

**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI**  
**SECOND SEMESTER 2019-20**

Dated: 7.1.2020

**Course Handout Part II**

**Course No.** : BIO G513  
**Course Title** : Microbial & Fermentation Technology  
**Instructor In-charge** : JAYATI RAY DUTTA  
**Instructors** : Jayati Ray Dutta, Mohammad Wasil & Venkata Manjari

**1. Course 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

**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, kinetics of growth and enzyme catalyzed reactions. The course also focuses on implications of r-DNA 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, 3<sup>rd</sup> 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, 3<sup>rd</sup> edition, (2017).
2. **‘Bioprocess Engineering: Basic Concepts’** by Michael L. Shuler & F. Kargi, 2<sup>nd</sup> edition, (2007), Prentice-Hall.
3. **“Biotechnology: A Text Book of Industrial Microbiology”** 2<sup>nd</sup> 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	<b>General Introduction</b>	Introduction to the course & chronological development of Biotechnology	<b>Chap 1 (TB, RB I)</b>
2. 3. 4.	<b>Introduction to Applied Enzyme Catalysis</b>	Biocatalysis; comparison with synthetic catalysts, Mechanisms, Michaelis-Menten Model for Saturation kinetics. Enzyme Immobilization.	<b>Chap 12 (TB) Chap 3 (RB II)</b>
5. 6.	<b>Media Formulation &amp; Preparation</b>	Complex and synthetic media, Selection of components, buffers, precursors, pH adjustment	<b>Chap 4 (RB I)</b>
7. 8.	<b>Media/Air sterilization And Death Kinetics</b>	Media & Air: Batch & Continuous In-situ sterilization in fermenter	<b>Chap 5 (RB I)</b>
9. 10. 11.	<b>Isolation, selection and improvement of Industrial cultures</b>	Enrichment culture, Screening Methods, Culture preservation, Strain improvement: Mutagenesis, Protoplast fusion and r-DNA technology.	<b>Chap 2, 3 (RB I)</b>
12. 13. 14. 15. 16.	<b>Inocula Development &amp; Fermentation: Microbial Growth &amp; Product Formation</b>	Aseptic culture transfer & incubation, inoculum age/size, studies on growth kinetics in batch, continuous & fed-batch cultures, Applications. Primary & Secondary metabolism and important biotechnological products and implications.	<b>Chap 2, 5 (TB) Chap 5, 6 (RB I)</b>

17. 18. 19. 20. 21. 22. 23.	<b>Fermenters: Configurations &amp; Modes of Operation</b>	Ideal bioreactors, Various configurations, Mechanical construction: various parts & accessories, Introduction to Mass & Heat Transfer: Agitation and aeration, Modes of Reactor Operations. Instrumentation and control of bioprocesses, Demonstration of various parts with the Laboratory Fermenter.	<b>Chap 15 (TB) Chap 7 (RB I)</b>
24. 25. 26. 27. 28. 29. 30.	<b><u>Downstream processing</u> Basic Concepts on Product Recovery &amp; Purification</b>	<b>Basic principles of <u>Cell Separation</u>:</b> Filtration and Centrifugation etc. and <b><u>Cell disruption</u></b> – Mechanical & Non-mechanical methods. <b>Fundamentals of <u>Cell and Filtrate Processing</u>:</b> Precipitation, Centrifugation, Filtration, Dialysis, Reverse osmosis, Chromatography, Drying, Crystallization and Product Formulation	<b>Chap 10 (RB I) Chap 11 (RB II)</b>
31. 32. 33. 34. 35. 36. 37. 38. 39.	<b>Industrial Biotechnology Illustrations of industrial Processes: Fermentation &amp; Product recovery steps - with some suitable Examples using process flow chart diagrams.</b>	Details of the process, parameters and materials for the industrial manufacture of Antibiotics ( $\beta$ -lactum), Solvents (acetone) Amino acid (Lysine), Organic acids (Citric acid), Alcohols (Ethanol), Ind. Enzymes (Protease/Amylase) and Biopharmaceuticals (Insulin/Interferon etc.) Microbial Transformations, Microbial leaching.	<b>Chap 8, 9, 11, 13 15, 16, 18 (RB III)</b>
40. 41.	<b>Medical applications of Bioprocess engineering</b>	Tissue engineering, Heterologous/Therapeutic proteins.	<b>Chap 12 (RB I) Chap 15 (RB II)</b>

#### 7. Evaluation Scheme:

EC No.	Evaluation Component	Duration	Weightage (%)	Date, Time & Venue	Remarks
1.	Mid-semester	90 min	20	6/3 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	3 hours	40	12/05 FN	CB

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

**9. Notices:** All notices will be displayed on 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 component 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**