DISCIPLINE SPECIFIC CORE COURSE – 5: Biochemistry of Nucleic Acids and Proteins

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
MICROB-DSC202: Biochemistry of Nucleic Acids and Proteins	4	3	0	1	Class XII pass with Biology/ Biotechnology/ Biochemistry	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- The main objective of this course is to enable the students to develop a clear understanding of the structures and properties of biomolecules: proteins, lipids, carbohydrates and nucleic acids, and lays the foundation for a basic understanding of cellular processes.
- The students will gain an understanding of the principles of thermodynamics and bioenergetics, and will be introduced to the basic concepts of enzymes and enzyme kinetics.
- This course will empower the students with essential knowledge to support learning in subsequent courses offered in the program.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Student will be able to describe the chemical structures of the building blocks of nucleic acids and the structures of the different types of DNA.
- Student will be able to describe the composition of proteins, and the structure and chemical properties of the different amino acids.
- Student will be able to describe the structural attributes of some classical proteins.
- Student will be able to analyze the constituents of an active enzyme, the interactions at enzyme active sites, and steady- state kinetics, allosteric regulation, and will be able to describe many different forms of enzymes found in living cells.

- Student will be able to analyze the structures of biomolecules using different types of models.
- Student will be able to analyze proteins qualitatively and quantitatively using different biochemical tests.

SYLLABUS OF DSC-5

UNIT – I (3 Weeks)
Nucleic acids: Introduction to importance of nucleic acids. Structures of purines and pyrimidines, nucleosides and nucleotides. Formation of DNA chains by phosphodiester bonds. Structure of DNA: the double helix. Types of DNA: A, B and Z. Properties of DNA. Types of RNA:rRNA, mRNA, tRNA

UNIT – II (3 Weeks)
Composition of Proteins: Introduction to the importance of proteins. Amino acids as building blocks: structures and properties of standard amino acids. Zwitterion, titration curves of amino acids, and determination of pKa and pI of monocarboxylic amino acid. Ninhydrin reaction. Essential amino acids, non-protein amino acids: beta-alanine, D-alanine and rare amino acids: selenocysteine, hydroxyproline. Oligopeptides: structure and functions of glutathione and aspartame

UNIT – III (2 Weeks)
Protein structure: primary, secondary (α helix, β sheets), super secondary (collagen), tertiary (myoglobin) and quaternary (haemoglobin). Structure of insulin

UNIT – IV (7 Weeks)
Enzymes: Concept of holoenzyme, coenzyme and apoenzyme. Cofactors: prosthetic group, Coenzyme: NAD, metal cofactors. Enzyme nomenclature and classification. Active site and activation energy. Lock and key hypothesis, induced fit hypothesis. Concept of steady state kinetics, Vmax and Km, significance of hyperbolic and double reciprocal plots. Enzyme unit, specific activity and turnover number. Temperature and pH effects on enzyme activity. Michaelis-Menten kinetics versus kinetics of allosteric enzymes. Competitive, non-competitive and uncompetitive enzyme inhibition. Allosteric enzymes: Phosphofructokinase. Multienzyme complex: pyruvate dehydrogenase. Isozyme: lactate dehydrogenase. RNA as enzymes: Hammerhead ribozyme

Practical component

UNIT 1: (5 Weeks)
Study of biomolecules with the help of models: The use of different types of models for visualizing molecular structures of biomolecules: Space filling models, Ball and stick models, Ribbon Models. Study of protein secondary and tertiary structures with the help of photographs/ models: collagen, myoglobin, hemoglobin.

Unit 2: (10 Weeks)

Qualitative and quantitative analysis of proteins: Qualitative analysis of proteins using Xanthoproteic Test, Millon's Test, Biuret Test, Ninhydrin Test. Quantitative estimation of proteins by Lowry's method using bovine serum albumin as the standard. Demonstration of enzyme activity (amylase / urease / catalase) and effect of temperature, pH and heavy metal salt on activity.

Essential/recommended readings

Theory:

1. Lehninger Principles of Biochemistry by D.L. Nelson and M.M. Cox. 8th edition. W.H. Freeman and Company, UK. 2021.
2. Biochemistry by J.M. Berg, J.L.Tymoczko, G.J. Gatto, and L. Stryer. 9th edition. W.H. Freeman and Company, UK. 2019.
3. Biochemistry by T.A. Brown and S.N. Mukhopadhyay. 1st edition. Viva Books, India. 2018.
4. Fundamentals of Biochemistry by D. Voet, J.G. Voet and C.W. Pratt. 5th edition. John Wiley and Sons, UK. 2016.

Practicals:

1. Practical Biochemistry by R.C. Gupta and S. Bhargava. 5th edition. CBS Publishers and Distributors, India. 2018.
2. An Introduction to Practical Biochemistry by D. Plummer. 3rd edition. McGraw Hill Education, India. 2017.
3. Introduction to Practical Biochemistry (ebook) by G. Hegyi, J. Kardos, M. Kovacs, A. Malnasi-Csizmadia, L. Nyitray, G. Pal, L. Radnai, A. Remenyi and I. Venekei. Eotvos Lorand University. 2013.
4. Modern Experimental Biochemistry by Rodney Boyer.3rd edition. Pearson, India. 2002.

Suggestive readings

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time. **CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**