

Course Code	Course Name	Credits
26CH512	BIOPHYSICAL CHEMISTRY	04

Course Objectives

- To understand the structure and properties of biological molecules, including proteins, nucleic acids, carbohydrates, and lipids.
- To explain the principles of biophysical techniques, such as spectroscopy, chromatography, electrophoresis, and imaging methods used in biological systems.
- To develop knowledge of molecular behavior and kinetics, including protein folding, hydrodynamics, and analytical methods for biomolecular characterization.

Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Understand the structure and interactions of biological molecules such as proteins, nucleic acids, lipids, and carbohydrates.
- Apply principles of hydrodynamics and kinetics to study biomolecular behavior and protein folding.
- Analyze spectroscopic techniques such as UV, fluorescence, and IR for characterization of biomolecules.
- Evaluate separation and imaging techniques including chromatography, electrophoresis, microscopy, and NMR in biological systems.

Unit 1 - Biological molecules (12 Hrs.)

Introduction; polypeptides, polynucleotides, polysaccharides; fats and lipids; proteins—primary, secondary and tertiary structure; forces in protein folding; electrostatic interactions; intermolecular interactions; dipole–dipole interactions; hydrophobic effect; hydrogen bonding.

Unit 2 – Hydrodynamics (14 Hrs.)

Density and molecular volume; analytical ultracentrifugation; sedimentation equilibrium and sedimentation rate; diffusion and Brownian motion; dynamic light scattering; viscosity; basics of kinetics; rapid reaction techniques; relaxation methods; protein folding—mechanism and kinetics; Chevron plot.

Unit 3 - Spectroscopy of Biomolecules (10 Hrs.)

Franck–Condon principle; electronic absorption spectroscopy and fluorescence; fluorescence quenching; infrared spectroscopy of proteins.

Unit 4 – Chromatography and electrophoresis (14 Hrs.)

Chromatography and electrophoresis—types and uses in biological systems; imaging—waves and particles; X-ray diffraction and crystallography; fibre diffraction and small-angle scattering; neutron diffraction and scattering; electron microscopy.

Unit 5 - Advanced Analytical Techniques (10 Hrs.)

Atomic force microscopy; optical tweezers and traps; single-molecule fluorescence; mass spectrometry; nuclear magnetic resonance spectroscopy and their uses in biological systems.

Reference Books:

- Alan Cooper, Biophysical Chemistry, 2nd edition, Royal Society of Chemistry, Cambridge, UK
- Robin Leatherbarrow, R H Templer, Biophysical chemistry, Royal Society of Chemistry, Cambridge, UK
- Charles Cantor and Paul Schimmel, Biophysical Chemistry: Part I: The Conformation of Biological Macromolecules Biophysical Chemistry, W. H. Freeman and company, San Francisco,
- D. Freifelder, Physical Biochemistry, W.H. Freeman & Company.
- C. Tanford, Physical Chemistry of Macromolecules, John Wiley & Sons.
- K.F. von Holde, Physical Biochemistry, Prentice-Hall Inc.

Websites and eLearning Sources:

- https://onlinecourses.nptel.ac.in/noc22_cy43/preview
- https://onlinecourses.nptel.ac.in/noc19_cy34/preview

COs and Bloom's Taxonomy Mapping – 26CH512

Course Outcomes	On completing P.G. program the students will be able to	BTL
CO1	Recall and explain the structure and function of biomolecules, protein folding, hydrodynamics, kinetics, and key spectroscopic and imaging techniques.	K1, K2
CO2	Apply knowledge and techniques to study biomolecular interactions, protein folding kinetics, and structures using spectroscopy and imaging.	K3
CO3	Analyze biomolecular interactions and behaviors using spectroscopy, chromatography, and imaging to determine structure and function.	K4
CO4	Evaluate the roles of biomolecules in health, protein folding, and the effectiveness of analytical and imaging techniques in biological research.	K5
CO5	Design methods to explore biomolecular structure-function relationships using kinetics, hydrodynamics, spectroscopy, imaging, and mass spectrometry.	K6

BTL K1 and K2 – remembering and understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6- Create

Relationship Matrix – 26CH512

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	1	1	2	2	2	2	1	1.7
CO2	2	3	3	3	2	1	2	3	3	2	1	2.2
CO3	3	3	3	3	2	1	3	3	3	3	2	2.3
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3
Total												2.4

Mean Score: 3- High, 2- Medium/Moderate, 1-Low

