Course title: Concepts in Biochemistry			
Course code: BBP154	**No. of credits:** 3	**L-T-P:** 26-16-0	**Learning hours:** 42
Pre-requisite course code and title (if any)			
Department: Department of Biotechnology			
Course coordinator (s): Dr Chaithanya Madhurantakam		**Course instructor (s):** Dr Chaithanya Madhurantakam	
Contact details: Chaithanya.madhurantakam@teriuniversity.ac.in			
Course type	Core	**Course offered in:** Semester 1	

Course description

The course is concept-driven and is aimed at providing students the fundamental answers to the molecular logic of life, the macromolecular structure and function relationships, the molecular circuits and the biochemical energy transformations of life. Biochemistry as a discipline is constantly evolving and the course acts as a platform to understand the complex molecular mechanisms underlying the survival of living systems and their interaction with the immediate environment. Familiarity with these concepts allows students to translate these into biotechnological applications.

Course objectives

1. To familiarize students with the molecular components of a cell and their interactions with the environment.
2. To acquaint students with the macromolecular structural organization and relation to the functional significance of such a conformation.
3. To familiarize students with molecular interplay involved in signal transduction and ubiquitination, transport mechanisms and metabolic pathways.
4. To provide students with fundamentals of laws of thermodynamics and bioenergetics of cell organelles

Course contents

Sr. No.	Topic	L	T	P
Module 1: The Molecular Logic of Life				
1	**Biomolecules, Bioactive compounds and Molecular Environment** Carbohydrates, Lipids, Amino Acids, Nucleic Acids, Vitamins, Hormones, Bioactive Compounds, Water and Acid-Base Chemistry	1	1	0
2	**Bio-Molecular Interactions** Supra-molecular Chemistry of Biomolecules (Specific and Non-specific Molecular Interactions, Short range Repulsions, Electrostatic Interactions, Dipolar Interactions, Fluctuating Dipoles, Hydrogen Bonding, Cation-π Interactions, Hydrophobic Effect, Counter-ion Release)	2	1	0
Module 2: Protein Structure and Function				
1	**Levels of Structural Organization & Conformation** The different aspects of protein structure, DSSP Classification, Ramachandran's Plot, Protein Folding & Misfolding, Protein structure determination, web resources and databases	2	1	0
2	**Fibrous Proteins & Regulatory Proteins** Structural proteins, Contractile Proteins and the Cytoskeleton, Receptors, Transporters, Storage proteins, Hormones and Immunoglobulins, Transcription Factors, Enzymes	2	1	0
3	**Enzymes** Enzyme Catalysis and Kinetics, Enzyme Inhibition and inhibition kinetics, Biological regulation of enzymes (Allosteric and Feedback Inhibition), Mapping of the active site and investigation of mechanism, Fermentation Process Kinetics	2	2	0
Module 3: Molecular Circuits				
1	**Membrane Transport** Bio-membranes (Structure, Activity, Fluidity, Permeability and Dynamics), Lipid-Protein Interactions, Membrane Channels & Transporters (Types of ATPases, ABC family, SLC family), Membrane Potential	2	2	0
2	**Signal Transduction Cascades** Primary and Secondary Messengers (cAMP, cGMP, Calcium ion, IP3, DAG), G Protein Signal Cascade & Epinephrine s1ignaling, Phosphatidyl-Inositol Signal	3	2	0

	Cascade, Nitric Oxide as Signal, , EGF Signaling and Receptor Tyrosine Kinases-the Ras-MAPK pathway, Insulin Signaling and the PI3K/akt kinase pathway, Wnt Signaling, Two-Component Signal Transduction, Apoptosis Signaling			
3	**Ubiquitin System** Enzymes in Ubiquitin System, Mechanisms of Ubiquitination, Ubiquitin-Proteasome Pathway	3	2	0
4	**Metabolic Pathways** Metabolic Pathways of Macromolecules and Cellular Respiration,The Generation and storage of metabolic energy, Glycolysis, The citric acid cycle, Oxidative phosphorylation, Glycogen metabolism, gluconeogenesis and the pentose phosphate pathway, Fatty acid metabolism	3	1	0
Module 4: Bioenergetics				
1	**Principles of Bioenergetics** The Laws of Thermodynamics, Gibbs free energy and Free energy changes, Redox Potentials and energy currency, The Three Levels of Bioenergetics in Eukaryotes/ Energy Transfer within Biosphere, Non-equilibrium Thermodynamics	2	1	0
2	**Chloroplast Bioenergetics** Redox Couples, Electron Transfer in Chloroplasts, Transmembrane Or Chemi-osmotic hypothesis	2	1	0
3	**Mitochondrial Bioenergetics** Electron Flow Components in Mitochondria, Oxidative Phosphorylation	2	1	0
	Total	**26**	**16**	**0**

Evaluation criteria

- 2 minor tests : 30% each
- 1 major test (end semester) : 40%

Learning outcomes

1. An understanding of the basic components involved in cell survival.
2. An insight into macromolecular organization and its functional importance.
3. A detailed analysis of metabolic pathways, transduction and transport mechanisms vital for living systems. Grasp of molecular networks and their interplay.
4. The ability to understand and apply the energy transformation mechanisms and laws governing the transformations.

Pedagogical approach

Providing case studies to support the concepts
Peer-Reviewed Reviews and Research Articles to discuss various modules in the course

Materials

Suggested readings

1. Hershko A, Ciechanover A. Annu Rev Biochem.67,425-79 (1998)
2. Cecile M.P. Annu Rev Biochem. 70, 503-533 (2001)
3. Ann M.S., Victoria L.R., Paul N.G. Annu Rev Biochem. 69, 183-215 (2000)
4. Fabrizio C., Christopher M.D. Annu Rev Biochem. 75, 333-366 (2006)
5. Voges D., Zwickl P., Baumeister W. Annu Rev Biochem. 68, 1015-1068 (1999)
6. Gaden Jr. E.L. J. Biochem. & Microbiol. Tech & Engg. 1, 413-429 (1959)
7. Andreas Strasser, Liam O'Connor, Vishva M. Dixit. Annu Rev Biochem. 69, 217-245 (2000)
8. Douglas C.W. PNAS, 107(2), 8947-8953 (2010)
9. Voet D., Voet, J.G. Biochemistry, John Wiley & Sons, Inc.; 4th edition (November 22, 2010)
10. West E.S., Todd W.R. Textbook of Biochemistry, The Mac Millan Publishing Company; 4th edition (1966)
11. Nelson D.L., Cox M.M. Lehninger Principles of Biochemistry, Mac Millan; 6th edition (2013)

Additional information (if any)

Student responsibilities

Attendance, feedback

Course reviewers:

1. Prof. Amit Kumar Das, IIT Kharagpur
2. Dr. Rajan Sankaranarayanan, CCMB- Hyderabad