



GUJARAT TECHNOLOGICAL UNIVERSITY
Integrated Master of Science (Biotechnology)

Semester: 8

Subject Name: Enzyme Engineering

Subject Code: 1380403

Prerequisite: Candidates enrolling in the Integrated MSc in Industrial Biotechnology program with an elective in Enzyme Engineering should have a solid foundation in biochemistry, molecular biology, and microbiology. Proficiency in organic chemistry is also essential to comprehend enzyme mechanisms and catalytic functions. Additionally, familiarity with basic concepts in chemical engineering, such as reaction kinetics and thermodynamics, will aid in understanding enzyme kinetics and process design. Prior laboratory experience in protein purification techniques, enzyme assays, and analytical methods like spectrophotometry and chromatography is highly beneficial. This comprehensive background ensures that students are well-prepared to engage with advanced topics in enzyme modification, immobilization, and industrial applications within the Enzyme Engineering course.

Rationale: Integrating an elective in Enzyme Engineering into the MSc Industrial Biotechnology curriculum is essential due to the pivotal role enzymes play as biocatalysts in various industrial processes. Advancements in enzyme engineering, particularly through protein engineering and directed evolution, have enabled the development of enzymes with enhanced properties such as improved stability, specificity, and catalytic efficiency, which are crucial for optimizing industrial applications. By equipping students with knowledge of enzyme modification techniques and their practical applications, this course prepares graduates to innovate and improve biotechnological processes, contributing to more sustainable and efficient production methods across industries such as pharmaceuticals, biofuels, and food processing.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
4	0	0	4	70	30	0	0	100

Course Content:

Module No:	Module Content	No. of Sessions	Weightage
1	Introduction to enzymes What are enzymes, Brief history of enzymes, Nomenclature and classification of enzymes, Properties of enzymes, Structure of enzymes, Active site of enzymes, Factors influencing enzyme activity, Enzyme assays.	8	13
2	Specificity and mechanism of enzyme action Types of specificity, Koshland “induced fit” hypothesis, Strain or transition – state stabilization hypothesis; Mechanism of catalysis, Mechanism of reaction catalyzed by enzyme without cofactors, Metal-activated enzyme and metalloenzyme, Coenzymes in enzyme catalyzed reactions.	8	13



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3	<p>Enzyme Kinetics</p> <p>Kinetics of enzyme-catalyzed reaction, Methods for investigating kinetics of enzyme catalyzed reactions, Interpretation of K_m, V_{max}, Turnover number and K_{cat}, Specific activity of enzymes, Enzyme units, Inhibition of enzyme activity, Regulation of enzyme activity.</p>	8	13
4	<p>Immobilization of enzymes</p> <p>Concept, Methods of immobilization, Kinetics of immobilized enzymes, Effects of immobilization on enzymes, Use of immobilized enzymes, Bioreactors using immobilized enzymes.</p>	6	11
5	<p>Industrial application of enzymes</p> <p>Industrial enzymes: Sales value of industrial enzymes, Traditional (non-recombinant) sources of industrial enzymes, Impact of genetic engineering on enzyme production, Engineered enzymes, Extremophiles: hyperthermophiles, Enzymes from hyperthermophiles, Enzymes from additional extremophiles, Enzymes in organic solvents.</p>	8	13
6	<p>Industrial enzymes Proteases and Carbohydrases, Proteolytic enzymes: Carbohydrases, Lignocellulose degrading enzymes, Pectin and Pectic enzymes.</p>	8	13
7	<p>Additional industrial enzymes</p> <p>Lipases, Penicillin acylase, Amino acylase and Amino acid production, Cyclodextrins and cyclodextrin glycosyltransferase, Enzymes in animal nutrition, Enzymes in molecular biology; Clinical applications of enzymes.</p>	8	13
8	<p>Enzyme Engineering</p> <p>Prediction of enzyme structure, Design and construction of novel enzymes.</p>	6	11



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Reference Books:

1. T. Palmer and P.L. Bonner Enzymes: Biochemistry, Biotechnology and Clinical Chemistry Woodhead publishing limited Latest Edition
2. Wolfgang Aehle Enzymes in Industry: Production and Applications Wiley-VCH Verlag GmbH & Co. KGaA Latest Edition
3. Branden and Tooze Introduction to Proteins Structure Garland Publishing Group Latest Edition
4. Gary Walsh Proteins: Biochemistry and Biotechnology John Wiley & Sons Ltd.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
1	To learn the factors involved in and factors affecting the enzyme activity.	UN
2	To know the catalytic activity of enzymes and its regulation. To learn the enzyme used in clinical diagnosis and industries.	AN
3	To learn the kinetics of single and multi enzyme substrate enzyme catalysed reaction.	EL
4	Communicate concepts and ideas effectively.	RM

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