GENERIC ELECTIVE COURSE (BIOMED-GE): BIOCHEMICAL BASIS OF LIFE

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		
BIOCHEMICAL BASIS OF LIFE]	4	3	0	1	XII Passed	Basic knowledge of biology

Learning objectives

The Learning Objectives of this course are as follows:

- The objective of this course is to address how the wonderful and remarkable properties of living organisms arise from the various biomolecules, the building blocks.
- The course focuses on the chemical complexity and organization of molecules in a living cell, extraction and transformation of energy
- It gives insights into the changes that occurred during the gradual evolution of life.

Learning outcomes

The Learning Outcomes of this course are as follows:

- The fundamental Chemistry of Life: students will gain an understanding of the elements found in living systems and appreciate the importance of water as the solvent for living systems. It is important to learn about the units used for expressing the biochemical basis of a living system. Students will learn the unit system for the molecular mass of biomolecules, units used for the concentration of solutions, and units for expressing the distances, etc.
- Cellular foundations of life**: a** stepwise organization of a living system, starting from the smallest unit to an entire living organism would be the focal point in this unit.

- Molecular basis of life**: s**tudents will understand the monomeric forms of different types of biomolecules. In addition, the relationship between the structure and function of biomolecules would also be learnt.
- Physical foundation of life: students would learn the concept of enthalpy, entropy and free energy in a living system and understand the importance of the energy currency and the significance of coupled biochemical reactions.
- Biochemical events in the origin of life: students would learn the origin of life and the nature of transformative changes that occurred for life to evolve from the pre-biotic world to the modern times.

SYLLABUS (

Unit I: The fundamentals of chemistry of life (06 hrs)

Carbon chemistry of life, structure and importance of water, diverse inorganic ions, major elements (C, H, O, N, S), trace elements. Units used in biochemistry such as those expressed for the atomic mass unit (daltons), concentration (moles/litre) and distance (in nanometer-scale).

Unit II: Cellular foundations of life (06 hrs)

Levels of organization in a living system. The important features of living cells, subcellular organelles in eukaryotic cells and subcellular organization in prokaryotic cells. Brief description on phototrophs, chemotrophs, autotrophs and heterotrophs.

Unit III: Molecular basis of life (12 hrs)

Common functional groups and linkages in biomolecules.

Macromolecules: classification, building blocks, structural and functional diversity. Structural and functional forms of macromolecules: Proteins (collagen, albumin, hormones (insulin), enzyme (proteases, nucleases, amylases and lipases); Polysaccharides (starch, glycogen, cellulose), Nucleic acids, Lipids (cholesterol and triglycerides).

Unit IV: Physical foundation of life (11 hrs)

Enthalpy, Entropy, Free Energy, Standard Free Energy, Equilibrium constant, Open and closed systems, endergonic and exergonic reactions, the energy currency in a biological system (ATP), energy coupling reactions.

Unit V: Biochemical events in the origin of life **(10 hrs)**

Landmark events in the evolution of life. Biochemical basis of the origin of aerobic and anaerobic world. Evolution of biological monomers and polymers from pre-biotic compounds. Properties of DNA as genetic material. Structural and functional analysis of eukaryotes and prokaryotes, with suitable examples.

Practical **(30 hrs)**

(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. Preparation of buffer at a specific molarity and pH.
2. Numerical problems based on Enthalpy, Free Energy and Entropy.
3. Comparative analysis of protein content in egg white and egg yolk using Bradford method.
4. Detection of a glucose polymer (starch) in rice/potato/corn, using iodine test.
5. To assess the differential solubility of lipids in aqueous and organic solvents.
6. Extraction of DNA from plant/microbial cells by the spooling method.
7. Demonstration of agarose gel electrophoresis for analyzing the isolated DNA.
8. To compare the structural features of a prokaryotic and eukaryotic cell by studying their electron micrographs.

Essential readings

- Nelson, D.L. and Cox, M.M. (2021). Lehninger: Principles of Biochemistry(7th ed.). W.H. Freeman & Company (New York), ISBN:13:9781319322328
- Pratt, C.W. and Cornely, K.(2017). Essential Biochemistry (4th ed.) John Wiley& Sons, Inc.ISBN:9781119012375
- Plummer, D.T. (2012). An Introduction to Practical Biochemistry. New Delhi, India: McGraw-Hill College.

Suggestive readings:

- Berg, J., Gatto, G., Stryer, L. and Tymoczko, J. L. (2019). Biochemistry. New York, USA: W. H. Freeman and Company.
- Campbell, M. K. and Farrell, S. O. (2017) 9th Edition. Biochemistry. Boston, USA: Brooks/Cole Cengage Learning. ISBN-13: 978-1305961135