



GUJARAT TECHNOLOGICAL UNIVERSITY
Integrated Master of Science (Biotechnology)
Semester: 5
Subject Name: Bioprocess Technology
Subject Code: 1350403

W.e.f. Academic Year:	2024-2025
Semester:	5
Category of the Course:	Compulsory Subject

Prerequisite:

Students should be aware of microbiological technique, bacteriology, and bio-physical chemistry.

Rationale:

This course is designed so that students can have deep understanding of formulation of medium for the maximum production of metabolites and biocatalyst for various commercial use. The students can design bioreactor configurations and operation modes based upon the nature of bio products. This course will be useful for students to understand the kinetics of living cells and to develop a strategy to solve the issues emerging during fermentation processes and Evaluate own model required for the microbial growth and can design own batch thermal sterilization.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Practical		
				ESE (E)	PA(M)	ESE (V)	PA (I)	
4	0	8	8	70	30	30	20	150

Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	Historical development of bioprocess technology, an overview of traditional and modern applications of biotechnological processes, General requirements of fermentation processes, Basic design and construction of fermenter and ancillaries, Main parameters for monitoring & control of fermentation processes, Different raw materials used in fermentation industry and their pretreatment, Medium for plant cell culture and animal cell culture, Medium design of commercial media for industrial fermentations - Plackettburman design, response surface methodology, simplex design.	15	25
2	Stoichiometry of cell growth and product formation, elemental	15	25



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	balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients. Energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.		
3	Mass transfer includes transport phenomena in bioprocesses, Factors affecting oxygen transfer rate in bioreactors, Techniques for measurement of volumetric oxygen transfer coefficient, Fluidrheology and factors affecting bioreactor processes, Flow Patterns in agitated tanks, Mechanism & Power requirements of mixing, Scale up of mixing systems.	15	25
4	Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes, Induction, nutritional repression, carbon catabolite repression, Crabtree effect, feedback inhibition and feedback repression, Concept of Overproduction of metabolites, Case studies on production of Lactic acid, Glutamic acid, Penicillin, Microbial Lipase and Protease, Recombinant Insulin, Interferons, Hepatitis Vaccines etc. Case studies should deal with strain improvement, medium designs, process optimization technology.	8	13
5	Filtration, filter aids, filtration Equipment and filtration theory, Centrifugation process and its equipments, Cell disruption, Aqueous Two-Phase Liquid Extraction. Adsorption process and its operations, Chromatography: Theory and mechanism, Scaling-up chromatography.	7	12

Reference Books:

1. Biochemical Engineering- S. Aiba, A.E. Humphray, University of Tokyo Press.
2. Lee J.M, Biochemical Engineering 2nd ed, Prentice Hall, 2000.
3. Principles of Cell Energetics: BIOTOL series, Butterworth - Heinemann.
4. Biotechnology Vol.4 Meaning Modelling and Control Ed. K.Schugerl, VCH 1991.
5. Unit operations of Chemical Engineering 5th ed. by W L McCabe, J C Smith and P. Harriot McGraw-Hill 1993.
6. Diffusion by E L Cussler, Cambridge University Press (1984).
7. Bioprocess Engineering Principles by Pauline M.Doran, Academic Press.
8. Biochemical Engineering- S. Aiba , A.E. Humphray, University of Tokyo Press.

Suggested Course Practical List:



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1. Fermenter designing and the study of various parts of fermenter and their function for microbial cell culture.
2. Fermentative production of Penicillin by using *Penicilium chrysogenum*.
3. Microbial production of enzymes Cellulase & Protease.
4. Ethanol production from molasses or starchy raw material.
5. Fermentative production of Wine from grapes.
6. Separation and purification of microorganisms from yogurt and cheese.
7. Fermentative production of alpha amylase under solid & submerged conditions.
8. Protein profiling of fermentation broth through dialysis procedure.
9. To study the Scale-up and Sterilization in Bioreactors
10. Fermentative production of lactic acid / citric acid.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
1	Formulate medium using statistical tool for the maximum production of metabolites and biocatalyst for various commercial use (UN,RM,AP)	UN
2	Design bioreactor configurations and operation modes based upon the nature of bio products (UN,RM,AP)	AN
3	Model the kinetics of living cells and to develop a strategy to solve the issues emerging during fermentation processes (UN,RM,AP,CR)	EL
4	Develop a research career or job in biotechnology industry with strong foundation in bioreactor design and scale-up or to become entrepreneur (UN,RM,AP,CR)	EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create
