



Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2022-2023
Course Handout Part II

Date: August 29, 2022

In addition to Part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : CHE F421
Course Title : Biochemical Engineering
Instructor-in-Charge : Dr. Debirupa Mitra

Scope and Objective of the Course:

This course will focus on the application of chemical engineering principles to design, develop and analyze bioprocesses. Students will be introduced to enzyme kinetics, applications of enzyme catalysis, bioreactor design considerations, and transport phenomena in bioprocesses. In the end, students will be given a flavor of application of biochemical engineering in some advanced biological systems.

Learning Outcomes

At the end of the course, the student should be able to

- Appreciate the role of a chemical engineer in a biochemical manufacturing processes
- Solve mathematical problems dealing with stoichiometry, microbial growth kinetics, enzyme kinetics
- Differentiate between batch, fed-batch and continuous modes of operation of bioreactors
- Solve mathematical problems related to the design of bioreactors
- Describe the transport phenomena involved in bioprocesses
- Describe the basic principles involved in recovery and purification of products

Textbooks:

T1. Biochemical Engineering Fundamentals, James E. Bailey and David F. Ollis, 2nd Edition, Tata McGraw-Hill.

T2. Bioprocess Engineering Basic Concepts, Michael L. Shuler and Fikret Kargi, 2nd Edition, Pearson Education International.

Course Plan:



Lecture No.	Learning Objectives	Topics to be covered	Chapter in the textbook
1-2	Introduction to biochemical engineering	<ul style="list-style-type: none"> What is biochemical engineering? What is the role of a chemical engineer in the life sciences industry.? 	T2 Ch 1
3 – 5	An overview of biology basics	<ul style="list-style-type: none"> Basics of microbiology Chemicals of life Cell nutrition 	T1 Ch 1-2 T2 Ch 2
6 – 9	Understanding enzyme kinetics & calculating kinetic constants for a given system	<ul style="list-style-type: none"> What are enzymes & why are they important? Mechanism of enzyme activity Enzyme kinetics with one & two substrates using Michaelis-Menten equation Enzyme deactivation 	T1 Ch 3 T2 Ch 3
10-12	Application of enzyme-catalyzed reactions	<ul style="list-style-type: none"> Types of enzymes & their applications Immobilized enzyme technology 	T1 Ch 4 T2 Ch 3
13-15	Product formation and yield	<ul style="list-style-type: none"> Energy & metabolism Stoichiometry of cell growth & product formation 	T1 Ch 5 T2 Ch 7
16-21	Bioreactors for kinetic measurements& biomass production	<ul style="list-style-type: none"> Ideal reactors (batch & CSTR) Biomass growth kinetics Product formation kinetics 	T1 Ch 7 T2 Ch 6
22-28	Design considerations for a bioreactor	<ul style="list-style-type: none"> Design equation for single-stage chemostat, chemostat with recycle & multistage chemostat Fed-batch operation Bioreactor for immobilized cell system Sterilization reactors 	T1 Ch 9 T2 Ch 9
29-33	Transport phenomena in bioprocesses	<ul style="list-style-type: none"> Oxygen transfer rates Power requirement calculations Scale up criteria 	T1 Ch 8
34-36	Recovery & purification of products	<ul style="list-style-type: none"> Separation of insoluble products Separation of soluble products Finishing steps for product purification 	T1 Ch 11 T2 Ch 11
37-40	Application in advanced biological systems	<ul style="list-style-type: none"> Animal vs. plant cell culture Wastewater treatment Medical applications of bioprocess engineering 	T2 Ch 12, 13, 15, 16 T1 Ch 14

Evaluation Scheme:

Evaluation Component	Duration	Weightage (%)	Date and Time	Nature of Component
Mid semester test	90 min	30	02/11 9.00 - 10.30AM	Closed book
Assignment (4)	NA	20	To be announced in class	Open book
Project presentation	NA	10	To be announced in class	Open book
Comprehensive Examination	180 min	40	22/12 FN	Open book

Chamber Consultation Hour: Monday 3-4 pm, D-206

Notices: Course-related notices will be uploaded on the CMS website

Make-up Policy: Make-up will be granted only for genuine cases with valid justification and only with prior permission of Instructor-in-charge. There will be no make-up for assignments, quizzes, and project presentation.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.



Dr. Debirupa Mitra
INSTRUCTOR-IN-CHARGE

