



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3723020

Semester – II

Subject Name: Bioprocess Engineering

Type of course: Elective

Prerequisite: Basic Concepts of Transport Phenomena, Mass transfer and Reaction kinetics

Rationale: This subject is an integration of chemical engineering with biological systems. It deals with kinetics of biological reactions, mass and heat transfer concepts and transport phenomena occurring within biological reactors.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Kinetics of Enzyme Catalyzed Reaction The Enzyme Substrate Complex and Enzyme Action, Simple Enzyme kinetics with one and two substrates, Determination of Elementary Step Rate Constants, Other patterns of substrate concentration dependence, Modulation and Regulation of Enzymatic Activity, Other Influences on enzyme activity, Enzyme deactivation, Enzyme reactions in Heterogeneous systems	
2	Kinetics of Substrate Utilization, Product Formation, Biomass Production in Cell Cultures Ideal Reactors for kinetics measurements, Stoichiometry and kinetics of Balanced Growth, Transient growth kinetics, structured kinetic models, product formation kinetics, Segregated kinetic models of Growth and Product Formation, Thermal Death kinetics of Cells and Spores.	
3	Transport Phenomena in Bioprocess Systems Gas Liquid Mass transfer in cellular systems, determination of oxygen transfer rates, mass transfer for freely rising or falling bodies, forced convection mass transfer, overall K_{La} estimates and power requirements for sparged and agitated vessels, Mass transfer across free surfaces, other factors affecting K_{La} , Scaling of Mass transfer equipment, Heat Transfer, Sterilization of Gases and liquids	
4	Design and Analysis of Biological Reactors: Ideal reactors, reactor dynamics, reactors with non-ideal mixing, sterilization reactors, immobilized biocatalysts, multiple	



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	bioreactors, Fermentation Technology, animal and plant cell reactor technology	
5	Product Recovery Operations Recovery of particulates – cells and solid particles by Filtration, Centrifugation, Flocculation, Cell Disruption, Production isolation by Liquid Liquid extraction, Precipitation, Chromatography and Fixed Bed Adsorption, Dialysis, Membrane Separation, Electrophoresis, Crystallization and Drying	

Reference Books:

1. Bioprocess Engineering- Basic Concepts; M.L. Shuler and F. Kargi, second edition, PHI Pvt. Ltd.
2. Bioprocess Engineering Principles by - Doran P.M., Elsevier Science and Technology Publishers, 1995.
3. Biochemical Engineering Fundamentals by James E. Bailey, David F. Ollis, Publisher: McGraw-Hill Inc.,US, 2nd Edition.
4. Principles of Fermentation Technology, by Whitaker, Peter F Stanbury, S. Hall and A. Whitaker, Publisher: Butterworth-Heinemann; 2nd edition

Course Outcomes: At the end of the course, the students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the different cells and their use in biochemical processes	20
CO-2	Understand the role of enzymes in kinetic analysis of biochemical reaction	35
CO-3	Analyze bioreactors, upstream and downstream processes in production of bioproducts	20
CO-4	Apply the concepts of various unit operations in downstream processes of biological products	25

List of Open Source Software/learning website:

Preparation of power-point slides, which include videos, animations, Pictures, graphics for better understanding theory – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus of Bioprocess and Biochemical Engineering is covered.