



Master of Science (Microbiology)
M. Sc. (Microbiology) Semester II

Course Code	PS02CMIC51	Title of the Course	BIOPROCESS AND BIOCHEMICAL ENGINEERING
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	<ol style="list-style-type: none">1. Understanding of upstream and downstream processing2. To understand Isolation, preservation, improvement, handling of organisms and optimization of media3. Understand various types of small and large scale equipment, controls and concept of scale up4. Understand basic concepts of growth, cultivation and product recovery
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Course Content		
Unit	Description	Weightage* (%)
1.	Introduction to bioprocess technology & Upstream processes Industrially important microorganisms, Isolation, primary and secondary screening Preservation method and Microbial culture collections. Improvement of industrially important organisms Inoculum development and large scale inoculation and sampling Substrates for fermentation processes Medium optimization strategies	25
2.	Bioreactor design: Laboratory, pilot and large scale reactors. Plug flow reactors, enzyme reactors, single use bioreactors. Approaches and bioreactor designs for cultivation of algal, plant and animal cells, suspension cultures, methods for microalgal cultivation, stem cell cultivation, high cell density cultivations, mixed cultures Sterilization of media and air. Scale up and Scale down	25
3.	Mass transfer of oxygen: Agitation and aeration, Determination of K_{La} , factors affecting K_{La} , fluid rheology. Bioprocess kinetics: Kinetics of growth and substrate utilization in batch, fed batch and continuous systems. Control of process parameters: Instrumentation for monitoring bioreactor and fermentation processes, Sensors, Controllers, fermentation control systems and architecture, Incubation and sequence control, advanced control.	25
4.	Introduction to Downstream processing: Bio-separation: Sedimentation, Filtration, Centrifugation, Cell Disruption: Mechanical and Non-mechanical	25





	Product Extraction and Concentration by Precipitation, Liquid-Liquid Extraction, Super critical fluid extraction, Aqueous two phase and three phase partitioning Product purification by various chromatographic techniques, Membrane processes (Dialysis, Reverse Osmosis and Ultrafiltration) Product drying and crystallization Fermentation Economics	
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Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Appreciate the concept and scope of Bioprocess upstream and downstream processing and the economics of industrial processes
2.	Handle and work with Microbial cultures, especially its screening, maintenance, preservation and cultivation
3.	Get trained and work with industrial processes for large scale sterilization, inoculation, production and product recovery





Suggested References:

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Sr. No.	References
1.	Principles of Fermentation Technology : Whitekar & Stanbury
2.	Comprehensive Biotechnology : Murray Moo Young
3	Methods in Industrial Microbiology : Sikyta <ul style="list-style-type: none">• Fermentation Microbiology and Biotechnology, El Mansi and Bryc
4	Bioprocess Engineering Basic Concepts: Shular and Kargi

On-line resources to be used if available as reference material

<https://onlinecourses.nptel.ac.in>

<https://www.swayamprabha.gov.in/index.php/home>

