

DISCIPLINE SPECIFIC CORE COURSE -1 (DSC-1) BIOORGANIC 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		
Bioorganic Chemistry	4	3	0	1	Class XII with Chemistry	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- Bioorganic Chemistry is a discipline that integrates organic chemistry and biochemistry.
- It aims at understanding the relevance of biological processes using the fundamental concepts of organic chemistry.
- This course includes basic principles of organic chemistry like concepts of stereochemistry and their importance in understanding various bio-molecular reactions along with introduction to biomolecules.

Learning outcomes

The Learning Outcomes of this course are as follows:

- By studying this course, the student will be able to identify, assess and analyze different types of stereoisomers and their properties in organic compounds and biomolecules.
- They will understand the structures and function of biomolecules (carbohydrates, amino acids, lipids and nucleotide).
- Student will understand the mechanism of biologically significant name reaction and their role in biological systems.

SYLLABUS OF DSC-1

UNIT – I : Stereochemistry (2 Weeks)

Optical isomerism: Optical activity, specific rotation, enantiomerism, D and L designation, racemic modification, R and S sequence rules, diastereoisomers.

Conformational isomers: conformation of ethane and butane, inter conversion of projection formula, cyclohexane (mono- and di-substituted), resolution, optical purity.

Geometrical isomerism: Definition, nomenclature– E and Z

UNIT – II: Introduction to Biomolecules I (4 Weeks)

Monosaccharides- cyclization of aldoses and ketoses, conformations, concept of mutarotation, anomers, epimers.

Disaccharides- structure, reducing and non-reducing sugars. Polysaccharides- Starch, glycogen and cellulose.

Lipids:

Fattyacids, triacylglycerols, phospholipids, lipid bilayer formation, steroids (cholesterol)

UNIT – III: Introduction to Biomolecules II (6 Weeks)

Amino Acids:

Structure and classification of amino acids, ionization, chemistry of peptide bond, non-ribosomal peptide bond formation, essential and non-essential amino acids, amino acids as precursors of other bioactive compounds, zwitterion, isoelectric point, optical properties of amino acids, Definition of a peptide, peptide unit, peptide group, bond length, cis and trans conformation, primary, secondary (alpha helix, beta sheet, beta turn, collagen helix), tertiary and quaternary structures(with examples).

Nucleotides:

Sugars and Bases, conformation of sugar phosphate backbone, hydrogen bonding and tautomerism in nucleic acid bases

Effect of structure on reactivity of biomolecules.

UNIT – IV: Biologically Significant Name Reactions (3 Weeks)

Aldolcondensation (Glucogenesis), retro-aldol(Glycolysis),benzoinecondensation (umpolung-decarboxylation of pyruvate in the presence of TPP), Claisen condensation (synthesis of fattyacids), Michael addition (Dehydrases),Cannizzaro (Sugar metabolism), Bayer Villiger reaction (FAD dependent ketone synthesis), Pinacol pinacolone rearrangement(1,2-carboncarbonshift)

Practical component

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

1. Qualitative tests for carbohydrates to identify the given unknown carbohydrate solution: Mohlisch, Barfoed, Fehling/ Tollen/ Benedict tests
2. Qualitative tests for carbohydrates to identify the given unknown carbohydrate solution: Iodine test, Selvinoff, Osazone, Bial's tests
3. Qualitative tests for Amino acids and Proteins: Ninhydrin, Xanthoproteic, Million's, Lead Acetate, Biuret test
4. Qualitative test for Fats
5. To determine the Iodine number of the given oil/fat.
6. To find pKa value of acetic acid
7. To study the titration curve of glycine
8. Absorption spectrum of Protein
9. Absorption spectrum of DNA
10. Estimation of a Reducing sugar in a given sample.

Essential/recommended readings

- Nelson, D. L. and Michael M. Cox (2021) 8th Edition. Lehninger Principles of Biochemistry. New Jersey, USA: Prentice Hall Publishers.ISBN-13:978-1319228002.
- Nasipuri, D. (2020), Stereochemistry of Organic Compounds: Principles and Applications, 4 th Edition, New Age International. ISBN 10: 9389802474
- Solomons, T. W. G.; Fryhle, C. B.; Snyder, S. A. (2017), Organic Chemistry, 12th Edition, Wiley. ISBN: 978-1-119-24897-2

- Plummer, D. (2017) An Introduction to Practical Biochemistry, 3rd edition. McGraw-Hill College; ISBN-13: 978-0070841659.

Suggestive readings:

- Hoffman, A. 8th Edition (2018). Wilson And Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge: Cambridge University Press. ISBN- 13: 9781316677056