



Subject: Bioprocess engineering -MSCMB12510

Type of course: Major

Prerequisite: Student must have comprehensive understanding of industrial microbiology

Rationale: It helps in understanding fermentation process, sterilization, fermentative productions and fermentative economics. Along with developing a new and innovative food, medicine, drugs and helps to protect the environment.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks					Total Marks
CI	T	P		Theory Marks		Practical Marks		CA	
			ESE	MSE	V	P	ALA		
4	0	0	4	60	30	10	00	50	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.



Course Content:

Unit No	Course content	Hrs	% Weightage
1	<p>Chapter:1 Enhancement of strains, separation, and screening</p> <ul style="list-style-type: none"> • Microbial diversity and its importance in Industrial Microbiology • Methods for isolation: Sources, strategies and methods, enrichment methods, high throughput screening (HTS) • Screening: types and screening artifacts. • Yeast strain improvement for ethanol production. • System biology (transcriptome, proteome, metabolome, fluxome) in strain development. <p>Chapter:2 Good manufacturing practice and safety:</p> <ul style="list-style-type: none"> • Quality management, quality control. • Introduction to GLP and its principles, safety guidelines. 	15	25%
2	<p>Chapter:3 Biological reactor and sterilization</p> <ul style="list-style-type: none"> • Concept, design, types factors affecting selection of bioreactor, body construction, Aeration and agitation. • Immobilization of cells and enzymes: Physical and chemical methods, applications of various immobilized cells and enzymes • Sterilization of fermenter by various method: In situ (batch and continuous) and Ex situ (filter sterilization) sterilization • Sterilization of air supply • Sterilization of exhaust gas supply. 	15	25%



3	<p>Chapter:4 Process Economics and Upstream and Downstream Processing</p> <ol style="list-style-type: none"> 1. Introduction to scale up 2. Up-stream processing, fermentation and downstream processing <ul style="list-style-type: none"> • Product recovery (downstream processing): <ol style="list-style-type: none"> 1. Separation (filtration, centrifugation) 2. Cell disruption (physio-mechanical and chemical method) 3. Preservation methods for industrially important microorganisms (enrichment method) 4. Effluent treatment (physical, chemical, trickling filter) 5. Fermentation Economics 	15	25%
4	<p>Chapter:5 Generation of biomass and products by the use of fermentation process</p> <ul style="list-style-type: none"> • Organisms exploited, Physiology and biochemistry of the organism, fermentative processes, recovery • Organic acids: kojic acid, itaconic acid. • Enzymes: L-asparaginase production • Hormone: Insulin production • Vitamin: vitamin B12 • Antibiotics: Nucleoside antibiotics (puromycin, polyoxin) and aromatic antibiotics (novobiocin, griseofulvin). • Other commercially or medically important compounds: β-carotene and lova statin. 	15	25%

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	<p>Flow chart preparation Faculty will assign different industrially important products and student will prepare production flow chart and upload them to the GMIU web portal.</p>	10
2	<p>Instrument Description Faculty will provide the figure of instrument and students will detailize the figure and upload on GMIU web portal.</p>	10



3	Problem solution Faculty will provide a problem related to industrial media preparation and students will upload a solution on the GMIU web portal.	10
4	Online Industry Exploration Faculty will provide the topic related to industrial product and group of students will explore regarding that and upload it to GMIU web portal.	10
5	Industrial visit Students will visit industry and prepare the report on instruments and techniques used in that specific industry and report will be upload it to GMIU web portal.	10
Total		50

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	40%	30%	10%	-	-

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course the students should be able to:	
CO1	Apply the principles and methods of strain enhancement, separation, and screening
CO2	Understand the principles and operation of biological reactors
CO3	Describe the principles of upstream and downstream processing to the production and purification of biological products
CO4	Elucidate the principles of fermentation and its application to the production of biomass and products



Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

- 1) Stanbory P. F. A. Whitakar Hall. (1995). Principles of fermentation Technology. Porgaman, Mc Neul and Harvey.
- 2) Crueger W and Crueger A, (2000), Biotechnology: A Text Book of Industrial Microbiology, 2nd edn, Panima Publishing Corporation, New Delhi, India
- 3) Frazier W C and Westhoff D C (1988), Food Microbiology, 4th edn. McGraw-Hill Book Company, NY.
- 4) A. L. Demain, Biology of Industrial Microorganisms.
- 5) G. Reed (Editor). Industrial Microbiology, CBS Publishers, (AVI publishing Company).

