



Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2023-2024

Course Handout Part II

Date: 11-08-2023

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. : BIO F441
Course Title : **BIOCHEMICAL ENGINEERING BIO**
Instructor-in-Charge : SUPRATIM GHOSH
Co-instructor : NA

Course Description:

The course introduces various principles of biochemical engineering, fermentation process parameters & controls, kinetics of biomass production, substrate utilization, product formation, kinetics of enzyme catalyzed reactions and immobilized enzyme systems, Mass and energy balance in microbial processes, Medium and air sterilization, Design of batch, continuous and fed batch bioreactors, Transport Phenomena in biological reactors, Scale-up principles for biochemical processes, Instrumentation and control of bioprocesses, Bio separations.

Scope and Objective of the Course:

Being an elective course for the first-degree students, the course exposes the students to those foundational aspects as described above. At the end of the course, the student will have developed a basic understanding of the kinetics of biomass production, upstream, downstream processing, scale up and operation of industrial bioprocess plants. The students will be able to apply biochemical engineering concepts on biological systems.

Textbooks:

1. **TB1:** "Bioprocess Engineering: Basic Concepts" by Michael L. Shuler and Fikret Kargi (2005) Third Indian Reprint, Pearson Education.

Reference books

2. **RB1:** "Biochemical Engineering Fundamentals" by James E. Bailey and David F. Ollis (2010) 2nd Ed. McGraw Hill International Edition.
3. **RB2:** "Environmental Biotechnology: Principles and Applications", Bruce E. Rittmann and Perry L. McCarty (2001) McGraw Hill International Edition
4. **RB3:** "Biochemical Engineering" by Harvey W. Blanch & Douglas S. Clark (1997), Marcel Dekker, Inc., New York.
5. **RB4:** "Bioprocess Engineering Principles", by Pauline M. Doran, 2nd Ed., Academic Press, Elsevier, USA.



Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book
1-3	Introduction to Biochemical Engineering	Introduction to Biochemical Engineering; Biologists and engineers' perspective; Basics of Biology; Overview of Biotechnology; Diversity in Microbial Cells, Cell Constituents, Chemicals for Life.	1,2 (TB); 1, (RB1)
4-8	Bioenergetics, Chemical reaction thermodynamics, kinetics and reactor analysis	Microbial Stoichiometry and Energetics: Reversible and irreversible reactions; chemical reaction kinetics; chemical reactor kinetics (batch, CSTR and plug flow reactors)	5,7 (TB); 5 (RB1)
9-13	Enzyme catalysis: Reaction kinetics & application	Enzyme Kinetics: Introduction, Mechanistic Models, experimental determination of rate parameters, Effects of pH and temperature, Enzyme inhibition kinetics. Immobilized Enzyme Systems: Enzyme immobilization methods, their limitations & applications, Immobilized enzyme kinetics.	3 (TB); 3,4 (RB1)
14-20	Kinetics of Substrate Utilization, Product formation and biomass production in cell cultures	Cell Growth kinetics: Kinetics of Balanced Growth; Ideal reactors for kinetics measurement (Batch, CSTR, Fed batch); Monod Growth Kinetics; Product formation kinetics; Bioreactor design and analysis	6 (TB); 7, 9 (RB1)
21-26	Transport Phenomena and Sterilization in Bioprocess Systems	Gas-liquid mass transfer in cellular systems; Forced convective mass transfer; Scaling of mass-transfer equipment; Heat transfer in bioprocess systems and various correlations; Sterilization of bioprocess fluids	8, 9 (RB1)
27-34	Bioprocess scale-up, operation and control; Product purification and recovery	Scale up and its difficulties; Bioreactor instrumentation and control; Strategies, separation of soluble and insoluble products, cell disruption, purification and integration of processes.	10 (TB); 10 (RB1)
35-40	Industrial utilization of mixed cultures and traditional industrial bioprocesses	Introduction to mixed cultures, Models for mixed culture interaction, Mixed culture application to biological wastewater treatment, Fermentation processes for baker's yeast, ethanol and citric acid	16 (TB); 14 (RB1)



Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Mid-semester Examination	90 min	30	09/10 - 11.30 - 1.00PM	CB
Comprehensive Examination	180 min	40	06/12 AN	CB
2 Quizzes* (all are considered for evaluation)	30 min each	10	Continuous evaluation	OB
Assignments [§]	Diverse	20	Continuous evaluation	OB

***Quiz will be conducted during Lecture hours.**

[§]Assignments will be problem based.

Chamber Consultation Hour: To be announced in the class.

Notices: All notices will be displayed in the Course Management System (CMS).

Make-up Policy: Make-up decisions will be made on a case-by-case basis and only genuine cases as determined by the team and validated by Wardens and/or Medical Officers will be considered. No make-up will be considered for quizzes. Also refer to Clause 4.07 of *BITS Academic Regulations* for more details.

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.

**INSTRUCTOR-IN-CHARGE
BIO F441**

