

Sri Venkateswara College

COURSES OFFERED BY DEPARTMENT OF
BOTANY, BIOCHEMISTRY, ZOOLOGY, CHEMISTRY AND PHYSICS

B.Sc. (Hons.) Biological Science

Category-I

DISCIPLINE SPECIFIC CORE COURSE – 01: Basic concepts of Biomolecules

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		
Basic concepts of Biomolecules	DSC-101	2	0	2	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: Physics+ Chemistry+ Biotechnology Biology/	Nil

Learning Objectives

The Learning Objectives of this course are as follows:

- to develop a basic understanding of the structure, bonding, stability, stereochemistry and reactivity of organic molecules with focus on biomolecules.
- This basic knowledge will empower the students to develop an understanding about chemistry and biology of biomolecules such as proteins and nucleic acids. This course also provides a basic understanding of the chemistry of carbohydrates and lipids.
- This knowledge will help students to better understand the biological applications of these biomolecules.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understand and apply the fundamental principles of chemistry which include bonding, electronic effects, molecular forces and stability of reactive intermediates to biomolecules.
- Gain an insight into the influence of chemical bond polarization on a molecular structure and its reactivity.
- Identify the type of metabolic reaction and draw reaction mechanisms for key metabolic processes.
- Recognize stereochemistry of a biomolecule and give a rational explanation of its biological reactivity based on stereochemistry.
- Understand the chemistry and biological functions of carbohydrates and lipids

SYLLABUS OF DSC-1

Unit I: Basic Concepts

(6 hours)

Electronic displacements and their applications: Inductive, electromeric, resonance and hyperconjugation. Dipole moment, acidity and basicity. Types, shape and relative stability of carbocations, carbanions and free radicals. Electrophiles and nucleophiles, Intramolecular and intermolecular molecular forces including hydrophobic, hydrophilic interactions and hydrogen bond (emphasis on effect of these forces on the stability of biomolecules),

Unit II: Stereochemistry

(8 hours)

Stereochemistry and its importance to biological systems, Stereoisomerism: Optical activity and optical isomerism, asymmetry, chirality, enantiomers, diastereomers. Mesomers, specific rotation; Resolution of racemic modification, Configuration and projection formulae: Newmann, Sawhorse, Fischer projections and their interconversion. Chirality in molecules with one and two stereocentres; CIP rules: Erythro/Threo, D/L and R/S designations.; Relative and absolute configuration; thalidomide case and chiral drugs; Geometrical isomerism: cis-trans, syn-anti and E/Z nomenclature.; Cis-trans isomerism in vision.

Unit III: Biologically significant chemical reactions

(6 hours)

Aldol condensation (Glucogenesis), Retro-aldol (Glycolysis), Benzoin condensation (umpolung-decarboxylation of pyruvate in the presence of TPP), Claisen condensation (Synthesis of fatty acids), Michael addition (Dehydrases), Cannizzaro (Sugar metabolism), Baeyer Villiger reaction (FAD dependent ketone synthesis), Pinacole-pinacolone rearrangement (1,2-carbon carbon shift), Isomerisation (Glycolysis), Redox reaction (Lactate dehydrogenase).

Unit IV: Carbohydrates

(6 hours)

Classification of carbohydrates, reducing and non-reducing sugars, biological functions, linkage between monosaccharides, general properties and reactions of glucose and fructose, their open chain structure, epimers, mutarotation and anomers, reactions of monosaccharides, configuration, cyclic structure (exclude structure elucidation) and Haworth projection formulae of glucose and fructose: structure of disaccharides (sucrose, maltose, lactose); polysaccharides- classification, structure of important members, storage polysaccharides (Glycogen, Starch) and structural polysaccharides (Cellulose, chitin, peptidoglycans and glycosaminoglycans)

Unit V: Lipids

(8 hours)

Introduction, classification, biological importance of triglycerides, phospholipids, glycolipids, eicosanoids and steroids (cholesterol). Oils, Fats and Waxes: Common fatty acids present in oils and fats, essential fatty acids, characteristics of fatty acids and fats (saponification, iodine, acid, acetyl and peroxide values). Rancidity and reversion of fats; waxes, trans-fats and their biological significance.

Practical component: (60 hours)

1. Purification of organic compounds by recrystallization using the following solvents:
 - i. Water
 - ii. Water-Alcohol
 - iii. Alcohol
2. Criterion of purity of organic compound- melting point, mixed melting point and boiling point of organic compounds.
3. Estimation of saponification value of fat/oil.
4. Estimation of iodine value of fat/oil.
5. Qualitative tests for carbohydrates and lipids
6. Chromatography
 - a) To separate a mixture of sugars by circular paper chromatography
 - b) To separate a mixture of lipids in a sample by Thin Layer Chromatography.

Essential/recommended readings

- A Guidebook to mechanism in organic chemistry (2003) 6 th ed., Sykes, P. New York: John Wiley & Sons. Inc
- Organic Chemistry (2014) 7 th ed., Morrison, R.T., Boyd, R.N., Bhattacharjee, S. K., Pearson Education
- Stereochemistry of Organic Compounds (1994), Eliel, E. L., Wilen, S. H. John Wiley& Sons.
- Stereochemistry: Conformation and Mechanism (2015) 8 th ed., Kalsi, P. S. New Age International
- Organic Chemistry (2013), Madan, R. L. Tata McGraw Hill Education Private Limited, New Delhi
- Organic Chemistry (2020) 8th Edn., Bruice, P. Y., Pearson

Suggestive readings: Nil

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.