DISCIPLINE SPECIFIC CORE COURSE -4 (DSC-4) – : BIOCHEMISTRY

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		
Biochemistry	**4**	**3**	**-**	**1**	**Class XII pass with Physics, Chemistry and Biology as papers in Class XII.**	**NA**

Learning Objectives

The Learning Objectives of this course are as follows:

- To effectively incorporate the fundamentals of metabolism through key biochemical pathways.
- Make the learners appreciate the requirement for the stringency of the regulation of these pathways.
- Introduce various biochemical techniques used in the characterization of the proteins.
- To give a detailed account on how enzymes function: their kinetics, regulation, and inhibition.

Learning outcomes

The Learning Outcomes of this course are as follows:

- By studying this course, students will be able to gain an understanding of fundamental biochemical principles of metabolism of biomolecules (Carbohydrates, Proteins, Lipids and Nucleic acids) and the associated bio- energetics. They will learn the biochemical reactions in metabolic pathways and understand their interrelations, logics, and patterns.
- By studying this course, students will be able to understand the role of enzymes in the biochemical reactions and the connection between biochemical defects and metabolic disorders. Students would additionally gather a firm understanding and relevance of stringent regulation of metabolic pathways.
- By studying this course, students will be able to learn how biological molecules (especially proteins) are characterized through various analytical techniques such as types of column chromatography methods, Polyacrylamide Gel Electrophoresis (PAGE) that are used in contemporary biochemistry research laboratories.
- By studying this course, students will be able to grasp the central concepts underlying enzyme catalysis, kinetics, and their mechanism of action. Effects of different kinds of enzyme-inhibitors will also be learned.
- By studying this course, students will be able to learn how coenzymes assist enzymes in catalyzing biochemical reactions and what is the criterion for their classification.
- By studying this course, students will be able to learn the general properties of regulatory enzymes, their activity and kinetics.

SYLLABUS OF DSC-4

UNIT – I (6.3 Weeks)

Metabolic pathways and their allosteric regulation

Carbohydrates- Glycolysis, Gluconeogenesis, Tricarboxylic acid cycle and their regulation, Cori cycle, Hexose monophosphate shunt.

Lipids- Mobilization of triglycerides, Metabolism of glycerol, Biosynthesis and β- oxidation of saturated fatty acids (palmitic acid) and their regulation. Significance of ketone bodies.

Proteins- General over view, Transamination, Deamination, Glucose-Alanine cycle, Urea cycle and its regulation.

Nucleic acid- General overview, an outline of purine and pyrimidine metabolism. Electron transport chain, Oxidative phosphorylation, and Substrate-level phosphorylation.

UNIT – II (2.3 Weeks)

Analytical methods in protein characterization

Introduction to spectrophotometry & Lambert-Beer's law, Column chromatography: Ion exchange chromatography, Gel filtration and Affinity chromatography, SDS-PAGE

UNIT – III (2 Weeks)

Enzymes

Introduction to enzymes, Concept of Lock & key and 'Induced fit theory, Concept of activation energy and binding energy. Enzyme kinetics: Michaelis-Menten equation and its physiological significance. Concept of enzyme inhibition: types of inhibitors (competitive & non-competitive) and their examples.

UNIT – IV (0.6 Weeks)

Coenzymes

Classification: various types and their function.

UNIT-V (0.6 Weeks)

Regulatory Enzymes

General properties of allosteric enzymes. Enzyme regulation by covalent modification. Zymogens.

Practical component

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Measurement of absorbance & %transmittance of a solution using spectrophotometer/colorimeter.
2. Preparation of standard plot and estimation of protein concentration by any one method: Biuret/Lowry/Bradford.
3. Estimation of glucose concentration by an enzymatic/non-enzymatic method.
4. Separation of biomolecules (sugar/amino acids) by thin-layer chromatography (TLC).
5. Separation of biomolecules by gel filtration/Calculation of void volume of Sephadex G-25 column, using Blue Dextran.
6. Analysis of SDS-PAGE as a separation technique (gel analysis).
7. To perform an assay of an enzyme under optimal conditions.
8. Determination of Km, Vmax and Kcat value of a given enzyme from the provided experimental data.

Essential/recommended readings:

- Nelson, D. L., & Cox, M. M. (2021). Lehninger: Principles of Biochemistry (8th ed.). Macmillan. ISBN:9781319322328
- Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018). 8th ed. Hofmann A. and Clokie S.(Eds.) Cambridge University Press, Cambridge, U.K.
- Plummer, D.T. (2012). An Introduction to Practical Biochemistry. New Delhi, India: McGraw-Hill College.
- S. K. Sawhney / Randhir Singh. (2009): Introductory Practical Biochemistry, Narosa Publishers, ISBN-13 : 978-8173193026
- Donald Voet, Judith G. Voet (2021) Voet's Biochemistry, Adapted ed 2021, ISBN: 9789354243820.

Suggestive readings:

- Berg, J., Gatto, G., Stryer, L. and Tymoczko, J. L. (2019). Biochemistry. New York, USA: W. H. Freeman and Company.
- Devlin, (2011). Textbook of biochemistry with clinical correlations. UK: Wiley T & Sons.