

**Syllabus for Master of Science**
**Microbiology**
**Subject Code: 02MB0501**
**Subject Name: Bioprocess Technology**
**M. Sc. Semester - III**

**Objective:** To acquaint students with technical and biological aspect of microbial utilisation for production of metabolites.

**Credits Earned:** 6 Credits

**Course Outcomes:** After completion of this course, student will be able to

- Designing of bioreactors and control necessary for maximising production.
- Select and optimise media for maximum production of microbial metabolites.
- Designing of protocols for strain improvement and separation of molecules after fermentation process.

**Pre-requisite of course:** N.A.

**Teaching and Examination Scheme**

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	Mid Sem (M)	Internal (I)	Viva (V)	Practical (PR)	
4	0	4	6	50	30	20	25	25	150

**Contents:**

<b>Unit</b>	<b>Topics</b>	<b>Contact Hours</b>
1	Introduction to fermentation technology: Interaction between biochemical engineering; Microbiology and Biochemistry; Introduction to fermentation processes; Microbial culture; Screening and selection for fermentation processes; Preservation and improvement of industrially important microorganisms; Inoculum production for bacterial and fungal processes.	15
2	Raw material and media formulation for fermentation process: Fermentation media; Natural media; synthetic media. Sources of Carbon; Nitrogen and vitamins; antifoams and optimization; Types of Fermentation: Solid Substrate fermentation and submerged fermentation; Process parameters: measurement of temperature; pressure and pH; dissolved Oxygen; foam etc. Strain improvement by mutation and screening of improved cultures; random and strategic screening methods; strategies of strain improvement for primary; secondary metabolites with relevant examples; Preservation of cultures after strain improvement programme.	15
3	Design and construction of a Fermentors: Body construction; construction material; Aeration and agitation systems; Stirrer glands and bearings; Baffles; Valves and steam traps; Pressure-control valves; computer applications in fermentation technology; specialized bioreactors; membrane bioreactors; tower bioreactors; fluidized bed bioreactors; Immobilized system and packed bed reactors and Photobioreactors.	15
4	Downstream Processing: Biomass separation by centrifugation; filtration; flocculation and other methods; Cell disintegration: Physical; chemical and enzymatic methods; Separation of solid and liquid phases; isolation and purification techniques for proteins and other products based on different physico-chemical properties; Principles of bioprocess control; bioprocess automation and application of computers in bioprocessing; recombinant products with representative examples.	15
	<b>Total Hours</b>	<b>60</b>

**References:**

- Peter F Stanbury, Allan Whitaker, Stephen J Hall. *Principles of Fermentation Technology*. (2016) Butterworth-Heinemann Press. UK.
- H. J. Pepler, D. Perlman. *Microbial Technology: Fermentation Technology*. (2014). Academic Press.
- T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. *Fermentation Microbiology and Biotechnology*. Second Edition. (2006). CRC Press, USA.
- Hongzhang Chen. *Modern Solid State Fermentation: Theory and Practice*. (2013). Springer Press, Germany.
- John E. Smith. *Biotechnology*. (2009). Cambridge University Press. UK.
- Celeste M. Todaro, Henry C. Vogel. *Fermentation and Biochemical Engineering Handbook*. (2014). William Andrew Press. Norwich, NY.
- G. Lancini, R. Lorenzetti. *Biotechnology of Antibiotics and other Bioactive Microbial Metabolites*. (2014). Springer publications, Germany.

**Suggested Theory distribution:**

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process.

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
20%	20%	30%	15%	10%	5%

**Instructional Method:**

- a. 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, etc.
- b. The internal evaluation will be done on the basis of continuous evaluation of students in the class-room in the form of attendance, assignments, verbal interactions etc.
- c. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

**List of Practicals:**

- Isolation of industrially important microorganisms for microbial processes (citric / lactic/ alpha amylase) and improvement of strain for increase yield by mutation.
- Comparison of ethanol production using various Organic wastes /raw Material [Free cells/ immobilized cells].
- Cell disruption for endoenzymes by sonication.
- Microbial production of glutamic acid.
- Production of rifamycin using yeast strain.