

Semester	2
Course	Major 4:C1MB230222T/P
Paper Title	Environmental Microbiology
No. of Credits	4
Theory/Practical/Composite	Composite
Minimum number of preparatory hours per week a student has to devote	4 hours/wk
Number of Modules	No modules
Syllabus	<ul style="list-style-type: none"> • Microorganisms and their Habitats <p>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.</p> <p>Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body.</p> <p>Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.</p> <ul style="list-style-type: none"> • Microbial Interactions and their role in bioremediation <p>Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation.</p> <p>Microbe-Plant interaction: Symbiotic and non symbiotic interactions.</p> <p>Microbe-animal interaction: Specific examples in ruminant animals and soil.</p> <ul style="list-style-type: none"> • Biogeochemical Cycle and Bioremediation <p>Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin</p> <p>Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction</p>

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.

- **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 and septic tank) and tertiary sewage treatment.

- **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.

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 <i>Rhizobium</i> from root nodules.
Learning Outcomes	<ul style="list-style-type: none"> • To understand microbial interactions and their natural habitats. • To know the waste management systems. • To have the idea of Biogeochemical cycles.
Reading/Reference Lists	<ol style="list-style-type: none"> 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. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York 5. Metcalf and Eddy. Waste water management 6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England. 7. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning. 8. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K. 9. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New

	York & London. 10. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi. 12. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.	
Evaluation	Theory 60 (45+15) CIA-10+3+2	Practical 40 CA (38+2)

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