

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
FIRST SEMESTER 2022-23

Dated: 30.08.22

Course Handout Part II

Course No. : BIO G513
Course Title : Microbial & Fermentation Technology
Instructor In-charge : JAYATI RAY DUTTA
Instructors: Jayati Ray Dutta, Abhirami & Hemanjali

Description : Metabolic Stoichiometry- energetics, fundamentals of microbes and their morphology, Stoichiometry of cell growth and product formation, fermentation kinetics, phases of growth in batch culture, continuous culture and fed-batch cultures, kinetics of cell growth, product formation and substrate utilization-substrate and product inhibition kinetics, enzyme technology. Industrial Biotechnology- strain selection and improvement, media formulation and sterilization strategies, industrial applications, fermentation and product recovery, preparation of alcohols, antibiotics, organic acids, enzymes, bakery and dairy products, biopharmaceuticals, vaccine production.

1.Course Description: Fermentation Technology and Downstream Processing, Fermenter configurations and modes of operation, Enzyme catalyzed reactions, Industrial Biotechnology and Commercial manufacture of value-added biotechnological products.

2.Scope & Objective of the Course:

The course introduces and delineates various aspects of pure and applied microbiology. It mainly dwells upon the basic principles of Fermentation Technology and Downstream Processing, which involve various strategies for strain selection and improvement, media formulation, sterilization, inoculum development, various fermenter configurations and modes of operation, cell harvesting and product recovery, the kinetics of growth and enzyme-catalyzed reactions. The course also focuses on the implications of rDNA technology and the industrial applications of bioprocesses (Industrial Biotechnology) for the commercial manufacture of value-added biotechnological products like solvents, organic acids, antibiotics, enzymes, biopharmaceuticals etc.

3.Text Book (TB):

“Fermentation Microbiology and Biotechnology” Edited by E.M.T El-Mansi, C.F.A. Bryce, A.L. Demain & A.R. Allman, 3rd edition, (2012), Taylor and Francis Grp., London.

4.Reference Book (RB):

1. **“Principles of Fermentation Technology”** by Stanbury, Whitaker & Hall, Aditya Books (P) Ltd., New Delhi, IChemE, 3rd edition, (2017).
2. **“Bioprocess Engineering: Basic Concepts”** by Michael L. Shuler & F. Kargi, 2nd edition, (2007), Prentice-Hall.
3. **“Biotechnology: A Text Book of Industrial Microbiology”** 2nd Edition, by W. Crueger & A. Crueger (2005) Panima Publishing Corporation, New Delhi/Bangalore.

5.Course Plan:

Lec. No.	Learning Objectives	Topic to be covered	Ref. to Chapters
1	General Introduction	Introduction to the course & chronological development of Biotechnology	Chap 1 (TB, RB I)
2-4	Introduction to Applied Enzyme Catalysis	Biocatalysis; comparison with synthetic catalysts, Mechanisms, Michaelis-Menten Model for saturation kinetics, Enzyme Immobilization.	Chap 12 (TB) Chap 3 (RB II)
5-6	Media Formulation & Preparation	Complex and synthetic media, Selection of components, buffers, precursors, pH adjustment	Chap 4 (RB I)
7-8	Media/Air sterilization And Death Kinetics	Media & air: Batch & Continuous In-situ sterilization in fermentor	Chap 5 (RB I)
9-11	Isolation, selection, & improvement of industrial cultures	Enrichment culture, Screening methods, Culture preservation, Strain improvement: Mutagenesis, & rDNA technology.	Chap 2, 3 (RB I)
12-16	Inoculum development & Fermentation: Microbial	Aseptic culture transfer & incubation, inoculum age/size, studies on growth kinetics in batch,	Chap 2, 5 (TB)

	growth & product formation	continuous & fed-batch cultures, applications, Primary & secondary metabolism & important biotechnological products & implications.	Chap 5, 6 (RB I)
17-23	Fermenters: Configurations & modes of operation	Ideal bioreactors, Various configurations, Mechanical construction: various parts & accessories, agitation and aeration, modes of reactor operations.	Chap 15 (TB) Chap 7 (RBI)
24-30	Downstream processing: Basic concepts on product recovery & purification	Basic principles of Cell separation: Filtration and centrifugation etc. & Cell disruption – Mechanical & non-mechanical methods. Fundamentals of Cell & filtrate processing: Precipitation, centrifugation, filtration, dialysis, reverse osmosis, chromatography, drying, crystallization & product formulation	Chap 10 (RB I) Chap 11 (RB II)
31-39	Industrial Biotechnology: Illustrations of industrial processes: Fermentation & product recovery steps - with some suitable examples.	Details of the process, parameters & materials for the industrial manufacture of antibiotics (β -lactum), solvents, amino acid, organic acids (Citric acid), alcohols (Ethanol), industrial enzymes (Protease/Amylase) & biopharmaceuticals (Insulin/Interferon), microbial transformations & leaching.	Chap 8,9,11,13 15, 16, 18 (RB III)
40-41	Medical applications of Bioprocess engineering	Tissue engineering, Heterologous/Therapeutic proteins.	Chap 12 (RB I) Chap 15 (RB II)

List of experiments:

- Carbohydrate fermentation test
- Demonstration of ammonification
- Demonstration of nitrification
- Demonstration of denitrification
- Demonstration of the oligodynamic effect of metals
- Estimation of Indole acetic acid in a culture broth
- Estimation of L – proline in a culture filtrate of *E. coli*

7. Evaluation Scheme:

EC No.	Evaluation Component	Duration	Weightage (%)	Date, Time & Venue	Remarks
1.	Mid-semester	90 min	25	01/11 9.00 - 10.30AM	CB
2.	Lab practical (Evaluation components include: i. Lab quiz based on experiments conducted during class + Attendance ii. Comprehensive quiz		20		OB
3.	Presentations/assignments		20		OB
4.	Comprehensive	3hours	35	20/12 FN	CB

8. Chamber consultation hour: To be announced in the class.

9. Notices: All notices will be displayed on the Course management system.

10. Make-up policy: Make-up decisions will be considered for only genuine cases and validated by proper evidence of illness. No make-up for Lab components and assignments.

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 G513