GENERIC ELECTIVE: CONCEPTS IN MEDICINAL CHEMISTRY

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
CONCEPTS IN MEDICINAL CHEMISTRY	4	3	-	1	XII Passed	Basic knowledge of Chemistry and Biology

Learning Objectives:

The introduction to Concepts of Medicinal Chemistry course at undergraduate level to students has been conceived to make them understand:

- Concepts of chemical science interlinked to other science disciplines such as chemistry, biology, biochemistry, pharmacology etc.
- Application of the area in revealing new drug design and targets through studying the drug receptor interactions and lead discovery.
- Various drug targets in the body and drug development strategies.

Learning Outcomes:

- After completing the course, students shall be able to understand the structure and function of biomolecules, chemistry of stereoisomers and its importance in process of drug designing. Further, they will be able to explore various kinds of drug targets including protein, enzymes, nucleic acids etc.
- They will also appreciate the process of drug-receptor interactions; identify association between chemical structure and its physicochemical properties.
- After completion of the course, learners will demonstrate a strong foundation via problem solving, critical thinking and analytical reasoning in the fundamentals of medicinal chemistry, physicochemical principles of drug action and measurement of drug effects, comprehend the physicochemical basis for the rational drug design, analogue synthesis, and mechanism of action of drugs.
- Students will be able to design and carry out small molecule (low molecular drug-relevant compounds) synthesis. They will understand the natural product isolation and identification of their phytochemical constituents. They will also learn to identify biomolecules.

SYLLABUS **(45 hours)**

Unit I: Introduction and Stereoisomerism **(16 Hours)**

Importance of water as solvent, Partition coefficient, Drug dissolution, Acid-base properties, Henderson Hasselbach equation, Surface activity, Bio-availability, Hammett equation. Physicochemical Interactions-bonding and non-bonding interactions, Rational drug design and Introduction to SAR, Concept of prodrugs and Stereochemical aspects of drug action.
Optical isomerism: Optical activity, enantiomerism, D and L designation, racemic modification, R and S sequence rules, diastereoisomers, (2L), Geometrical isomerism: Definition, nomenclature– E and Zisomerism, Walden inversion, Conformational isomers: conformation of ethane and butane, Specific rotation, optical purity.

Unit II: Biomolecules **(8 Hours)**

Amino Acids: Structure and classification of amino acids, ionization & titration curves and formation of peptide bond, cis and trans conformation and planarity. Ramachandran Plots (phi, psi and omega), Secondary structure of proteins (α-helical, β-pleated sheet). Nucleotides: structure and numbering, Tautomerism in nucleic acid bases, pH and properties; Sugars and conformation of sugar phosphate backbone. Monosaccharides- cyclization of aldoses and ketoses, concept of mutarotation, anomers, epimers.

Unit III : Principles of Drug Action: Receptor Interactions & Target Classification

(a): Drug-Receptor Interaction **(8 Hours)**
Kinetic analysis of ligand receptor interactions using Scatchard plot, Double reciprocal plot, Hill plot, Forces involved, Affinity, Efficacy and potency, Relationship between dose and effect (graded and quantal response). Concept of Enzyme inhibition and Michaelis equation. Drug distribution and Zero & First order kinetics, half life, Microsomes and drug metabolism-Phase I and Phase II enzyme
(b): Drug Target Classification **(8 Hours)**
Drug Target Classification: Proteins as target: a) Classification of receptors and their functions and their activation/inhibition (such as Agonist, antagonists and inverse agonist) , Desensitization and sensitization of receptors. b) Enzymes as targets: Enzyme inhibitors (competitive, non-competitive, suicide inhibitors)Nucleic acids as drug targets: Classes of drugs that interact with DNA: DNA intercalators (amsacrine) and DNA alkylators (amine: mechlorethamine, nitrosoureas: carmustine).

Unit IV: New Drug Approval Process and regulatory affairs **(5 Hours)**

Investigational New Drug Applications (INDs): Approval processes and timelines involved, Preclinical testing, Clinical testing - Phase I, II, III and IV, Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures. Pharmacovigilance - Safety monitoring in clinical trials, Introduction of Drugs and Cosmetics Act (1940 and 1945) and patent act 1970. Process of drug patent filing- specifications, framing of claims and various forms.

Practical: **(30 hours)**

(Wherever wet lab experiments are not possible the principles and concepts can bedemonstrated through any other material or medium including videos/virtual labs etc.)

1. Recrystallization of an organic compound (e.g., benzoic acid) and determination of its melting point.
2. Preparation of Hippuric acid/s-benzyl thiouronium salt/ Benzoquinone, recrystallization and characterization.
3. Phytochemical qualitative examination of *Curcuma Longa* constituents by solvent extraction (Tannins, Saponins, Flavanoids, Alkaloids, Polyphenols)
4. Conduct qualitative tests for amino acids/proteins**:** Ninhydrin, Xanthoproteic, Million's, Lead Acetate, Biuret test.
5. Prepare the titration curve of acetic acid/glycine.
6. Measure absorption spectrum of protein and DNA and calculate the purity of protein
7. Measure protein concentration using absorption spectrum (BSA)
8. Extraction of caffeine from tea leaves.
9. Study absorption property of caffeine using absorption spectroscopy.

Essential Readings:

- Patrick G.I. (2017). 6 th Edition. Introduction to medicinal chemistry. Oxford, UK: Oxford University Press. ISBN-13: 978-0198749691.
- Silverman, R.B. and Holladay, M.W. (2014). 3 rd Edition. The organic chemistry of drug design and drug action. San Diego, USA: Elsevier, Academic Press. ISBN-13: 9780123820303.
- Nelson, D. L. and Michael M. Cox (2021) 8th Edition. Lehninger Principles of Biochemistry. New Jersey, USA: Prentice Hall Publishers.
- Nasipuri, D. (2020), Stereochemistry of Organic Compounds: Principles and Applications, 4 th Edition, New Age International.
- Plummer, D. (2017) An Introduction to Practical Biochemistry, 3rd edition. McGraw-Hill College.

Suggested Readings:

- Wermuth, C. G., Aldous, D., Raboisson, P., & Rognan, D. (2015). *The Practice of Medicinal Chemistry* (4th ed.). Elsevier, Academic Press.
- King, F. D. (2003). *Principles and Practice of Medicinal Chemistry* (2nd ed.). The Royal Society of Chemistry
- Nogrady, T., & Weaver, D. F. (2005). *Medicinal Chemistry: A Molecular and Biochemical Approach* (3rd ed.). Oxford University Press