Course: Discipline Specific Elective

Semester	**5**
Paper Number	**HCHDS5022T (60 MARKS) & HCHDS5022P (40 MARKS)**
Paper Title	**DSE 2 : BIOCHEMISTRY**
No. of Credits	**Theory-04, Practicals-02**
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 3
Name of Faculty member(s)	Dr. Rina Ghosh Dr. Indranil Chakraborty
Course description/objective	***Theory:*** Acquaintance with the Chemistry of life : Understanding the chemical and three dimensional structures of biological molecules – proteins and nucleic acids, and their interactions. An insight into membrane organisation and structure and a detailed study of transport across membranes. Applying the knowledge of chemical kinetics to enzymes and an insight into their specificity. An introduction to answering the primary question – how is genetic information transmitted and expressed ? ***Practical:*** 1. Determination of the enzymatic parameters of a specific enzyme. ***2.*** Performing experiments in Clinical Biochemistry. ***3.*** To prepare buffers of a given pH and using it to estimate RNA. ***4.*** Understanding enzymatic activity through pH dependence studies.
Syllabus	Annexure Core Course: 3
Texts	
Reading/Reference Lists	**Theory:** 1. Biochemistry, Garret and Grisam, Thomson Books 2. Biochemistry, Voet and Voet, John Wiley. 3. Principles of Biochemistry, Lehninger. 4. Principles of Chemical Kinetics, J.E. House, Elsevier. 5. Biochemistry: Stryer, Freeman. **Practical:** 1. An introduction to Practical Biochemistry, David T Plummer 2. Biochemical Methods, S Sadasivam and A.Manickam 3. Introductory Practical Biochemistry, Sawhney and Singh
Evaluation	**Theory: 60 marks** / **Practical: 40 marks** *(Continuous Assessment)* CIA: 10 End-Sem: 50 Internal Assessment Exams: 30 Viva (End Sem): 8 Attendance: 2
Paper Structure for the End Sem **Theory Exam** (50 marks)	6 (SIX) Questions (each of 10 marks) will be set and the students will have to answer any 5 (FIVE). Each of the Questions (10 marks) will consist of 2 or 3 parts (of 2/ 3/ 4/ 5)

Annexure Discipline Specific Elective (DSE): 2
(Credits: Theory-04, Practicals-02)

BIOCHEMISTRY
Theory: 60 Lectures

DSE – 2: **Biochemistry**

Proteins : Structure and Function **[16 Lectures]**

1. Amino acids: the building block of proteins
2. Essential amino acids are L-amino acids
3. pK_a of -COOH and $–NH_3^+$ functional groups and structure around the α-carbon at physiological pH. Zwitterionic structure.
   The R groups and their classification: acidity, basicity, hydrophobicity, aromatic rings.
4. Polymerization among amino acids: The amide bond
5. Primary structure and amino acid sequence.
6. The amide plane and dihedral angle.
7. Ramachandran plot and its significance
8. Secondary structure of proteins.
9. α-helical structure driven by intrachain hydrogen bond.
   Factors affecting the stability of α-helices.
10. β – pleated structure driven by interchain hydrogen bond.
    Factors affecting the stability of □□sheet structures.
11. Parallel and antiparallel β-sheet structure.
12. β-turns.
13. Factors affecting tertiary and quaternary structures of proteins.
14. Structural features of fibrous proteins: collagen, carotin and fibroin.

Lipids and membranes: **[14 Lectures]**

1. Biological membranes
2. Fatty acids – structure and function
3. Properties of Lipid Aggregates
   Micelles and Bilayers
   Liposomes
   Bilayer dynamics
4. Association of proteins with the lipid bilayer
5. Diffusion of lipids in the membrane – the fluid mosaic model
6. Membrane channels and pumps
   i) Active and passive transport
   ii) ATP driven pumps – active transport (Na^+-K^+ pump)
   iii) Carriers – secondary transporters

iv) Passive transport systems - ion channels.

Nucleic acids **[15 Lectures]**

1. Nucleotides and Nucleic acids
   i) Nucleotides , Nucleosides and Bases
   ii) The chemical structures of DNA and RNA
2. Double helical DNA
   i) The Watson-Crick structure
   ii) Denaturation and renaturation
3. Gene expression and Replication
   i) RNA synthesis : Transcription
   ii) Protein synthesis:Transcription
   iii) DNA Replication

Enzymes **[15 lectures]**

1. Mechanism of enzyme activity – standard free energy change in a reaction, transition state, activation energy both in non-enzymatic and enzymatic reaction, specificity of enzymes, geometric and stereospecificity with examples, lock & key hypothesis, induced fit hypothesis, proximity and orientation effect, strain and distortion theory.
2. Enzyme kinetics :
   Concept of steady state kinetics, initial rate, maximum velocity, Michaelis - Menten equation, graphical representation, significance of K_M & V_{Max} , Lineweaver Burk double reciprocal plot, K_{cat}/K_M, enzyme catalyzed bi substrate reaction, sequential & ping pong reaction-(only example). Quantitative assay of enzyme activity- Unit of enzyme activity, specific activity, molecular activity/ turnover number, molar activity. Factors on which enzyme catalyzed reaction depends - substrate concentration, enzyme concentration. pH, temperature, time, co-factors (role of NAD & NADP, FMN & FAD, TPP PALPO, FH4, HSCoA),
   Inhibition of enzyme catalyzed reaction- competitive, noncompetitive, uncompetitive, irreversible inhibition, detailed kinetic study and example in each case.
3. Enzyme catalysis i) acid- base catalysis, ii) metal ion catalysis iii) covalent catalysis – Examples

CHEMISTRY LAB-DSE II LAB

(60 Lectures)

Experiment 1: Determination of K_M and v_{max} of the enzyme alkaline phosphatase.

Experiment 2: Construction of the pH dependence curve of alkaline phosphatase.

Experiment 3: Estimation of RNA by orcinol method.

Experiment 4: Estimation of proteins by biuret method.

Experiment 5: Estimation of blood cholesterol chod pap method.