Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Science College
Semester-5 (B.Sc.)

Subject: Bioprocess Engineering - BSCMB15315

Type of course: Major

Prerequisite: Student must have comprehensive idea about cell structure, biochemistry, enzyme function, metabolic pathways, growth factors, nutritional types, genetics, and laboratory techniques for prokaryotic metabolism.

Rationale: Bioprocess engineering equips microbiology students with the skills to translate lab-scale discoveries into industrial biomanufacturing, enhancing career prospects in the growing biotech sector.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				SEE		CCE			
CI	T	P	C	Theory	Practical	MSE	LWA/V	ALA	
3	0	2	4	75	25	30	20	50	200

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation; MSE- Mid Semester Examination; LWA - Lab Work Assessment; V -- Viva voice; CCE-Continuous and Comprehensive Evaluation; ALA- Active Learning Activities

3 Credits * 25 Marks = 75 Marks (each credit carries 25 Marks) Theory
1 Credits * 25 Marks = 25 Marks (each credit carries 25 Marks) Practical
SEE 100 Marks will be converted in to 50 Marks
CCE 100 Marks will be converted in to 50 Marks
It is compulsory to pass in each individual component.

GYANMANJARI INNOVATIVE UNIVERSITY BHAVNAGAR

Course Content:

Unit No	Course content	Hrs	% Weightage
1	**Chapter: - 1 Introduction to Bioprocess** • Range of bioprocess technology and its chronological development • Introduction to Upstream processing, fermentation, downstream processing. • Screening of industrially important organisms. • Characteristics of an industrially ideal organism. • Introduction to Primary screening. • Introduction to Secondary screening.	15	25%
2	**Chapter:- 2 Media for industrial fermentation** • Introduction and Principles of media formulation. • Water, energy source, carbon source, nitrogen source, minerals, growth factors, buffers, precursors, oxygen requirement, antifoams, medium optimization. • Sterilization of media – in situ and ex situ. • Inoculums development: General principles for development of seed culture. • Media optimization by statical method.	10	25%
3	**Chapter:- 3 Bioreactor Design and controlling parameters.** • Basic design of bioreactor: Batch and Continuous, Fed batch. • Controlling parameters - Aeration and agitation system, measurement and control of dissolve oxygen, pH, temperature, foam sensing. • Maintenance of Aseptic operation.	10	25%

4	**Chapter:- 4 Types of Bioreactor & fermentation economics:** • Based on growth of microbes: Surface and Submerged fermentation. • Based on operating parameter: Batch, fed-batch and continuous fermentation. • Airlift, Tower Cylindroconical vessels, Deep jet, Packed tower. • Rotating Disc • Stirred tank Bioreactor • Fermentation economics	10	25%

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Fermenter and its parts** Students will draw the diagram of fermenter based on operating parameter and upload the photo on to the GMIU web Portal.	10
2	**Bioprocess Technology Timeline** Students (Group of five) have to find out the ancient bioprocess to resent bioprocess techniques and its benefits, prepare timeline chart and upload it to GMIU web portal.	10
3	**The Fermentation Factory Challenge** Student (Group of five) will prepare cost effective fermentation media for different products and upload the report on GMIU web portal.	10
4	**Industrial Visit** Student will Prepare Report on Industrial Visit and upload it to GMIU web Portal.	10
5	**Attendance**	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	30%	40%	20%	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	Design and analyze bioreactors for various fermentation processes, considering factors such as vessel type, component function, and operational mode.
CO2	Formulate and optimize media for industrial fermentation processes, considering the nutritional and environmental requirements of target microorganisms.
CO3	Explain the principles of bioreactor design and operation, including batch, continuous, and fed-batch modes.
CO4	Outline the steps involved in upstream processing, fermentation, and downstream processing of a bioproduct.

List of Practical:

Sr. No	Descriptions	Unit No	Hrs
1	Primary screening of amylase producers from soil	1	3
2	Primary screening of organic acid producers from soil	1	3
3	Primary screening of antibiotic producers by modified crowded plate method	1	3
4	Primary screening of antibiotic producers by modified Wilkin's method	1	3
5	Preparation of fermentation media for microbial growth	2	3

6	Determination of OTR under static, sparging and shake flask condition by sulfite oxidation method.	2	3
7	To use Statistical method for media preparation.	2	3
8	To produce Alcohol by using jiggery as source of carbon and nitrogen.	3	3
9	Preparation of different flavored yogurt	4	3
10	To study various primary and auxiliary parts of a standard bioreactor.	4	3
Total			**30**

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] Stanbury, P.F., Whitaker, A. and Hall, S.J. (2003) Principal of Fermentation Technology. 2nd Edition, Butterworth-Heinemann, Oxford.
[2] Prescott L, Harley J P, and Klein D A, (2008). Microbiology, 7th edn. Wm C. Brown - McGraw Hill, Dubuque, IA.
[3] Lehninger A.L -2012, Principles of Biochemistry,Freeman, W.H.& ComConn E.E and Stumps P.K(1972), Outlines of biochemistry, 3rd edition,John Wiley & Sons
[4] Crueger W and Crueger A, (2000), Biotechnology: A Text Book of Industrial Microbiology, 2nd edn, Panima Publishing Corporation, New Delhi, India
[5] Waites M J, and Morgam N L,(2002). Industrial Microbiology: An Introduction
[6] Practical Microbiology: Dubey RC and Maheshwari DK, S Chand Publication.