GUJARAT UNIVERSITY
B.Sc. (Honors) Microbiology Syllabus (as per NEP)
Second Year B. Sc. Semester IV, Microbiology
Discipline Specific Course - Core
Effective from June-2024

Paper Code: DSC-C-MIC-241T
Paper Name: Soil and Water Microbiology
Credits: 04 (04 hrs/ week, Total: 60 hrs)

Learning objectives:

- Explain the role of microorganisms in soil and water ecosystems.
- Describe properties of soil and water that influence microbial activity.
- Explain how microbial processes impact soil fertility, water quality, and ecosystem health.
- Perform laboratory techniques for isolating, culturing, and identifying soil and water microorganisms.

Unit 1Microbiology of Soil **Teaching Hours: 15**

[A] Microbial flora of soil
[B] Methods to study soil flora:
1. Direct microscopic method
2. Agar plate technique
3. Enrichment culture technique
4. Buried slide technique
5. Soil respiration technique

[C] Microbial interactions in soil
1. Neutral, positive and negative associations

[D] Interaction between plant roots and microorganisms
1. Rhizosphere and its significance
2. Mycorrhiza

Unit 2 Microorganisms as Biogeochemical Agents **Teaching Hours: 15**

[A] Introduction to biogeochemical transformations in soil:
1. Mineralization and immobilization of elements

[B] Rotation of elements in nature
1. Nitrogen Cycle
2. Carbon Cycle
3. Sulphur Cycle – Growth of sulphur metabolising microbes in Winogradsky's column
4. Phosphorous Cycle
5. Iron Cycle

[C] Soil fertility: Biofertilizers

Unit 3 Microbiology of Drinking Water **Teaching Hours: 15**

[A] Microbial indicators of fecal pollution of drinking water
1. Coliforms as indicator
2. Differentiation of fecal and non fecal coliforms by Elevated temperature test
3. Differentiation of *E. coli* and *E. aerogenes* by IMViC test

[B] Nuisance organisms in drinking water:
1. Fecal streptococci, Slime forming bacteria, Iron bacteria, Sulphur bacteria, Algae and Viruses

[C] Bacteriological examination of drinking water
1. Sampling
2. Standard plate count of water sample
3. Detection of coliforms in water sample:
   (i) Presumptive, Confirmed and Completed test
   (ii) Membrane filtration technique
   (iii) Defined substrate test
   (iv) Presence - Absence test

[D] Purification of drinking water: Sedimentation, Filtration and Disinfection

[E] Sanitary survey of water producing system

[F] Water borne diseases: Introduction to Typhoid, Cholera, Hepatitis (A), Polio, Amoebiasis, Giardiasis

Unit 4 Microbiology of Waste Water **Teaching Hours: 15**

[A] Waste water
1. Types of waste water
2. Chemical and microbiological characteristics of waste water
3. BOD, COD and TOD as indicators of untreated waste water
4. Pollution problems due to disposal of untreated waste water

[B] Waste water treatment
1. Home treatment system: Septic tank
2. Municipal waste water treatment system
   (i) Primary treatment
   (ii) Secondary (Biological) treatment: Role of microorganisms in Trickling filters, Biodisc system, Activated sludge process and Oxidation ponds
   (iii) Tertiary (Advanced) treatment
   (iv) Final treatment: Disinfection and Post aeration
   (v) Solid waste processing: Anaerobic sludge digestion and Composting

Text Books:

1. PelczarJr, M J, Chan E C S, Krieg N R, (1986) Microbiology, 5thedn, McGraw-Hill Book Company,NY.
2. Alexander M, (1977), Soil Microbiology, 2nd Edition Krieger Publ. Co. Melbourne, FL
3. Atlas R M, (1977), Principles of Microbiology2nd Edition, Wm. C. Brown Publ. Iowa USA
4. Prescott L, Harley J P, and Klein D A, (2008), Microbiology, 7th edn. Wm C. Brown - McGraw Hill, Dubuque, IA.

URLs/Weblinks for E-content

1	Nuisance organisms in water	**https://www.youtube.com/watch?v=hP5k3H58WVw**
2	Enrichment culture technique	**https://www.youtube.com/watch?v=9cy9VqVUODo**
3	Rotation of elements in nature	**https://www.youtube.com/watch?v=2ntOAisr8b4**
4	Microbial indicators of fecal pollution	**https://www.youtube.com/watch?v=hP5k3H58WVw**
5	Purification of drinking water	**https://www.youtube.com/watch?v=Cm1-K9_bOyc**
6	Bacteriology exam. of drinking water	**https://www.youtube.com/watch?v=4-SRMmqH2s4&list**
7	Solid waste processing	**https://www.youtube.com/watch?v=k0ktJRoRcOA**

B.Sc. (Honors) Microbiology Syllabus
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Discipline Specific Course -Core

Paper Code: DSC-C-MIC-242T
Paper Name: Food and Dairy Microbiology
Credits: 04 (04 hrs/ week, Total: 60 hrs)

Learning objectives:

- Describe how microorganisms interact with food substrates and influence fermentation, spoilage, and safety.
- Perform laboratory techniques for isolating, identifying, and quantifying microorganisms in food and dairy products.
- Assess the impact of microbial contamination on food safety and quality, including methods for detection and control.
- Develop and apply strategies for quality control and assurance in food and dairy production to ensure product safety and consistency.

