

SRI VENKATESWARA UNIVERSITY
B.Sc. DEGREE COURSE IN ORGANIC FARMING
III - SEMESTER
(Syllabus under CBCS w.e.f. 2021-22)
Fundamentals of Soil Microbiology
(Total hours of teaching – 60 @ 04 Hrs./Week)

Theory :

Learning Outcomes : On successful completion of this course, the students will be able to :

- Develop a critical understanding of soil biota.
 - Explain the role of microbes in mineralization of nutrients for plants.
 - Realize the operation of various biogeochemical cycles in nature.
 - Explain the formation of soil organic matter due to activities of soil microbes.
 - Realize the interaction among soil biota and between microbes – plants.
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Unit -I :Soil as a living medium

1. Soil - definition and composition; soil structure and characteristic features.
2. Role of humus and clay in ion exchange and nutrient availability.
3. Soil as a habitat for microorganisms; soil microbes – algae, bacteria, action mycoses, fungi, protozoa and nematodes.
4. Microbial balance in soil; molecular markers for ecological studies of soil micro organisms.

Unit II :Microbes in rhizo sphere

1. Rhizo sphere and rhizoplane micro organisms; reasons for increased microbial activity in rhizo sphere.
2. Composition of root exudates factors affecting exudation, rhizo sphere microorganisms, rhizo sphere effect.
3. Factors affecting microbial community in soil-soil moisture, organic and inorganic chemicals.
4. Nitrogen cycle: microbiology and biochemistry of Ammonification, nitrification and denitrification, utilization of various nitrogen sources.
5. Nitrogen fixation, diversity of diazotrophs, associative and symbiotic Nitrogen fixation. Mechanism of nodulation and nitrogen fixation, role of various genes in these processes.

Unit III :Microbial transformation of minerals

1. Microbial transformation of Phosphorus—Phosphorus cycle.
2. Source of organic and inorganic phosphates in soil and elsewhere, mineralization of inorganic phosphates; factors affecting phosphate solubilization and mechanism.
3. Microbial transformation of sulphur- Sulphur cycle; source of Sulphur, Sulphur oxidizing and reducing microorganisms (*Thiobacillus* and *Desulfovibrio*), biochemistry of transformation. Sulphate and Sulphur reduction, H₂S formation.
4. Role of *Thiobacillus* in agriculture and soil reclamation.
5. Microbial transformation of Iron, Manganese, Zinc, Copper and Potassium

Unit – 4 :Soil organic matter

1. Soil organic matter. Organic matter decomposition; Organic matter dynamics in soil.
2. Microbial decomposition of cellulose, hemicellulose and lignin.
3. Factors affecting organic matter decomposition (litter quality, temperature, aeration, soil pH, inorganic chemicals, moisture).
4. Pesticide degradation in soil, effects of pesticides on soil micro flora, soil microbial biomass as an index of soil fertility.

Unit –V :Interactions among soil microbes

1. Microbial interactions; negative interactions. Ammensalism, competition, parasitism and predation (mycoparasitism, mycophagy, nematophagy – predaceous fungi),
2. Commensalism positive interactions – mutualism, synergism.
3. Associative symbiosis - cyanobacterial, bacterial (*Rhizobium* legume symbiosis), actinomycetes (actinorrhiza –*Frankia* non root legume symbiosis) and fungal symbiosis – types and significance of mycorrhiza.
4. Concept of beneficial microorganisms.

Books for Reference :

- **SubbaRao, N.S., 2017.** Soil Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- **Subarea, N.S., 1995.** Soil Microorganisms and Plant Growth, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- **Martin Alexander, 1986.** An introduction to Soil Microbiology, Wiley, New Jersey.
- **Paul, E.A., 2007.** Soil microbiology Ecology and Biochemistry, Academic press, Cambridge.

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Practical-III Fundamentals of Soil Microbiology

Total hours of laboratory exercises 30 Hrs. @ 02 Hrs./Week)

Course Outcomes: On successful completion of this course, the students shall be able to :

- Perform various tests on physico-chemical parameters of soil.
 - Isolate and culture various soil microbes in the laboratory.
 - Determine the organic matter in a given soil sample.
1. Study of soil composition and structure.
 2. Isolation of bacteria from soil sample using serial dilution or streaking method and culture.
 3. Demonstration of Gram staining technique.
 4. Isolation and culture of Cyanobacteria from a soil sample.
 5. Isolation and culture of algae from a soil sample.
 6. Isolation and culture of Actinomycetes from a soil sample.
 7. Identification of *Rhizobia* from root nodules of a legume.
 8. Isolation of microbes from phylloclade.
 9. Isolation of mycorrhiza.
 10. Determination of soil organic matter.

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Model Question Paper for Practical Examination
Fundamentals of Soil Microbiology

Max. Time: 3 Hrs.

Max. Marks: 50

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|------------------------------------------------------------------------------|--------------|
| 1. Experiment 'A' (Soil composition and structure) | 10 M |
| 2. Experiment 'B' (Isolation of bacteria/cyan bacteria/algae/ Actinomycetes) | 10 M |
| 3. Experiment 'C' (Soil Organic Matter) | 10 M |
| 4. Identify the following and justify with reasons | 2 x 5 = 10 M |
| D. Mycorrhiza | |
| E. Rhizoid | |
| 5. Record + Viva voce | 5 + 5 = 10 M |

Suggested co-curricular activities for Organic Farming Core Course -3 in Semester-III:

A. Measurable :

a. Student seminars :

1. Soil atmosphere and water.
2. Soil pH and temperature.
3. Rhino sphere as a habitat.
4. Organic matter decomposition and mummification.
5. Types of mycorrhizae.
6. Acquisition and transport of nutrients in mycorrhizae.
7. Soil fauna.
8. Soil profile.
9. Soil microorganisms and carbon cycle.
10. Classification of soil types.

b. Student Study Projects:

1. A report on composition of different soil samples.
2. A study report on microbes from a soil sample.
3. Determination of water, pH and temperature of different soil samples.
4. Microbes on phylloclade of a crop plant.
5. Microbes from rhino sphere of a crop plant.
6. Isolation and identification of cellulolytic microbes from soil sample of a crop field.

7. Isolation and characteristics of Rhizobium from some leguminous plants.
8. Study report on microbes from sperm sphere of some crop plants.

c. Assignments: Written assignment at home / during '0' hour at college; preparation of charts with drawings, making models etc., on topics included in syllabus.

B. General :

1. Group Discussion (GD)/ Quiz/ Just A Minute (JAM) on different modules in Syllabus of the course.
2. Visit to soil science and microbiology laboratories in Agriculture/ Horticulture University/ Research station.