BSc. (Hons.) Biochemistry
Category-I

DISCIPLINE SPECIFIC CORE COURSE – 4:

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		
Enzymes	04	02	-	02	-	-

Learning Objectives

The objective of the course is to provide detailed knowledge about enzymes, the biological catalysts with remarkable properties that sustain life, so as to develop an understanding of enzyme kinetics, mechanism of enzyme action and their regulation. The course also aims to outline the diverse applications of enzymes in disease diagnosis and therapy as well as in industry.

Learning outcomes

- Students will learn the nature and importance of enzymes in living systems
- Students will gain insight into the thermodynamic and molecular basis of catalysis by enzymes and the underlying basis of their specificity
- Students will understand the mechanisms of enzyme action, kinetics of enzyme catalyzed reactions and clinical importance of enzyme inhibitors
- Students will also learn to appreciate how enzymes are regulated and the physiological importance of enzyme regulation in the cell
- The course will introduce students to the applications of enzymes in research and medicine as well as in industry, which will bolster their foray into industrial and biomedical research.

SYLLABUS OF DSC-4

B.Sc. (HONOURS) BIOCHEMISTRY (NEP STRUCTURE)
BCH-DSC-201: ENZYMES
Semester – II

2.2 Course Contents

Theory

Credits: 2 **Total weeks : 15**

Unit I: Introduction to enzymes and features of catalysis (3 weeks)

General characteristics of enzymes; nature of enzymes - Ribozymes. apoenzyme, holoenzyme, Cofactor and prosthetic group. Classification and nomenclature of enzymes. Types of Enzyme assays - discontinuous, continuous, coupled assays; Enzyme activity, specific activity, units to express enzyme activity. Features of enzyme catalysis, factors affecting the rate of enzymatic reactions, activation energy and transition state theory. Catalysis, reaction rates. Catalytic power and specificity of enzymes, Fischer's lock and key hypothesis, Koshland's induced fit hypothesis. Metal activated enzymes and metalloenzymes.

Unit II: Enzyme kinetics and inhibition (5 weeks)

Relationship between initial velocity and substrate concentration, equilibrium constant, steady state kinetics, mono-substrate reactions. Derivation of Michaelis-Menten equation; other enzyme plots like Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot. Determination of K_m V_{max} and K_{cat}, specificity constant. Types of bisubstrate reactions (sequential-ordered and random, ping pong reactions), examples.
Reversible inhibition (competitive, uncompetitive, non-competitive and mixed) and irreversible inhibition. Structural analogs (allopurinol, methotrexate). Mechanism based inhibitors (β-lactam antibiotics).

Unit III: Mechanism of action of enzymes and Regulation of enzyme activity (5 weeks)

General features - proximity and orientation, strain and distortion, acid-base and covalent catalysis (chymotrypsin). Coenzymes (TPP, NAD, pyridoxal phosphate) in enzyme catalyzed reactions.

Control of activities of single enzymes and metabolic pathways, feedback inhibition, allosteric modulation (aspartate transcarbamoylase), regulation by covalent modification (glycogen phosphorylase), Zymogen (chymotrypsinogen)**.** Isoenzymes - properties and physiological significance (lactate dehydrogenase).

Unit IV: Applications of enzymes (2 weeks)

Enzymes as reagents (glucose oxidase, cholesterol oxidase); Marker enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases); Enzyme linked immunoassay; Enzyme therapy (streptokinase); Enzymes in research. Immobilized enzymes.

2.3 Practical:

Credits: 2 Total weeks : 15

1. Assay to determine activity and specific activity of an enzyme.
2. Progress curve for an enzyme.
3. Partial purification of an enzyme using Ammonium sulfate fractionation.
4. Effect of pH on enzyme activity.
5. Effect of temperature on enzyme activity.
6. Determination of K_m and V_{max} of an enzyme using Lineweaver-Burk plot.

7. Calculation of inhibitory constant (Ki) for an enzyme.
8. Immobilization of enzyme using calcium alginate beads.

2.4 Essential readings:

1. Nelson, D.L., Cox, M.M. (2017). Lehninger: Principles of Biochemistry (7th ed.). New York, WH: Freeman and Company. ISBN: 13: 978-1-4641-2611-6 / ISBN:10:1-46412611-9.
2. Nicholas, C.P., Lewis, S. (1999). Fundamentals of Enzymology (3rd ed.). New York, Oxford University Press Inc. ISBN:0 19 850229 X.
3. Stryer, L., Berg, J., Tymoczko, J., Gatto, G. (2019). Biochemistry (9th ed.). New York, WH: Freeman. ISBN-13: 9781319114671

Suggested reading:

1. Voet, D., Voet. J. G. (2013). Biochemistry (4th ed.). New Jersey, John Wiley & Sons Asia Pvt. Ltd. ISBN: 978-1-11809244-6.

3. Teaching Learning Process and Assessment Methods

Facilitating the Achievement of Course Learning Outcomes**

Unit No.	Course Learning Outcomes	Teaching and Learning Activity	Assessment Tasks
I	Students will be introduced to Enzymes. They will also gain insight into features of enzyme catalysis and factors affecting the rate of enzymatic reactions	Teaching will be conducted both through black board mode and power point presentation mode.	Students will be given questions that are application based and require analytical skills. Quizzes will be held to gauge their conceptual understanding.
II	Knowledge about the kinetics of enzymatic reactions by understanding different plots and calculating the parameters. They will understand the mechanism of bisubstrate reactions, inhibitions in enzymes.	Classical chalk and board teaching, oral discussions and power point presentation whenever needed. Practical knowledge of enzyme kinetic reactions by determination of Km, Vmax and other values.	Students will be asked to analyze case studies. Written tests will be held to promote self-learning. Practical related oral questions will be asked.
III	Students will gain insight into regulation of activities of single enzymes and metabolic pathways	Teaching will be conducted both through black board mode and power point	Regular class question-answer sessions. Students will be asked to prepare PowerPoint presentations on

	by feedback inhibition, allosteric modulation, covalent modification, zymogen and isoenzymes	presentation mode. Practical assessment	any topic of interest relating to Enzymes. Internal assessment tests will be conducted.
IV	Students will learn applications of enzymes as reagents, markers in diagnostics, ELISA; Also use of enzymes in therapy, research and industries as immobilized enzymes	Teaching will be conducted through black board and power point presentation. Useful video clips will be shown for better clarity.	Regular oral evaluation will be done. Internal assessment tests will be conducted

(Assessment tasks enlisted here are indicative in nature)**

4. Keyword

Enzymes, Catalysis, Specific activity, Mechanism of action, Isoenzymes.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 5

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		
Metabolism of Carbohydrates	**04**	**02**	**-**	**02**	**-**	**-**

Learning Objectives

The objective of this course is to provide an understanding of metabolism of carbohydrates and the enzymes involved in various metabolic pathways and regulation of carbohydrate metabolism in cells. The course also aims to outline the importance of such pathways in relation to metabolic defects.

Learning outcomes