Williams & Wilkins. Johnson, W. S. (2003). <i>Organic chemistry in the laboratory</i> . W. H. Freeman and Company. Abraham, D. J. (2017). <i>Burger's medicinal chemistry and drug discovery</i> (8th ed.). Wiley. Brown, W. H., & Bursten, M. L. (2014). <i>Introduction to organic chemistry</i> (8th ed.). Wiley. Vollhardt, K. P. C., & Schore, N. E. (2014). <i>Organic chemistry: Structure and function</i> (7th ed.). W. H. Freeman and Company. Thomas, G. (2013). <i>Medicinal chemistry: A molecular and biochemical approach</i> . Oxford University Press. Carey, F. A. (2007). <i>Advanced organic chemistry: Part A: Structure and mechanisms</i> (5th ed.). Wiley. Prasad, N. D. V. G. S., & Shinde, S. C. (2009). <i>Pharmaceutical organic chemistry</i> . Pharma Book Syndicate. Silverman, R. B. (2014). <i>The organic chemistry of drug design and drug action</i> (2nd ed.). Academic Press				
Course content (Practical/lab)				
1. Good laboratory practice for organic chemistry lab (Protocol for chemical handling of flammable, non-flammable, and acids) and introduction to organic chemistry lab apparatus and instruments. 2. Identify the functional group present in the given organic compound by systematic analysis. (carboxylic acids, phenol, aldehydes, ketones, amines, hydrazine, amide, thioamide, ester, nitro group, alcohol, etc.). 3. To identify compounds by synthesizing their derivatives (such as esters, amides, and salts of COOH; acetate, benzoate of alcohol; benzoate, 2,4-dinitrophenyl ether of phenol, etc. 4. Determination of melting point and boiling points of different organic compounds (Picric acid, oxalic acid, salicylic acid, citric acid, tartaric acid, succinic acid). 5. Purification of various organic compounds by crystallization (e.g., Benzoic acid). 6. Identification of various organic compounds (e.g., Oxalic acid, Salicylic acid, Phthalic acid, Benzoic acid, Cresol, Resorcinol.				
Assignments: Types and Number with Calendar				
Assignment/presentation (20 marks)			Class quiz (30 marks)	
No.	Week	Deadline for submission	No.	Week
Assignment 1 (Pre-mid)	Week 3	Within the timeline assigned by the teacher	Quiz 1 (pre-mid)	Week 4
			Quiz 2 (pre-mid)	Week 7
Assignment 2 (Post-mid)	Week 11		Quiz 3 (post-mid)	Week 10
			Quiz 4 (post-mid)	Week 14