



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Program Name: Bachelor of Science**

**Level: Under Graduate**

**Branch Name: Honors/ Honors With Research (Biotechnology)**

**Course / Subject Code: BS03001031**

**Course / Subject Name: Enzyme Technology**

W.e.f. Academic Year :	2025-26
Semester :	3
Category of the Course :	Core Courses

**Prerequisite:** Prerequisites: Chemistry & Biochemistry: Basic organic chemistry, protein structure, metabolic pathways. Physical Chemistry: Thermodynamics, kinetics, and transition state theory. Mathematics & Lab Skills: Graph analysis, calculus, enzyme isolation, and purification techniques. Molecular Biology: DNA/RNA basics and gene expression.

**Rationale:** To understand the evolution, structure, and function of enzymes. To distinguish enzymes from chemical catalysts and explore their specificity. To analyze enzyme kinetics, regulation, and inhibition. To apply this knowledge to biotechnological and industrial enzyme applications.

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	70	30	30	200

## Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	Historical development of enzymology Enzymes vs Chemical catalyst Structure and properties of enzymes Cofactors and coenzymes Enzyme nomenclature and classification (rationale, overview and specific examples) Nature of enzymes Other forms of enzymes: Abzymes, Ribozymes, Synzymes, Extremozymes Classification of enzymes with examples Concept of Holoenzymes, cofactors and coenzymes Enzyme mechanism and activation Various models of enzyme specificity Zymogens and their activation (Proteases and Prothrombin) Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity Isolation, crystallization and purification of enzymes Test of homogeneity of enzyme preparation	9	20



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	Methods of enzyme analysis Units of activity		
<b>2</b>	Kinetics of enzyme activity Michaelis-Menten equation and its derivation Different plots for the determination of $K_m$ and $V_{max}$ and their physiological significance Factors affecting initial rate, E, S, temp & pH Collision and transition state theories Significance of activation energy and free energy Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition Determination of $K_i$ Suicide inhibition	<b>8</b>	<b>18</b>
<b>3</b>	Allosteric enzymes with special reference to aspartate transcarbomylase and phosphofructokinase Isoenzymes-multiple forms of enzymes with special reference to lactate dehydrogenase Multienzyme complexes Ribozymes Multifunctional enzyme-eg Fatty Acid synthase Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency Techniques for studying mechanisms of action specific examples: chymotrypsin, Isozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase Enzyme regulation: Product inhibition, feedback control, covalent modification Structure function relationship in enzymes, structural motifs and enzyme evolution	<b>9</b>	<b>20</b>
<b>4</b>	Enzyme industry in India, scope for entrepreneurship in enzyme industry Methods for large scale production of enzymes Immobilized enzyme and their comparison with soluble enzymes Methods for immobilization of enzymes Immobilized enzyme reactors Improvement of enzymes Thermal stability and catalytic efficiency of enzyme Introduction to enzyme engineering site directed mutagenesis and enzyme engineering-selected examples Applications of enzymes: Application of Immobilized and soluble enzyme in health and industry Application to fundamental studies of biochemistry Enzyme electrodes	<b>10</b>	<b>22</b>
<b>5</b>	Importance of metabolic engineering Need for pathway synthesis (bioproduction)	<b>9</b>	<b>20</b>



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	Scope and future of metabolic engineering Methods for metabolic characterization: genome, transcriptome, proteome, metabolome, fluxome Regulation of enzyme activity versus regulation of enzyme concentration Regulation of metabolic networks Regulation of at the whole cell level Metabolic control analysis The theory of flux balances (Cell Capability Analysis, Genome Scale Flux Analysis) Examples of applications of flux analysis Experimental Determination Method of Flux Distribution with Isotope Labeling		
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## Reference Books:

1. **Principles of Enzyme Technology** (2015) – M. Y. Khan & Farha Khan
2. **Enzyme Technology: Pacemaker of Biotechnology** (2011) – Prasad N.K
3. **Enzyme Technology** (2012) – S. Shanmugam & T. Sathish Kumar
4. **Biocatalysts and Enzyme Technology** (2012) – Klaus Buchholz & Volker Kasche
5. **Enzyme Technology** (2009) – Anusha Bhaskar & V. G. Vidhya

**Course Outcomes:** After Completion of the Course, the Student will be able to:

Sr. No	Course Outcomes	RBT Level
1	Understand enzyme structure, function, and classification.	UN, RM, AP, AN
2	Perform enzyme purification, characterization, and activity assays.	UN, RM, AP, AN
3	Work in enzyme-based industries.	UN, RM, AP, AN
4	Analyze enzyme kinetics and inhibition mechanisms.	UN, RM, AP, AN
5	Develop skills in large-scale enzyme production, immobilization, and metabolic engineering.	UN, RM, AP, AN

\*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

## List of Practical Experiments:

1. Purification of Enzymes using Ion Exchange, Gel Filtration, and Hydrophobic Interaction Chromatography.
2. Enzyme Immobilization Techniques: Entrapment and Surface Immobilization.
3. Immobilized Enzyme Column Studies.
4. Determination of Mass Transfer Effect in Immobilized Enzymes.
5. Enzyme Kinetics & Inhibition Studies: Michaelis-Menten, Lineweaver-Burk Plot.
6. Thermal and pH Stability Analysis of Enzymes.
7. Metabolic Flux Analysis using Isotope Labeling.
8. Development of Enzyme Biosensors for Diagnostic Applications.