| THOMAS ADEWUMI UNIVERSITY OKO<br>COURSE OUTLINE | | |
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| Faculty | Computing and applied science | |
| Department | Biological Sciences | |
| Course title | **INDUSTRIAL MICROBIOLOGY** | |
| Year of study | 4 | |
| Course code | MCB 406 | |
| Credit hours | 4 | |
| Contact hours | 60 | |
| Mode of delivery | CLASSROOM LECTURES | |
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| Mode of assessment | | WEIGHT% |
| Continuous assessment | | 30% |
| Final examination | | 70% |
| Total | | 100% |
| Course lecturers and Instructors | Dr. Adekemi T. Dahunsi-LECTURER | |
| Course description | This course delves into the realm of Industrial Microbiology, exploring the historical underpinnings and contemporary advancements in the field. It provides a comprehensive understanding of the isolation, cultivation, and manipulation of microorganisms for a wide range of industrial applications. From fermentations to downstream processing and enzyme immobilization, students will gain insight into the intricate world of microbial bioprocessing. | |
| Course objectives | This course will facilitate the understanding of: | |
| Learning outcomes | By the end of the course, students will be able to:<br>i. Describe the historical progression and pivotal developments in Industrial Microbiology.<br>Isolate, identify, and maintain industrially important microbial strains using advanced techniques.<br>ii. Formulate and optimize fermentation media tailored to specific microbial processes.<br>iii. Differentiate between various fermentation processes, bioreactor types, and their operational parameters. | |

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| | iv. Apply downstream processing techniques for efficient recovery and purification of microbial products.<br>v. Analyze and optimize microbial fermentation conditions to enhance product yield and quality.<br>vi. Explain enzyme immobilization methods, advantages, and their diverse applications.<br>vii. Evaluate the potential of immobilized enzymes for large-scale industrial processes.<br>viii. Identify emerging trends and technologies shaping the field of Industrial Microbiology.<br>ix. Apply theoretical knowledge through hands-on practical experiences and case studies. |
| Teaching and learning | The class will be taught for four hours a week. |
| Detailed course content | Brief history and developments in Industrial Microbiology. Isolation of industrially important microbial strains and fermentation media: Sources of industrially important microbes and methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates. Types of fermentation processes, bio-reactors and measurement and control of fermentation parameters. Down-stream processing: Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying. Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses). Enzyme immobilization Methods, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase). |
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| Course content sequencing | |
| Weeks | |
| Week 1 | Historical Background and Developments<br>Overview of the origins and evolution of Industrial Microbiology<br>Key developments that have shaped the field's trajectory |

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| | Understanding the pivotal role of microorganisms in industrial processes |
| Week 2 | Isolation of Industrially Important Microbial Strains<br>Exploration of sources for industrially valuable microorganisms, techniques for isolating and identifying microbial strains, strategies for preserving and maintaining industrial strains, approaches to strain improvement through genetic and metabolic engineering |
| Week 3 | Fermentation Media and Optimization<br>Introduction to fermentation media and their composition, study of crude and synthetic media types, examination of various media components: molasses, corn-steep liquor, sulphite waste liquor, whey, yeast extract, and protein hydrolysates, formulation and optimization of media for specific microbial processes. |
| Week 4 | Types of Fermentation Processes and Bioreactors<br>Overview of fermentation processes: batch, fed-batch, continuous. Exploration of bioreactor designs and their applications, Parameters influencing microbial growth and product yield<br>Strategies for measuring and controlling fermentation parameters |
| Week 5 | Downstream Processing Techniques: importance of downstream processing in product recovery, techniques for cell disruption: mechanical, chemical, enzymatic, biomass separation methods: filtration, centrifugation, recovery techniques: solvent extraction, precipitation, preservation methods: lyophilization and spray drying. |
| Week 6 | Microbial Production of Industrial Products:<br>Identification of microorganisms used in industrial product synthesis, Optimization of fermentation conditions and media composition, Downstream processing steps: purification and isolation, Diverse industrial applications of microbial products |
| Week 7 | Enzyme Immobilization and Applications:<br>Methods for immobilizing enzymes and their mechanisms, Advantages of using immobilized enzymes in various processes, Broad spectrum of |

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| | applications in different industries, Case studies focusing on glucose isomerase and penicillin acylase immobilization. |
| Week 8 | Large-Scale Applications of Immobilized Enzymes:<br>Real-world instances of industrial processes employing immobilized enzymes,Understanding the scalability and economic benefits of enzyme immobilization, Addressing challenges and exploring potential improvements. |
| Week 9 | Emerging Trends and Future Prospects<br>Examination of current trends shaping the field of Industrial Microbiology, Introduction to novel technologies and their potential impact, Considerations for sustainable and eco-friendly practices. |
| Week 10 & 11 | Practical Applications and Case Studies<br>In-depth analysis of selected case studies across industries, Practical sessions on fermentation, downstream processing, and enzyme immobilization techniques, Hands-on experience with bioreactors and enzyme immobilization setups |
| Week 12 | Revision |
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| **Recommended reading material** | |
| 1. Joanne Willey and Kathleen Sandman and Dorothy Wood (2020). Prescott's Microbiology. 11th Edition.<br>2. David B. Wilson, Hermann Sahm, Klaus-Peter Stahmann, Mattheos Koffas. Industrial Microbiology.<br>3. Nduka Okafor. Modern Industrial Microbiology and Biotechnology.<br>4. Michael R. Ladisch and Nathan S. Mosier. Modern Biotechnology: Connecting Innovations in Microbiology and Biochemistry to Engineering Fundamentals. | |

Course code: MCB

Course title:

**A. Specific course objectives/learning outcomes.**

The course will enable the understanding of the following:

1. Describe the historical progression and pivotal developments in Industrial Microbiology.

2. Isolate, identify, and maintain industrially important microbial strains using advanced techniques.
3. Formulate and optimize fermentation media tailored to specific microbial processes.
4. Differentiate between various fermentation processes, bioreactor types, and their operational parameters.
5. Apply downstream processing techniques for efficient recovery and purification of microbial products.
6. Analyze and optimize microbial fermentation conditions to enhance product yield and quality.
7. Explain enzyme immobilization methods, advantages, and their diverse applications.
8. Evaluate the potential of immobilized enzymes for large-scale industrial processes.
9. Identify emerging trends and technologies shaping the field of Industrial Microbiology.
10. Apply theoretical knowledge through hands-on practical experiences and case studies.

**B. Learning activities/Course delivery methods**

**C. Lectures: detailed content of course are taught in class**

**Course content:** Brief history and developments in Industrial Microbiology. Isolation of industrially important microbial strains and fermentation media: Sources of industrially important microbes and methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates.
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