

Course title: Principles of Biochemistry and Biophysics				
Course code: BBP 161	No. of credits: 2	L-T-P: 30-0-0	Learning hours: 30	
Pre-requisite course code and title (if any): Science graduate				
Department: Department of Biotechnology				
Course coordinator: Dr. Chaithanya Madhurantakam		Course instructor: Dr. Chaithanya Madhurantakam		
Contact details: chaithanya.madhurantakam@terisas.ac.in				
Course type: Core		Course offered in: Semester 1		
Course description: The course is designed to provide students with basic concepts, principles and applications of biochemistry and biophysics. This is aimed at providing information on molecular logic of life, supramolecular chemistry, structure and function of macromolecules, molecular circuits/ information processing cellular networks, cell mechanics and dynamics, molecular bioenergetics, and applications. The course will provide inputs on how emerging biochemical and biophysical techniques greatly enhanced our understanding of biological systems and functioning. Furthermore, the course is focused on recent developments and evolving scenarios in biochemistry and biophysics and will be a good platform for students to further pursue their careers in sciences.				
Course objectives:				
<ol style="list-style-type: none"> 1. Introduction to the molecular components of a cell, complex chemistry, and their interactions with the environment. 2. Familiarization of students with the macromolecular structural organization and relation to the functional significance of such a conformation through enzyme kinetics. 3. Acquainting the students with concepts of cell mechanics and applications, cellular dynamics and techniques employed. 4. Familiarization with biomolecular interplay involved in signal transduction and ubiquitination, apoptosis, transport mechanisms and metabolic pathways. 5. Providing students with fundamentals of laws of thermodynamics, Non equilibrium thermodynamics and cellular bioenergetics. 				
Course contents				
Module	Topic	L	T	P
Module 1: Biomolecules and supramolecular chemistry				
1.1	Biomolecules, Bioactive compounds and Molecular Environment, 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)	5	0	0
Module 2: Structure and function of macromolecules				
2.1	Levels of Structural Organization & Conformation, DNA structure, Protein structure, DSSP Classification, Ramachandran's Plot, Protein Folding & Misfolding, Structural Proteins & Regulatory Proteins, Enzyme catalysis and kinetics	4	0	0

Pedagogical Approach:

1. Classroom lectures.
2. Providing case studies to support the concepts.
3. Peer-reviewed research articles to discuss various modules in the course.

Skill Set:

1. Analytical skills based on case studies provided.
2. Knowledge of macromolecular applications in various sectors.
3. Knowledge of techniques employed to understand cellular systems.

Employability:

The course will provide skillsets and knowledge that may play key role to get employed in Universities, R & D industry, Medical centres/Colleges, Research Institutes and Diagnostic centres apart from specialized units like pharma, breweries, dairy and agri sectors.

Materials:**Suggested Readings**

1. Delbianco M, Bharate P, Varela-Aramburu S, Seeberger PH. Carbohydrates in Supramolecular Chemistry. *Chem Rev.* 2016 Feb 24;116(4):1693-752. doi: 10.1021/acs.chemrev.5b00516. Epub 2015 Dec 24. PMID: 26702928.
2. RAMACHANDRAN GN, RAMAKRISHNAN C, SASISEKHARAN V. Stereochemistry of polypeptide chain configurations. *J Mol Biol.* 1963 Jul;7:95-9. doi: 10.1016/s0022-2836(63)80023-6. PMID: 13990617.
3. Dobson CM. Protein folding and misfolding. *Nature.* 2003 Dec 18;426(6968):884-90. doi: 10.1038/nature02261. PMID: 14685248.
4. Chiti F, Dobson CM. Protein Misfolding, Amyloid Formation, and Human Disease: A Summary of Progress Over the Last Decade. *Annu Rev Biochem.* 2017 Jun 20;86:27-68. doi: 10.1146/annurev-biochem-061516-045115. Epub 2017 May 12. PMID: 28498720.
5. Kabsch W, Sander C. Dictionary of protein secondary structure: pattern recognition of hydrogen-bonded and geometrical features. *Biopolymers.* 1983 Dec;22(12):2577-637. doi: 10.1002/bip.360221211. PMID: 6667333.
6. Michaelis L, Menten ML, Johnson KA, Goody RS. The original Michaelis constant: translation of the 1913 Michaelis-Menten paper. *Biochemistry.* 2011 Oct 4;50(39):8264-9. doi: 10.1021/bi201284u. Epub 2011 Sep 9. PMID: 21888353; PMCID: PMC3381512.
7. Ait-Haddou R, Herzog W. Brownian ratchet models of molecular motors. *Cell Biochem Biophys.* 2003;38(2):191-214. doi: 10.1385/CBB:38:2:191. PMID: 12777714.
8. Mereghetti, P., Kokh, D., McCammon, J.A. *et al.* Diffusion and association processes in biological systems: theory, computation and experiment. *BMC Biophys* **4**, 2 (2011). <https://doi.org/10.1186/2046-1682-4-2>
9. Lamparter L, Galic M. Cellular Membranes, a Versatile Adaptive Composite Material. *Front Cell Dev Biol.* 2020 Aug 5;8:684. doi: 10.3389/fcell.2020.00684. PMID: 32850810; PMCID: PMC7419611.
10. Strasser A, O'Connor L, Dixit VM. Apoptosis signaling. *Annu Rev Biochem.* 2000;69:217-45. doi: 10.1146/annurev.biochem.69.1.217. PMID: 10966458.
11. Wallace DC. Colloquium paper: bioenergetics, the origins of complexity, and the ascent of man. *Proc Natl Acad Sci U S A.* 2010;107 Suppl 2(Suppl 2):8947-8953. doi:10.1073/pnas.0914635107
12. Biochemistry, 4th Edition, Donald Voet, Judith G. Voet, ISBN: 978-0-470-57095-1.
13. Biophysical Chemistry, Vol I, II & III by Charles R. Canter and Paul R. Shimmel. (A classic textbook)
14. The Biophysical Chemistry of Nucleic Acids and Proteins: Thomas E. Creighton, Helvetian Press; 2010.

Additional information (if any): Not Applicable
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Student responsibilities:

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| 1. Study of course material as specified by the instructor. |
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Course reviewers:

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