Unit I Microbial Spoilage of Food **Teaching Hours: 15**

[A] Food as a substrate for microorganisms
[B] Contamination of food from soil, water, air and during handling & processing
[C] Microbial flora of food: Meats, Eggs, Fruits & Vegetables, Milk (biochemical, temperature and pathogenic types of microorganisms)
[D] Factors affecting microbial growth in food: Intrinsic and Extrinsic
[E] Microbial spoilage of food:
1. Biochemical changes: Putrefaction, Fermentation, Rancidity
2. Spoilage of fresh foods, fresh milk, canned foods

Unit II Food Infection and Poisoning **Teaching Hours: 15**

[A] Food infections:
Microorganism involved, source of infection, incubation period and characteristics in brief:
1. Bacterial infections: *Salmonella spp., Shigella spp, Vibrio spp., Campylobacter jejuni, Listeria monocytogenes*
2. Viral infections: Rotavirus, Hepatitis A, Poliovirus
3. Protozoal infections: Entamoeba

[B] Food poisoning:
1. Bacteria as poisoning agent: *Staphylococcus aureus, Clostridium botulinium*
2. Molds as poisoning agents: *Claviceps purpurea, Aspergillus flavus*, *Fusarium moniliformis.*

[C] Microbiological examination of foods
1. Generalized scheme for microbiological examination of foods
2. Microscopic techniques
3. Culture Techniques

Unit III Food Preservation **Teaching Hours: 15**

[A] General principles

[B] Methods of food preservation

1. Aseptic handling
2. High temperature: Canning, Pasteurization of milk – confirmation by phosphatase test, Sterilization
3. Low temperature: Refrigeration and freezing
4. Dehydration
5. Osmotic pressure
6. Chemicals
7. Radiations
8. Microbial product-based inhibition

Unit IV Fermented Food and Food Standards **Teaching Hours: 15**

[A] Fermented dairy products

1. Starter culture
2. Fermented milks: Cultured buttermilk, Acidophilus milk, Yogurt, Keffir
3. Cheese: Types, curdling, processing, ripening

[B] Other fermented foods: Bread, Sauerkraut, Pickles

[C] Traditional Indian fermented foods: Dahi, Idli, Dosa, Dhokla

[D] Fermented beverage: Wine

[E] Microbes as food: Yeast & Spirulina (SCP), Mushroom, Probiotics (including Prebiotics and Synbiotics)

[G] Microbiological criteria of food safety:

1. Introduction to Food Safety and Standards Act, 2006, India
2. Microbiological standards (criteria) for foods
3. Food certification marks in India: ISI, BIS, Agmark, FPO, India Organic, FSSAI

Text Books:

1. PelczarJr, M J, Chan E C S, Krieg N R, (1986), Microbiology: AnApplication Based Approach, 5th edn. McGraw-Hill Book Company, NY
2. Frazier W C and Westhoff D C (2018), Food Microbiology, 5th edn. McGraw-Hill Book Company, NY, Adapted by N. M. Vanitha, with special emphasis on Food of Indian Origin.
3. Prescott L, Harley J P, and Klein D A, (2008), Microbiology, 7th edn. Wm C. Brown - McGraw Hill, Dubuque, IA.
4. Indian Standards: Food Hygiene-Microbiological Criteria-Principles for Establishment and Application
5. Fssai: Manual of methods of analysis of foods- food safety and standards authority of India, Ministry of health and family welfare, Government of India, New Delhi, 2015

URLs/Weblinks for E-content

1	Food poisoning	https://www.youtube.com/watch?v=p788mo1DMKo
2	Microbial Spoilage of food	https://www.youtube.com/watch?v=dv73njzkWn0
3	Cheese production	https://www.youtube.com/watch?v=mD9Js5uryws
4	Bacteriological analysis of milk	https://www.youtube.com/watch?v=IqaA-XA-i50
5	Food Safety and Standards Authority of India (FSSAI)	https://www.youtube.com/watch?v=5xDBvv82Qyw

B.Sc. (Honors) Microbiology Syllabus
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Paper Code: DSC-C-MIC-243P
Paper Name: Microbiology Practicals
Credits: 04 (08 hrs/ week, Total: 120 hrs)

1. Isolation and cultivation of symbiotic nitrogen fixing bacteria from root nodules
2. Isolation and cultivation of non-symbiotic nitrogen fixing bacteria from soil
3. Isolation and cultivation of actinomycetes from soil
4. Isolation and cultivation of yeast from curd or grape
5. Isolation and cultivation of molds (*Mucor, Rhizophus, Aspergillus, Penicillium*) from soil
6. Standard plate count of soil, water, food and milk samples
7. Detection of fecal pollution of water by performing presumptive, confirmed and completed test
8. Determination of MPN of coliforms from water sample
9. Determination of microbial load by use of MBRT of raw, boiled and pasteurized milk
10. Determination of microbial load by use of RRT of milk sample
11. Detection of Acid-fast bacteria in milk
12. Study of permanent slides: Acid fast bacteria, *Clostridium spp., Fusarium spp, Amoeba, Spirulina*
13. Study of microbial diversity in soil by using Winogradsky's column (Demonstration only)