Syllabus template

Semester: II	
Course : Microbiology	
Paper Title: Environmental Microbiology	
Paper code: :C1MB230222T/P	**Credits: 4**
Hours/week : 5	
Category: Core/MDC/SEC/VAC : Core (Major)	
Theory / Practical / Composite : Composite	
No of Modules : No modules	

Course Overview: This course provides an insight into the diversity of the microflora present in the different environmental conditions as air, water, soil, etc. It also provides an information on the microbes surviving under harsh environmental conditions, ie. extremophiles and their survival strategies. The different kinds of microbial interactions as commensalism, amensalism, etc. The various kinds of biogeochemical cycles are also discussed and the role of bacteria in the degradation of pesticides.

Students will also explore the different types of wastes, solid and liquid, their eco-friendly disposal methods with the help of biological agents as microbes in the degradation of waste matter. To familiarise students with the term of BOD, COD, DO, TOC, etc. The functioning of waste water treatment plant in treating the effluents properly before their disposal. The learning unit also includes a practical component for better understanding of the theory.

Course Outcome:

1. Remember: Define, identify, recognize the nature, structure and function of microbial diversity existing in nature and understanding the microbial diversity in relation to its environment.
2. Understand: To understand microbial interactions from the foundations of microbial communities, shaping the structure and function of communities and their different types of interactions i.e. both positive and negative.
3. Apply: To understand the microbial interactions occurring in biogeochemical cycles, the diverse microbial metabolism, microbial role in nutrient recycling, maintaining a role in elemental flux thereby contributing to ecosystem dynamics.
4. Analyze: Understanding the role of extremophiles, their nature, classification based on habitat, physiological and biochemical adaptation, and their application in industries.
5. Evaluate: Remembering the core concepts of microbial diversity, their application in waste management systems (solid and liquid), physical, chemical and biological methods of waste treatment, engineering principles of waste treatment plant and their eco-friendly solutions.
6. Create: To create and develop the foundation principles behind the waste management systems, concepts of indicator bacteria, formulate core concepts in terms of physical, chemical and microbiological parameters of potable water. Develop microbiological tests to study indicator bacteria.

Prerequisites: ***Basic knowledge about any prior course***

SYLLABUS

UNIT/~~Module~~	CONTENT	HOURS or NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
I.	Microorganisms and their Habitats Structure and function of ecosystems; Terrestrial Environment: Soil profile and soil microflora, Microbial succession in soil. Aquatic Environment: Microflora of fresh water and marine habitats. Atmosphere: Aeromicroflora and dispersal of microbes. Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.	**8**	**CO1, CO2, CO4**	**K1, K2, K4**
II.	Microbial Interactions and their role in bioremediation Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non symbiotic interactions. Microbe-animal interaction: Specific examples in ruminant animals and soil.	**8**	**CO1, CO2**	**K1, K2**
III.	Biogeochemical Cycle and Bioremediation Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction. Phosphorus cycle: Phosphate immobilization and solubilisation. Sulphur cycle: Microbes involved in sulphur cycle. Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants.	**8**	**CO1, CO2, CO3**	**K1, K2,K3**
IV.	Introductory water microbiology • Waste Management Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill). Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process	**6**	**CO1, CO2,CO5**	**K1, K2,K5**

	and septic tank) and tertiary sewage treatment.			
V.	Water potability Indicator organisms, identification of fecal and non-fecal coliforms, treatment and safety of drinking (potable) water. Methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.	**6**	**CO1, CO2,CO6**	**K1, K2, K6**
VI.	**Environmental Microbiology Practical** 1. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action. 2. Isolation of microbes (bacteria & fungi) from soil (28°C & 45°C). 3. Isolation of microbes (bacteria & fungi) from Phyllosphere and Phylloplane. 4. Assessment of microbiological quality of water, MPN, IMViC. 5. Determination of BOD of waste water sample. 6. Isolation of Rhizobium from root nodules.	**24**	**CO1, CO2, CO3, CO6**	**K1, K2, K3, K6**

Text Books

1. **Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA**
2. **Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings.**
3. **Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.**
4. **Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York.**

Suggested readings

1. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning
2. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
3. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

Web Resources

1. **.**
2. **.**
3. **.**
4. **.**

Evaluation Theory CIA (10+3+2), Practical CA (38+2)

Paper Structure for Theory Semester Exam Module : Full Marks: 45 Long questions: 4 (each 10 marks) from 6 (4x10=40) Short questions: 5 (each 1 mark) from 7 (5x1=5)

Course outcomes (COs) and Cognitive Level Mapping

COs	**CO Description**	**Cognitive levels**
CO1	Remember: Define, identify, recognize the nature, structure and function of microbial diversity existing in nature and understanding the microbial diversity in relation to its environment.	K1
CO2	Understand: To understand microbial interactions from the foundations of microbial communities, shaping the structure and function of communities and their different types of interactions i.e. both positive and negative.	K2
CO3	Apply: To understand the microbial interactions occurring in biogeochemical cycles, the diverse microbial metabolism, microbial role in nutrient recycling, maintaining a role in elemental flux thereby contributing to ecosystem dynamics.	K3
CO4	Analyze: Understanding the role of extremophiles, their nature, classification based on habitat, physiological and biochemical adaptation, and their application in industries.	K4
CO5	Evaluate: Remembering the core concepts of microbial diversity, their application in waste management systems (solid and liquid), physical, chemical and biological methods of waste treatment, engineering principles of waste treatment plant and their eco-friendly solutions.	K5
CO6	Create: To create and develop the foundation principles behind the waste management systems, concepts of indicator bacteria, formulate core concepts in terms of physical, chemical and microbiological parameters of potable water. Develop microbiological tests to study indicator bacteria.	K6