

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (05)

BIOCHEMICAL ENGINEERING

SUBJECT CODE: 2160508

B.E. 6th SEMESTER

Type of course: Department Elective – I

Prerequisite: Basics of Mass Transfer Operations and Reaction Kinetics

Rationale: This subject is an integration of chemical engineering with biological systems. It deals with kinetics of biological reactions, designing of biological reactors and recovery mechanisms of biochemical products.

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)		
PA	ALA	ESE		OEP						
4	0	2	6	70	20	10	20	10	20	150

Course Contents:

Sr. No.	Topics	Teaching Hours	Weightage %
1	Introduction to Biochemical Engineering Historical background, interdisciplinary approach, Integrated bioprocess systems, Unit Operations in Bioprocess	5	7
2	Microbial Growth Kinetics Batch Culture, Continuous Culture – Multistage systems, Feedback systems, Fed Batch Culture – Variable volume, fixed volume, Cyclic. Applications.	15	21
3.	Design of Fermentor Introduction, Basic Functions, Body construction, Aeration and Agitation, Maintenance of aseptic conditions, Control of parameters, Valves and steam traps, Variants of fermentation vessels.	16	22
4.	Aeration and Agitation Introduction, Oxygen requirement in fermentations, Oxygen supply, Determination of K_{La} values, Fluid rheology, Factors affecting K_{La} values, Balance between oxygen demand and supply, Scale up and Scale down.	16	22
5.	Basic Outline of fermentation process and purification of fermentation products Introduction, Range of fermentation process, Components of fermentation process, Disruption of cells, precipitation, filtration, Centrifugation, Liquid Liquid Extraction, Chromatography, Membrane processes, Drying, Crystallization	20	28

Suggested Specification table with marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
5	10	15	15	15	10

Legends: R= Remembrance; U= Understanding; A= Application; N = Analyze; E = Evaluate C = Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Principles of Fermentation Technology, by Whitaker, Peter F Stanbury, S. Hall and A. Whitaker, Publisher: Butterworth-Heinemann; 2nd edition.
2. Bioprocess Engineering Principles by Pauline Doran, Publisher: Elsevier Science & Technology Books.
3. Introduction to Biochemical Engineering by D. G. Rao, Tata McGraw-Hill Education, 2005.
4. Biochemical Engineering and Biotechnology by Ghasem D. Najafpour, Publisher: Elsevier Science & Technology Books.

Course Outcome:

After learning the course, the students should be able to:

- Develop a fundamental understanding interdisciplinary approach of bioprocess systems.
- Compare batch, fed batch and continuous systems.
- Understand different parts of bioreactor and its working.
- Evaluate different mass transfer operations used in biochemical industries.

List of Experiments:

1. Determination of Oxygen Transfer rate.
2. Determination of K_{La} value.
3. To obtain growth curve of bacteria under batch culture.
4. To obtain growth curve of bacteria under fed batch culture.
5. To carry out precipitation of protein.
6. To perform column chromatography.
7. To perform drying operation.
8. To perform crystallization operation.

Open Ended Problems:

Students are free to select any project related to Biochemical engineering based on its application in the field of Biotechnology. Some of the suggested projects are:

- To perform formulation of some bioproducts.

- To perform downstreaming of some bioproducts.

List of Open Source Software/learning website:

Students can refer to video lectures available on the websites including NPTEL. Students can refer to the CDs which are available with some reference books. Students can develop their own flowsheets for demonstration of various fermentation processes and the downstreaming process.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.