

Programme: M.Sc. (Microbiology)

Course Code: MIC 202

Title of the Course: INDUSTRIAL MICROBIOLOGY

Number of Credits: 3

Effective from Academic Year: 2018-19

Prerequisites	Basic knowledge about the types of microbes and their products of industrial relevance. Knowledge of microbial biochemistry, physiology, genetics and statistics.	
Objective:	Development of concepts in the processes, instruments, management, quality, etc. being used in the industries to produce the products using microorganisms.	
Content:		
1.		
1.1	History of Industrial Microbiology, fermentation processes, descriptive layout and components of fermentation process for extracellular and intracellular microbial products.	(05)
1.2	Microbial growth kinetics: Batch kinetics – Monod's model (single substrate), deviations from Monod's model, dual substrates – sequential utilization, multiple substrates – simultaneous utilization, substrate inhibition, product synthesis (primary and secondary metabolite), toxic inhibition, death constant.	(05)
1.3	Microbial growth kinetics: Fed-batch kinetics – fixed volume, variable volume and cyclic fed-batch, applications and examples of fed-batch systems. Continuous cultivation system – relationship between specific growth rate (μ) and dilution rate, comparison between various cultivation systems.	(04)
2.		
2.1	Bioreactor design and operation: classification of reactors; Ideal mixed v/s plug flow reactor; designing parameters for reactors (stirred tank reactor, airlift reactor, plug flow reactor), rheology of fermentation broth.	(05)
2.3	Bioreactor design and operation: gas-liquid mass transfer, heat transfer, analysis of dimension less parameters and their application (aeration number, power number and Reynold's number; Scale-up of bioprocesses: parameters used in scale-up and problems associated with scale-up.	(05)
3.		
3.1	Solid substrate fermentation (SSF): Principles and application; Surface fermentation Comparison between SSF, Surface fermentation and SmF. Immobilized enzymes and cell systems.	(03)

3.2	Fermentation monitor and control: Common measurement and control systems (speed, temperature, gas, pH, Dissolved oxygen, foam, redox, air flow, weight, pressure, biomass), On-line and off-line analysis.	(04)
3.3	Industrial scale Down-stream processing and product recovery: principle and general description of instrumentation, Recovery of particulates (cells and solid particles), recovery of intracellular products, primary isolation (extraction, sorption), precipitation, industrial processes for chromatography and fixed bed adsorption, membrane separations; Type Processes - Antibiotic (Penicillin including semi-synthetic).	(05)
Pedagogy:	Lectures/tutorials/assignments/self-study/Moodle/Videos	
References/ Readings	<ol style="list-style-type: none"> 1. Demain, A. L., Davies, J. E. and Atlas, R. M. Manual of Industrial Microbiology and Biotechnology, ASM Press. 2. Vogel, H. C. and Tadaro, C. M., Fermentation and Biochemical Engineering Handbook: Principles, Process Design and Equipment, William Andrew Publisher. 3. Atkinson, B. and Mavituna, F., Biochemical Engineering and Biotechnology Handbook, Stockton Press. 4. Flickinger, M. C. and Drew S. W., The Encyclopedia of Bioprocess Technology: Fermentation, Biocatalysis and Bioseparation, Volumes 1 - 5, John Wiley Publisher. 5. Stanbury, P. F., Whitaker, A. and Hall, S.J., Principles of Fermentation Technology, Butterworth-Heinemann Publishers. 	
Learning Outcomes	<ol style="list-style-type: none"> 1. Apply the principle of management and controls on the microbial processes in industrial settings. 2. Apply the principles of physiological understanding in improvement of the industrial processes. 	