GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (30)

BIOPROCESS AND BIOCHEMICAL ENGINEERING

SUBJECT CODE: 2743004

SEMESTER: IV

Type of course: Chemical Engineering (Major Elective-V)

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 occuring within biological reactors.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (M)		
						ESE	OEP	PA	RP	
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**A little of Microbiology and Chemicals of Life** Biophysics and Cell Doctrine, The structure of cells, Importance of Cell types, Basics of Lipids, Carbohydrates, Nucleic acids, Proteins, Hybrid Biochemicals. Overview of upstream processing, media formulation.	**4**	8
2	**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 Heterogenous systems	**8**	15
3	**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.	**12**	22
4	**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 Kla estimates and power requirements for sparged and agitated vessels, Mass transfer across free surfaces, other factors affecting Kla, Scaling of Mass transfer equipment, Heat Transfer, Sterilization of Gases and liquids	**12**	22
5	**Design and Analysis of Biological Reactors**	**10**	18

	Ideal reactors, reactor dynamics, reactors with nonideal mixing, sterilization reactors, immobilized biocatalysts, multiple bioreactors, Fermentation Technology, animal and plant cell reactor technology		
6	**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	**8**	15

Reference Books:

1. Biochemical Engineering Fundamentals by James E. Bailey, David F. Ollis, Publisher: McGraw-Hill Inc.,US, 2nd Edition.
2. Principles of Fermentation Technology, by Whitaker, Peter F Stanbury, S. Hall and A. Whitaker, Publisher: Butterworth-Heinemann; 2nd edition

Course Outcome:

After learning the course the students should be able to:

1. Develop fundamental understanding of biological systems.
2. Evaluate kinetics of biological reactions.
3. Understand transport phenomena in biological reactors
4. Apply the concepts of various unit operations in downstreaming of biological products.

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.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.