



SECOND SEMESTER 2023-2024

Course Handout Part II

Date: 09-01-2024

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 F451
Course Title	: BIOPROCESS TECHNOLOGY
Instructor-in-Charge	: Jayati Ray Dutta
Co-instructor	: Supratim Ghosh
Course Description:	

The course introduces various principles of bioprocess technology, fermentation process parameters & controls, bioprocess principles, kinetics of biomass production, substrate utilization, product formation, kinetics of enzyme catalyzed reactions and applied enzyme catalysis, bioreactor design & operation, transport processes in bioreactors; novel bioreactor configurations; immobilized biocatalysts; bioconversion, bio-separations for applications in bio-product separation & purification. It is essential for process development, scale up and design for product recovery from complex cellular components. There is need to design new as well as to improve existing processes for economic and efficient process development associated with upstream and downstream processing for product isolation and purification, industrial applications of bioprocesses and bioprocess patenting & economics.

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, bioconversion and industrial applications of bioprocesses.

Textbooks:

1. Principles of Fermentation Technology by Stanbury, Whitaker & Hall, (1997) Aditya Books (P) Ltd., IChemE, 3rd edition, copyright 2017.

Reference books

1. **RB1:** Industrial Microbiology: An Introduction. Michael J. Waites, Neil L. Morgan, John S. Rockey and Gary Higton. Blackwell Publishing, 2001.
2. **RB2:** Product Recovery in Bioprocess Technology – BIOTOL series, Butterworth Heinmann, 1992.
3. **RB3:** Basic Biotechnology by Colin Ratledge, Bjorn Kristiansen (2006), Cambridge University Press.
4. **RB4:** Bioprocess Engineering: Basic Concepts, Michael L. Shuler and Fikret Kargi, 2nd Edition, Prentice Hall PHI, 2007.
5. **RB5:** Practical Fermentation Technology Brian McNeil & Linda M. Harvey John Wiley and Sons 2008.



Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book
1-3	Introduction to Fermentation technology	Overview of the course; range of fermentation processes; mass and energy balances; stoichiometry; microbial biomass & growth; nutritional requirements	1 (TB); 2, (RB1)
4-8	Microbial growth kinetics	Batch culture; continuous culture; Fed-batch culture; effects of culture parameters on microbial growth, kinetics of biomass production, substrate utilization and product formation.	2 (TB); 2 (RB1)
9-13	Microbial fermentation parameters and controls	Solid state & submerged fermentation, industrial microbes; isolation & selection methods, media formulation; optimization of process parameters; carbon, nitrogen sources, addition of precursors & metabolic regulators to media, antifoam, pH & oxygen requirements	3, 4 (TB); 4, 5, 6 (RB1)
14-17	Bioreactor/Fermenter design and operation	Design & configuration; control systems & transport processes in bioreactor; optimization & kinetics of enzyme catalysed reactions; immobilized enzyme/biocatalyst technology and applied enzyme catalysis.	7, 8 (TB); 7, 24 (RB3), 2 RB5
18-21	Product recovery & purification methods	Upstream and Downstream processing & challenges; cell disruption; chemical methods	10 (TB); 7 (RB1); 9 (RB3)
22-24	Product development	Development; regulation; safety measures	8 (RB1);
25-27	Industrial applications of bioprocesses & products	Industrial chemicals, fuels, bioconversion methods, microbial polysaccharides, health care products	10, 11 (RB1); 16 (RB3)
28-30	Bioprocess applications in beverage & food industries	Alcoholic beverages, beer brewing, wine fermentation, Vinegar fermentation, dairy fermentations, cheese, food additives & supplements	12, 13 (RB1)
31-33	Bioprocess applications of high-value proteins	Analytical enzymes, Therapeutic proteins, regulatory aspects	21 (RB3)
34-37	Medical applications of Bioprocess engineering	Tissue-engineered skin replacements, Chondrocyte culture for cartilage replacement	15 (RB4)
38-40	Bioprocess economics, safety, feasibility, patenting	Overall production process, fermentation steps, downstream processing steps, capital costs, operating costs, the economic case for investment; IPR related issues	11 (RB3); 12 (TB)

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Assignment/Quiz		20% (40 M)		OB
Mid-semester Examination	90 min	25% (50 M)	14/03 - 2.00 - 3.30PM	CB
Assignment/Quiz		20% (40 M)		OB
Comprehensive Examination	180 min	35% (70 M)	15/05 FN	CB

Chamber Consultation Hour: To be announced in the class.

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

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.

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 F451

