Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-7

Subject: Fermentation Technology- BETBT17332

Type of course: Professional Core

Prerequisite: Basic knowledge of microbiology, biochemistry, food technology, and molecular biology is required.

Rationale: To equip students with theoretical knowledge and practical expertise in bioprocess technology, enabling them to design, optimize, and scale-up fermentation processes for production of pharmaceuticals, biologics, food products, and industrial enzymes through aerobic and anaerobic fermentation systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
CI	T	P	C	Theory Marks		Practical Marks		CA	
				ESE	MSE	V	P	ALA	
4	0	2	5	60	30	10	20	30	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End SemesterExamination;MSE-MidSemesterExamination;V–Viva;CA-ContinuousAssessment;ALA-ActiveLearningActivities.

Course Content:

Unit No.	Course content	Hrs	% Weightage
1	**Fundamentals of Fermentation Technology** Introduction to fermentation, Types of fermentation (aerobic, anaerobic, semi-aerobic), Historical perspective of fermentation, Microorganisms used in fermentation, Selection and maintenance of culture, Sterilization principles and methods (autoclaving, filtration, radiation), Media composition and preparation for fermentation.	15	20%

2	**Bioprocess Engineering and Reactor Design** Principles of bioprocess engineering, Bioreactor types (stirred tank, airlift, fluidized bed, photo bioreactors), Design and operation of bioreactors, Oxygen transfer and aeration, Agitation and mixing in fermentation vessels, Scale-up strategies, Fermentation monitoring and control parameters (pH, temperature, dissolved oxygen, foam control).	20	35%
3	**Microbial Kinetics and Fermentation Dynamics** Growth kinetics (batch, fed-batch, continuous fermentation), Substrate and product kinetics, Monod equation, Maintenance and death phases, Yield coefficients, Productivity optimization, Statistical design of experiments for fermentation optimization.	15	30%
4	**Industrial Fermentation Applications and Downstream Processing** Pharmaceutical fermentation (antibiotics, vaccines, monoclonal antibodies), Food fermentation (beverages, dairy, probiotics), Biofuel production, Industrial enzyme production, Downstream processing fundamentals, Product recovery and purification techniques, Quality assurance and GMP compliance.	10	15%

Continuous Assessment:

Sr. No.	Active Learning Activity	Marks
1.	**Bioreactor Design Project** Design a bioreactor system for a specific fermentation process (e.g., yogurt production, antibiotic synthesis). Include specifications, operational parameters, control strategies, and scale-up considerations. Submit as technical document on GMIU Web Portal.	10
2.	**Fermentation Process Optimization Report** Conduct a case study on optimizing a fermentation process using statistical design methods. Present findings with graphs, error analysis, and industrial applications. Submit on GMIU Web Portal.	10
3.	**Industrial Fermentation Technologies Review** Prepare a detailed report on recent advances in fermentation technology (CRISPR-optimized strains, continuous fermentation, single-use bioreactors). Include flow of advancements and future perspectives. Submit on GMIU Web Portal.	10
Total		30

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 the above table.

List of Practical

Sr.No	Title	Hours
1	Preparation and Sterilization of Fermentation Media	4
2	Inoculum Preparation and Maintenance of Cultures	4
3	Aerobic Fermentation using Shake Flask System	4
4	Anaerobic Fermentation (Batch Culture)	4
5	Fed-Batch Fermentation Experiment	4
6	Estimation of Microbial Biomass and Growth Rate	2
7	pH and Dissolved Oxygen Measurement in Fermentation	2
8	Product Recovery by Centrifugation and Filtration	2
9	Enzyme Assay and Activity Measurement	2
10	Protein Quantification by Bradford Assay	2
Total		30

Course Outcome:

After learning the course ,the students should be able to:	
CO1	Understand fundamental principles, microorganisms, and operational parameters involved in fermentation processes.
CO2	Describe different bioreactor types, design considerations, and their applications in industrial fermentation.
CO3	Analyze and optimize fermentation conditions using kinetic models and statistical design approaches.

CO4	Apply fermentation technology knowledge to design, troubleshoot, and scale-up bioprocesses for pharmaceutical, food, and industrial applications.

Instructional Method:

- The course delivery method will depend upon the requirement of content and the need of students. The teacher in addition to the conventional teaching method by blackboard, may also use any of the tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- From the content,10% of 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 based on the Active Learning Assignment

Reference Books:

[1] Pauline M. Doran. Bioprocess Engineering Principles (3rd ed.). Academic Press.
[2] Michael J. Fink. Fermentation Bioprocess Engineering. Springer Science.
[3] Dieter Eibl and Regine Eibl. Disposable Bioreactors: Advances in Technology. Wiley-VCH.
[4] Pierre Vértes et al. Industrial Bioprocessing: Production Scale Biopharmaceutical and Recombinant Protein. Wiley-VCH.
[5] Georgios Lyberatos. Fermentation Processes: Design and Applications in Food, Pharmaceuticals and Biofuels. Woodhead Publishing.
[6] David G. Allwood et al. Pharmaceutical and Biotech Fermentation Media Formulation. Springer.
[7] R.P. Singh and Dennis R. Heldman. Introduction to Food Engineering (5th ed.). Academic Press.