MST 301: FERMENTATION TECHNOLOGY	
Teaching Scheme Lectures: 4 hrs/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - MST101, MST151 Biochemistry, MST103, MST153 Molecular Biology, MST202, MST252 Microbiology & Industrial Applications, MST203, MST253 Genetic Engineering.

Course Objectives:

1. To understand the basic of fermentation, different bioreactor design, different media used for the fermentation of product, overview of product produced by biotechnological industries.
2. To learn the different instrumentation used for the downstream processing of different products.
3. To learn and have complete knowledge of type of enzymes and different fermented food products of different industries.
4. To understand how downstream processing instrumentation works or they can use like crystallization, during, liquid-liquid extraction, centrifugation, chromatography etc.
5. To learn the enzyme kinetics, microbial kinetics, thermal kinetics and the application of these in fermentation.
6. To expertise in the process involved in the effluents or waste of fermentation industries by latest technologies involved in treatment of waste like, Activated sludge process, Rotating Disk Biological Contractor (RBC) etc.

Detailed Syllabus

Unit-1 **An introduction to fermentation processes-** Range of fermentation process, microbial biomass, Microbial metabolites, Microbial growth kinetics- Batch culture, continuous culture, comparison of batch and continuous culture in industrial applications, fed-batch culture, variable and fixed volume fed batch culture.
Unit-2 Isolation, preservation and improvement of industrially important microorganisms, Screening methods, Isolation methods, enrichment liquid culture, enriched culture, Industrial fermentation typical media, media formulation, water, energy and carbon sources, nitrogen sources, minerals, vitamin sources, nutrient recycle, buffers, precursors and metabolic regulators, oxygen requirement.
Unit-3 **Media sterilization,** sterilization of fermenter, sterilization of the feed. Inocula for industrial fermentation-development of inocula for yeast, bacteria, fungi and actinomycetes, the inoculation of fermenters, the use of spore inoculums, inoculation from a laboratory and plant fermenter .
Unit-4 **Downstream processing:** Bioseparation - filtration, centrifugation, sedimentation, flocculation; Cell disruption; Liquid-liquid extraction; Purification by chromatographic techniques; Reverse osmosis and ultra filtration; Drying; Crystallization; Storage and packaging; Treatment of effluent and its disposal, anaerobic and aerobic treatment of effluents.

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Unit-5
Bioreactor: Types of reactor: Batch culture bioreactor, plug flow reactor (PFR), continuous stirred tank reactor (CSTR), Fixed and Fluidized bed, bubble column, air lift fermenter. Design of fermenter, basic functions, construction, aeration and agitation, oxygen requirements of industrial fermentation, Instrumentation and control of process parameters, Scale up and scale down process.
Text and Reference Books
1. Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991.
2. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall, Engel wood Cliffs, 2002.
3. Stanbury RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997
4. Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986.
5. Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2nd Edition, University of Tokyo press, Tokyo, 1973.
6. Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4. Young M.M., Reed Elsevier India Private Ltd, India, 2004.

Course Outcomes:
After completing the course, students will be able to:

1. Understand various types of fermentation mode of operation and their kinetics.
2. Analyze the effect of various fermentation and downstream processes involved in the synthesis of products.
3. Understand the enzyme production and their application involved in modern world.
4. Understand the instrumentation involved in the downstream processing of products produced by different pharmaceutical and biotechnological industries.
5. Evaluate performance of different fermentation processes i.e., whose work in batch and continuous mode of operation.
6. Will understand the production and application of some enzymes used in food and biotechnological industries.

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