AMITY UNIVERSITY
UTTAR PRADESH

Annexure 'CD – 01'

FORMAT FOR COURSE CURRICULUM

Course Title: Biophysics and Structural Biology
Course Code: GCMB621
Credit Units: 4

L	T	P/S	Lab	TOTAL CREDIT UNITS
3			2	4

Course Objectives:

Theory: The course aims to provide an understanding of the canonical and non-canonical structure of the nucleic acids and the detail structure of proteins, enzymes etc. Detailed structural analysis will also give an idea about the mode of recognition of different biomolecules, nature of interaction and their role in therapy and nanotechnology.

Practical: To train students practically to see the effect of cations, pH, organic solvents, and enzymes on the structure and stability of Nucleic Acid and protein.

Pre-requisites: Graduate in Life Sciences

Student Learning Outcomes:

- Gain working knowledge of higher order structures of Nucleic acid and proteins and their mode of interaction.
- Develop an understanding for the factors that can affect the structure and stability of Nucleic acid and proteins and their correlation with cell functioning.
- Students will also gain the knowledge about the techniques used for structure prediction.

Course Contents/Syllabus- Theory:

	Weightage (%)
Module I Canonical and Non-canonical Structure of Nucleic acids:	**30**
Descriptors/Topics: Canonical Structure: Detail structure of Double-Stranded DNA, helix parameters, Structural and biological significance of Major and Minor groove, Polymorphic DNA and monomorphic RNA structures effect of molecular environment on the structure and its thermal stability, Keto-enol tautomerization, Wobble base-pairing and its correlation with genetic diseases. Differences in helix parameters on different forms of DNA, Parallel DNA, Reverse Watson-Crick base-pairing, Repeat elements (inverted repeat, mirror repeat and direct repeat) and cruciform structures, Intramolecular and Intermolecular Triplex DNA and its role in therapeutics, Intramolecular and intermolecular four-stranded DNA (G-quadruplex and i-motif), Telomeric DNAs of different eukaryotic species, role of telomere in cancer and aging, G-quadruplex as a therapeutic target, G-wire, role of G-quadruplex and i-motif in nanotechnology. Effect of cations, pH, temperature and chemical agents on the structure and stability of nucleic acids. Thermal denaturation curves.	
Module II Protein structure and function:	**30**
Descriptors/Topics: Structural implications of the peptide bond; rigid planar peptide unit; cis and trans configuration; conformations of a pair of linked peptide units; torsion angles phi and psi -steric hindrance; hardsphere approximation; allowed and disallowed conformations; Ramachandran Diagram; conformational maps for glycine and other natural amino acids; conformationally constrained amino acids and their importance. Stability of protein structure: Folding/ unfolding, m- values, Models of protein folding. Effect of cations, pH, temperature	

and chemical agents on the structure and stability of proteins.	
Module III Lipid and membrane structure **Descriptors/Topics** Lipids: Assemblies, volume, surface area, length relationship, X-ray studies, phase transitions of anhydrous and hydrated lipid bilayers. Concept of thermodynamic parameters (free energy, enthalpy and entropy).	**15**
Module IV Bimolecular Interactions: **Descriptors/Topics:** Enthalpic and entropic co-operativity, Hydrophobic effect, Affinity and specificity in intermolecular interactions. Structural analysis by UV-VIS spectroscopy, Circular Dichroism, NMR and X-ray crystallography, Principles of Isothermal Calorimetry (ITC), Differential Scanning calorimetry (DSC), Fluorescence Spectroscopy.	**25**

Pedagogy for Course Delivery:

Lectures: 45
Tutorial: 0
Presentation/ Seminar/ Home assignment: 1
Class Test: 2
Total: 42

Lab/ Practical details, if applicable:

Tutorial: 0
Practical: 13
Class test: 2
Total: 15

List of Experiments:

- Calculation of extinction coefficient of olgonucleotides either manually or using the software.
- Quantification of genomic DNA, oligonucleotides and proteins by UV-VIS Spectroscopy.
- Effect of cations (monovalent or divalent) and pH on genomic DNA, oligonucleotides and proteins by UV-VIS Spectroscopy.
- Study of DNA-ligand (spermine, ethidium bromide, proflavin etc.) interactions using UV-VIS spectroscopy and PAGE.
- Electrophoretic shift assays to check molecularity of the structures with short designed synthetic nucleotide sequences.
- Protein Folding using SDS-PAGE.
- Effect of physical and chemical factors on protein structure.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	End Term Examination
75	**25**	**70**

Theory Assessment (L&T):

Continuous Assessment/Internal Assessment					End Term Examination
Components (Drop down)	**Class Test 1**	**Class Test 2**	**Home Assignment**	**Attendance**	
Weightage (%)	5	10	5	5	70

Lab/ Practical/ Studio Assessment:

Components (Drop down	Continuous Assessment/Internal Assessment				End Term Examination			Total
	Performance	**Lab record**	**viva**	**Attendance**	**Lab record**	**Performance**	**Viva**	
Weightage (%)	10	10	5	5	10	50	10	100

Text & References:

1. DNA Structure and Function by Richard R. Sinden, (Latest edition by Academic Press)
2. Protein Structure and function by Carl Braden and John Tooze (Latest edition by Garland Publishing).
3. Exploring Proteins: a student's guide to experimental skills and methods by Nicholas C. Price and Jacqueline Nairn (Latest edition by Oxford University Press)
4. Crystallography made crystal clear, Author: Gale Rhodes; Publisher: Ac ademic Press
5. Biophysical Chemistry, Vol. 1 & 3. C.R. Cantor and P.R.Schimmel; W.H. Freeman, 1980.
6. Proteins. Structure and Molecular properties. T.Creighton. W.H.Freeman, 2nd ed. 1992.
7. Protein structure. A practical approach. T.Creighton. Oxford Univ. Press. 2nd ed. 1997.
8. The structure of biological membranes. P.L.Yeagle. CRC Press. 2nd ed. 2004.

Any other Study Material:

- Research Papers