**Syllabus template**

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|---|---|---|---|---|
| **Semester:** | **5** | | | |
| **Course :** | Major | | | |
| **Paper Title:** | **INDUSTRIAL MICROBIOLOGY** | | | |
| **Paper code:** | C3MB230521T | | **Credits:** 4 | |
| **Hours/week :** | 4 | | | |
| **Category: Core/MDC/SEC/VAC :** | Core | | | |
| **Theory / Practical / Composite :** | Theory | | | |
| **No of Modules :** | No | | | |
| **Course Overview:** This course syllabus aims to provide basic knowledge on the microbiology involved in industrial production of microbially derived products. It also delivers basics and concepts of biotechnology and advanced studies in product purification. This course enables the students to be equipped with the biotechnological advances in microbial product formation by fermentation technology. | | | | |
| **Course Outcome:** | | | | |
| 1. Remember- Learning and remembering the basic concepts of microbial nutrition, growth and metabolism and basic physicochemical techniques. | | | | |
| 2. Understand- Understanding the basic concepts of bacterial metabolism and its regulation, the working of a bioreactor and functions of its parts. | | | | |
| 3. Analyze- To analyse the growth kinetics of microbial strains for product formation. | | | | |
| 4. Apply- Applying the knowledge of fermentation for product formation. | | | | |
| 5. Evaluate: Evaluation of process optimization for better yield. | | | | |
| 6. Create: To create ideas for new product generation through fermentation technology. | | | | |
| **Prerequisites:** ***Basic knowledge about any prior course*** | | | | |
| **SYLLABUS** | | | | |
| **UNIT/Module** | **CONTENT** | **HOURS or NUMBER OF CLASSES** | **CO Mapping** | **COGNITIVE LEVEL** |
| **I.** | **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology | 2 | CO1 | K1 |
| **II.** | **Isolation of industrially important microbial strains and fermentation media:** Sources of industrially important microbes and methods for their isolation, preservation and maintenance of | 6 | CO1, CO2, CO3, | K1,K2,K3 |

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| | industrial strains, strain improvement.<br>Crude and synthetic media; molasses, corn steep liquor, sulphite waste liquor, whey, precursors, inhibitors and antifoams. | | | |
| **III.** | **Fermentation processes and bio-reactors:**<br>Types of fermentation processes – Batch, fed-batch and continuous fermenters. Solid-state and liquid-state (stationary and submerged) fermentations. Components of a typical bio-reactor.<br>Types of bioreactors- constantly stirred tank and air-lift fermenters. Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration. | 12 | CO1, CO2, CO3, CO4 | K1,K2,K3,K4 |
| **IV.** | **Down-stream processing:**<br>Basic idea of downstream processing. Cell disruption, filtration, centrifugation, distillation, solvent extraction, precipitation, lyophilization and spray drying used for downstream processing. | 6 | CO1, CO2, CO4, CO5 | K1,K2,K4,K5 |
| **V.** | **Physio-Chemical techniques in Biology:**<br>Centrifugation: Sedimentation-theory. Types of centrifugation and centrifuges, rotors. Application of centrifugation in biological studies.<br>Chromatography: Principle, major types of chromatography, conventional and high performance chromatography, Gas/Gas | **8** | CO1 | K1 |

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| | liquid chromatography, biological applications. | | | |
| **VI.** | **Microbial production of industrial products** (micro-organisms involved, media, fermentation conditions, downstream processing and uses)<br>Alcohols: Beverages and fuel use<br>Organic acids: Citric acid, Acetic acid (Vinegar)<br>Antibiotics: Penicillin<br>Amino acids: Glutamic acid, lysine<br>Enzymes: Amylase, Protease<br>Vitamins | **12** | CO1, CO2, CO3, CO4, CO5, CO6 | K1.K2,K3, K4,K5,K6 |
| **VII.** | **Enzyme immobilization:** Methods of immobilization, advantages and applications of immobilization. | **2** | CO1,CO6 | K1.K6 |

**Text Books**


1. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
2. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001). Industrial Microbiology: An Introduction. 1st edition. Wiley – Blackwell
3. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and Company
4. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
5. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
6. Prescott and Dunn, Industrial Microbiology.


**Suggested readings**

1. Powerpoint slides provided in class

**Web Resources**

1. SWAYAM course on Industrial Microbiology

**Evaluation** Theory CIA: 30 Semester Exam:70

**Paper Structure for Theory Semester Exam:**
Short questions: 10 (each 2 marks) from 12 (10x2=20)
Long questions: 5 (each 10 marks) from 7 (5x10=50)

**Course outcomes (COs) and Cognitive Level Mapping**

| COs | CO Description | Cognitive levels |
|---|---|---|
| **CO1** | **Remember:** Learning and remembering the basic concepts of microbial nutrition, growth and metabolism and basic physicochemical techniques. | K1 |
| **CO2** | **Understand:** Understanding the basic concepts of bacterial metabolism and its regulation, the working of a bioreactor and functions of its parts. | K2 |
| **CO3** | **Analyze:** To analyse the growth kinetics of microbial strains for product formation. | K3 |
| **CO4** | **Apply:** Applying the knowledge of fermentation for product formation. | K4 |
| **CO5** | **Evaluate:** Evaluation of process optimization for better yield. | K5 |
| **CO6** | **Create:** To create ideas for new product generation through fermentation technology. | K6 |