

Semester- III
Course MI-202
Soil and Water Microbiology

Unit I. Microbiology of Soil

1. Physicochemical characteristics of soil, soil as a culture medium (1 hr)
2. Soil microflora: Diversity in soil microflora (1 hr)
3. Methods of studying soil micro flora: (3 hr)
 - A. Direct microscopic method, agar plate technique, enrichment culture technique, and buried slide method
 - B. Use of Winogradsky column in studying microbial diversity in soil
4. Microbial interactions in soil (5 hr)
 - A. Neutral, positive and negative associations
 - B. Interaction between plant roots and microorganisms:
 - i. Rhizosphere and its significance
 - ii. Mycorrhiza and root nodule formation

Unit II. Microorganisms as Biogeochemical Agents

1. Introduction to biogeochemical transformations in soil: Mineralization and immobilization of elements (1 hr)
2. Rotation of elements in nature (7 hr)
 - A. Nitrogen cycle: Proteolysis, ammonification, nitrification, denitrification and nitrogen fixation
 - B. Sulfur cycle: Sulfur oxidation and reduction
 - C. Carbon cycle: Degradation of complex organic compounds, carbon dioxide fixation, humus and its significance
 - D. Iron cycle: Iron oxidation and reduction
 - E. Phosphorus cycle: Mineralization, immobilization and solubilization of phosphorus
3. Soil fertility: Role of microorganisms in soil fertility, biofertilizers (2 hr)

Unit III. Microbiology of Drinking Water

1. Natural waters: Sources of contamination (1 hr)
2. Microbial indicators of fecal pollution (3 hr)
 - A. Coliforms as indicator, need for differentiation
 - B. Methods of differentiation: IMViC test and Elevated temperature test
 - C. Microbial indicators other than coliforms
3. Nuisance organisms in water: Slime forming bacteria, iron and sulfur bacteria and algae (1 hr)

4. Water-borne diseases (1 hr)
5. Bacteriological examination of drinking water (3 hr)
 - A. Sampling
 - B. Quantitative analysis: Standard plate count
 - C. Qualitative analysis: Multiple tube fermentation method (presumptive, confirm and completed test), MPN, membrane filter technique, defined substrate test, P-A (Presence-Absence) test
6. Purification of drinking water: Sedimentation, filtration and disinfection (1 hr)

Unit IV. Microbiology of Wastewater

1. Types of wastewater, chemical and microbiological characteristics of waste water (1 hr)
2. BOD, COD and TOD as indicators of strength of wastewater, pollution problems due to disposal of untreated wastewater (3 hr)
3. Methods of wastewater treatment (6 hr)
 - A. Primary treatment and secondary treatment: Principles and role of microorganisms in septic tank, Imhoff tank, trickling filters, activated sludge process, oxidation ponds
 - B. Advanced treatment and final treatment
 - C. Solid waste processing: Anaerobic sludge digestion and composting
 - D. Efficiency of wastewater treatment procedures

Text Books:

1. Pelczar Jr. M J, Chan E C S, Krieg N R, (1986), *Microbiology*, 5th edn, McGraw-Hill Book Company, NY
2. Alexander M, (1977), *Soil Microbiology*, 2nd edn. Krieger Publ. Co., Melbourne, FL
3. Atlas R M., (1997), *Principles of Microbiology*. 2nd edn. Wm. C. Brown Pub., Iowa, USA.

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