



JYOTI NIVAS COLLEGE AUTONOMOUS BANGALORE – 560 095
DEPARTMENT OF BIOCHEMISTRY
B.Sc. II SEMESTER BIOCHEMISTRY PAPER II SYLLABUS (2024 SEP BATCH)
BIO-ORGANIC CHEMISTRY

Course title	BIO-ORGANIC CHEMISTRY
Course code	24IIBC2T
Course credits	03
Total contact hours	56 Hours
Duration of ESA	03 Hours
Continuous Internal assessment (CIA)	20 Marks
End Semester Examination	80 Marks

COURSE OBJECTIVES

Through this course, the student is imparted with

- Fundamentals of bio-organic chemistry and its applications in biomolecules and biological reactions.
- Implementation of reaction mechanism in biomolecules and biological reactions.
- Knowledge to identify organic biomolecules and its significance in biological science.

LEARNING OUTCOMES

On completion of this course, the student should be able to:

- Apply the concepts of organic molecules that constitute the foundation of biomolecules.
- Illustrate how the organic reactions mechanism applies to biological systems.
- Link the fundamentals and applications of bio-organic chemistry in biomolecules and biochemical reactions.
- Understand the significance of organic reactions and their relevance to biological systems. It help them gain a good understanding of aliphatic and aromatic compounds, nomenclature, reactivity of functional groups and the importance of stereoisomers in biological systems, and structure activity relationships in biomolecules.

Course Content:

UNIT-I

14 Hours

1.1 Introduction to organic chemistry:

3 hours

Classification of organic compounds, unique characteristics, IUPAC nomenclature of organic compounds (including bi-functional) and biomolecules.

1.2 Hydrocarbons:

4 hours

Markownikoff and anti-Markownikoff addition. Addition of HBr to propene. Alkenes – Ozonolysis, oxidation. Dienes – types with examples, 1, 3 butadiene – Preparation, stability and mechanism of addition of HBr. Diels-Alder reaction. Conformational

analysis of ethane.

1.3 Reaction mechanisms:

4 hours

Concept of inductive effect, resonance and hyperconjugation. Classification of organic reactions (substitution, addition, elimination and rearrangement), with two examples for each. Concepts of the following – carbanions, carbocations, free radicals, carbenes, nucleophiles and electrophiles (Formation and Stability).

1.4 Alkyl halides and organometallic compounds:

3 hours

SN^1 , SN^2 and SN^i reactions, their mechanism with one example for each. Concept of elimination reactions (E^1 , E^2 and E^1CB with an example). Organometallic compounds – definition and applications of organo lead, organo lithium, cis-platin.

UNIT-II

14 Hours

2.1 Arenes:

7 hours

Structure of benzene – by Resonance and Molecular orbital theories. Aromaticity (Huckel's rule). Mechanism of Nitration and Friedel- craft reaction. Electronic interpretation of the orientating influence of substituents in the electrophilic substitution of toluene, chlorobenzene, nitrobenzene and phenol. Resonance structures of naphthalene and anthracene.

2.2 Stereochemistry:

7 hours

Stereoisomerism, types, Fischer-projection formulae, chiral carbon atom, asymmetry and dissymmetry, chirality, conditions for optical isomerism ex: glyceraldehyde, lactic acid, tartaric acid, Nomenclature of enantiomers, diastereomers. D and L notation, R and S system, racemization and resolution (Biochemical, chemical and physical methods). Geometrical isomerism: cis-trans isomerism in alkenes and ring compounds (5- and 6-membered), structure of maleic and fumaric acid. EZ system of specifying geometrical isomers, Significance of chirality in the biological world: Examples – D-phenylalanine and D-alanine.

UNIT-III

14 Hours

3.1 Alcohols and phenols

4 hours

- 4 Classification, monohydric alcohols: examples, general and distinguishing reactions. (any 2 reactions for primary, secondary and tertiary alcohols);.Dihydric alcohols: glycols (preparation – any 2 methods), Tri hydric alcohols: glycerol – synthesis from propene, properties and uses. Phenols: Classification, Structure and role of naturally occurring phenols.

3.2 Hydroxy acids and dicarboxylic acid

3 hours

Structure, properties and biological importance of hydroxy acids: Lactic acid, citric acid and isocitric acid. Dicarboxylic acid: Maleic and fumaric acid. Ketoacids: Pyruvic, α -ketoglutaric, oxaloacetic acids.

3.3 Carbonyl compounds:

4 hours

General properties. Aldehydes and ketones. Keto-enol tautomerism, Mechanism: Claisen and aldol condensations. Mechanism of addition of HCN to acetaldehyde (usefulness in Kiliani synthesis), addition of phenyl hydrazine and hydroxylamine to glucose (Osazone test) Quinones: Biologically important quinones (vitamin K1, K2, K3)

3.4 Amines:

3 hours

Classification, properties, functional amino group – Basicity of amines, acylation. React with HNO_2 & Schiff's base formation. Distinguishing reactions of primary, secondary and tertiary amines. Physiological importance of Biogenic amines.

UNIT-IV

14 Hours

4.1 Heterocyclic compounds:

4 hours

Definition, classification with examples, structure and biological importance of furan, pyrrole, thiophene, pyridine, pyran, thiazole, pyrimidine, purine, indole, imidazole, quinoline and isoquinoline. Basicity of pyrrole and pyridine.

4.2 Terpenes:

3 hours

Definition, isoprene rule, classification, structure and biological importance of menthol, camphor, farnesol, phytol, lanosterol, lycopene and dolichols.

4.3 Steroids:

3 hours

Basic ring structure in steroids. Structure and biological importance of cholesterol, phytosterols and ergosterol. Bile acids [Mono, Di & Tri cholic acids].

4.4 Alkaloids:

4 hours

Definition, classification based on their structure and biological functions, structure and biological action of morphine, nicotine & atropine. Chemical synthesis of nicotine.

Suggested Readings:

- Arun Bahl and B. S. Bahl, *Advanced Organic Chemistry*, 22nd Edition, 2019, S. Chand.
- L. Finar: *Organic Chemistry* (Vol. I & II), 6th Edition, 2002, Pearson Education India.
- R. T. Morrison & R. N. Boyd: *Organic Chemistry*, 7th Edition, 2010, Pearson Education India.
- D. Nasipuri .*Stereochemistry of Organic Compounds*, 4th Edition, 2020. NEW AGE International Pvt Ltd
- S. Sengupta. *Basic Stereochemistry of Organic Compounds*, 1st Edition, 2014, Oxford University Press.
- P. Sykes. *A Guide To Organic Reaction Mechanism*, 6th Edition, 2003, Pearson Education.

BIOCHEMISTRY PRACTICALS SEMESTER II

Course title	Bio-Organic Chemistry
Course code	24IIBC2P
Course credits	02
Total contact hours	3 Hours / week
Duration of ESA	03 Hours
Continuous Internal assessment (CIA)	10 Marks
End Semester Examination	40 Marks

Learning outcomes:

This laboratory course is aimed at imparting skills of identifying organic compounds, demonstrating reactivity of various functional groups, and synthesis of simple organic compounds of biological importance.

Practical content:

1. **Systematic qualitative analysis of the organic compounds:** Urea, glucose, benzamide, benzaldehyde, aniline, acetophenone, nitrobenzene, chlorobenzene, *p*-toluidine, benzoic acid, salicylic acid, resorcinol, and ethyl acetate.
2. **Organic preparations:** Aspirin from salicylic acid, benzoic acid from benzaldehyde, and meta-dinitrobenzene from nitrobenzene.

