Semester	7 and 8		
Course Code:	MIBI 41784		
Course Name:	Industrial Microbiology and Environmental Biotechnology		
Credit Value:	4		
Core/Optional	Core		
Hourly Breakdown	Theory	Practical	Independent Learning
	60 hrs	N/A	140 hrs

Course Aim/Intended Learning Outcomes:

Upon successful completion of this course student will be able to;

- Evaluate the need of protecting the intellectual property rights in microbiology related inventions,
- Identify the inventive concepts in protecting intellectual property,
- Apply microbial growth kinetics and principles of biochemical engineering in microbial product formations,
- Critique the role of microorganisms in specific biotechnological processes,
- Demonstrate understanding of some of the legislative and ethical issues related to microbial biotechnology,
- Review the accreditation schemes available,
- Appraise the bio deterioration of materials in different circumstances,
- Compare and contrast different bioremediation options available,
- Choose the suitable bioremediation options for a given situation,
- Practice the integrated solid management options in managing solid waste,
- Assess the cleaner production options used to minimize the production of waste and
- Evaluate the stages of implementation of environmental management systems in organizations.

Course Content:

Industrial Microbiology:

Introduction: The nature of industrial microbiology, historical evolution, Growth application and strategic planning in biotechnology. *Patents and intellectual property rights in Industrial microbiology and biotechnology*: Introduction to IP, types, patents, patent drafting, legal requirements for patentability, prior art, filing patent applications, Introduction and theory of patent claims, protection of inventive concepts. Microbiological inventions, Deposition of patent related microbial cultures. Microbial culture collections.

Microbial process development: Selection and Maintenance of industrially important microorganisms. Media formulation and the characteristics of the large scale fermentation. Scale up of the fermentation process.

Basic principles of biochemical engineering and its role in the development of fermentation technology: Industrial media and nutrition for industrial microorganisms, Methods of fermentation, Stoichiometry of microbial processes, Bioprocess kinetics, Unit operations, process design, Fermenter systems. Sterility in industrial microbiology, Downstream processing and products recovery. *Fermentation industry:* Different products of industrial fermentations. Economics in biotechnology and fermentation processes. Microbial quality assurance procedures, Ethical issues.

Accreditation: Introduction, schemes available and their applicability (Management system certification, Inspection bodies, Calibration and testing laboratories, Medical and clinical laboratories, Proficiency testing providers, Product certification bodies, Good Laboratory Practice, Personnel certification bodies etc.)

Environmental biotechnology:

Introduction: overview of environmental microbiology, historical perspective, and current developments. *Bio deterioration:* Introduction to bio deterioration, Bio deterioration process, Bio deterioration of different materials. Investigative bio deterioration. *Microorganisms and metal pollutants:* Classes of metals, Speciation and bioavailability. Metal toxicity. Microbial metal resistant and accumulation mechanisms. Adverse and beneficial effects of metal-microbe interactions. *Microorganisms and organic pollutants:* Classes of organic pollutants. Process of biodegradation. Microbial resistance and accumulation mechanisms. *Bioremediation of pollutants*: In-situ, Ex-situ, and Intrinsic Bioremediation. Monitoring bioremediation – chemical physical and microbial methods. Biosensors. *Solid and hazardous waste management*: Integrated solid waste management. Technologies associated with solid waste management.

Cleaner production (CP): CP techniques, CP methodology. *Environmental Management Systems (EMS):* Introduction. Basic elements, Development of EMS, EMS standards, ISO 14001 standard and its stages of implementation.

Teaching /Learning Methods:
Combination of lectures, group discussions, presentations, computer assisted learning and assignments.

Assessment Strategy: Continuous assessment and end of the course unit examination.

Continuous Assessment 20%	**Final Assessment** 80%		
Details:	Theory (%)	Practical (%)	Other (%)
Mid term: 10% Assignments: 10%	80	-	-

Recommended Reading:

- Wulf, C., Anneliese, C. and Aneja K.R. (2017), *Crueger's Biotechnology: A textbook of Industrial Microbiology*, 3rd edition, Medtech
- Okafor, N. and Okeke, B. C. (2017), *Modern Industrial Microbiology and Biotechnology*, 2nd Edition, CRC Press
- Maier, Raina M., Pepper, I. L. , Gerba, C. P. (2010). *Environmental Microbiology*, Academic Press.
- Atlas, R.M. & Phillip, J. (2005). *Bioremediation: Applied Microbial Solutions for Real World Environmental Cleanup*, American Society of Microbiology.
- George, T. and Frank, K. (2010). *Handbook of Solid waste management*, McGraw-Hill.
- Related current review and research articles peer-reviewed journals as recommended by the lecturers.