



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Environmental Engineering

Subject Code : DI04013071

Subject Name : Environmental Microbiology

w. e. f. Academic Year:	2025-26
Semester:	4 th
Category of the Course:	Professional Elective - II

Prerequisite:	Environmental Chemistry
Rationale:	Environmental Microbiology is a foundational subject that bridges the fields of microbiology and environmental engineering. Microorganisms play a vital role in natural processes such as nutrient cycling, water purification, and waste decomposition. The course provides a strong scientific base for understanding environmental processes and equips students with practical skills in microbiological analysis. It strengthens their ability to design, operate, and monitor environmental systems with microbial involvement. Thus, Environmental Microbiology is a crucial link between theoretical knowledge, laboratory skills, and real-world environmental engineering practice.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Classify microorganisms based on structure and characteristics.	R,U,A
02	Differentiate between genetic mechanisms such as mutation, conjugation, transformation, and transduction.	R,U,A
03	Summarize the role of microorganisms in biogeochemical cycles (C, N, S, P).	R,U,A
04	Explain the role of microbes in wastewater treatment processes	R,U,A
05	Perform microbial water quality tests (MPN, membrane filtration).	R,U,A

**Revised Bloom's Taxonomy (RBT)*



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Environmental Engineering

Subject Code : DI04013071

Subject Name : Environmental Microbiology

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1. Introduction to Environmental Microbiology	1.1 Scope and importance of microbiology in environmental engineering 1.2 Historical development and contributions of microbiologists 1.3 Classification of microorganisms – bacteria, fungi, algae, protozoa, viruses 1.4 Cell structure and differences between prokaryotes and eukaryotes 1.5 Aseptic techniques and laboratory safety	8	15
2. Microbial Growth and Physiology	2.1 Microbial nutrition – macro and micronutrients 2.2 Growth curve of bacteria – lag, log, stationary, death phase 2.3 Factors affecting microbial growth – temperature, pH, oxygen, moisture 2.4 Microbial metabolism – aerobic and anaerobic respiration, fermentation 2.5 Microbial genetics – mutation, gene transfer (conjugation, transformation, transduction)	9	20
3. Environmental Microbial Ecology	3.1 Soil microbiology – nutrient cycles (carbon, nitrogen, sulfur, phosphorus) 3.2 Aquatic microbiology – microbial communities in freshwater, marine, wastewater 3.3 Air microbiology – airborne microorganisms, bioaerosols, sampling methods 3.4 Microbial interactions – symbiosis, commensalism, parasitism, antagonism	9	20
4. Applied Environmental Microbiology	4.1 Microbiology of drinking water – pathogens, indicator organisms (coliforms, E. coli) 4.2 Microbiology of wastewater – activated sludge, trickling filter, anaerobic digestion	11	25



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Environmental Engineering

Subject Code : DI04013071

Subject Name : Environmental Microbiology

	4.3 Solid waste management – composting and role of microbes 4.4 Bioremediation and biodegradation of pollutants (oil spills, pesticides, heavy metals, plastics) 4.5 Emerging issues – antimicrobial resistance, biofilms, microbial biosensors		
5. Environmental Monitoring and Applications	5.1 Microbial water quality testing – Most Probable Number (MPN), membrane filtration method 5.2 Biochemical and serological identification of microorganisms (IMViC tests, antibiotic sensitivity) 5.3 Monitoring of air, soil, and sludge microorganisms 5.4 Role of microbes in environmental biotechnology (biofertilizers, bioenergy, biosorption) 5.5 Case studies – wastewater treatment plants, composting facilities	8	20
	Total	45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
35	45	20	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	A Textbook Of Microbiology	Dubey R.C. & Maheshwari D.K.	S. Chand Publishing, ISBN-13 : 978-9355015273
2	Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology	K.R. Aneja	New Age International Private Limited ISBN-13 : 978-9355015273
3	Environmental Microbiology	Annette Bolger	Oxford Book Company, ISBN-13 : 978-9380179711



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Environmental Engineering

Subject Code : DI04013071

Subject Name : Environmental Microbiology

S. No.	Title of Book	Author	Publication with place, year and ISBN
4	Environmental Microbiology	K Vijaya Ramesh	MJP Publishers, ASIN : B07RWB2KJ6
5	Wastewater Engineering: Treatment and Reuse	Metcalf & Eddy	McGraw-Hill, ISBN-13 : 978-0070418783

(b) Open source software and website:

1. www.gpcb.gov.in
2. <https://cpcb.nic.in>
3. www.Nptel.ac.in
4. <https://cellcollective.org>
5. <https://imagej.net>
6. <https://epgp.inflibnet.ac.in>
7. <https://swayam.gov.in>
8. <https://epgp.inflibnet.ac.in>

Suggested Course Practical List:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Introduction to microbiology lab – safety, aseptic techniques, sterilization methods	I	02
2	Preparation of nutrient agar and selective media	I	02
3	Microscopy – observation of bacteria, fungi, algae	I	02
4	Staining techniques – simple, Gram, and spore staining	II	02
5	Isolation of pure cultures by streak plate/pour plate method	II	02
6	Determination of bacterial growth curve	II	02
7	Enumeration of microorganisms (Total Plate Count)	II	02
8	Soil microbiology – isolation of actinomycetes and fungi	III	02
9	Study of activated sludge microorganisms (microscopy)	IV	02
10	Biodegradation study – oil/organic matter degradation by microbes	IV	02
11	Antibiotic sensitivity test (Kirby–Bauer method)	IV	02
12	Coliform detection – MPN test	V	02



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Environmental Engineering

Subject Code : DI04013071

Subject Name : Environmental Microbiology

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
13	Membrane filtration technique for water microbiology	V	02
14	Biochemical tests (IMViC series) for bacterial identification	V	02
15	Industrial/field visit – Water Treatment Plant/Wastewater Treatment Plant	V	02
			Total:30

List of Laboratory/Learning Resources Required:

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	<ul style="list-style-type: none">• Simple and Compound Microscopes• Autoclave• Hot air oven• Laminar air flow chamber• Incubator (bacteriological)• Bunsen burners / spirit lamps• Safety cabinets, fire extinguisher, first aid kit• Orbital shaker incubator• Colony counter (manual or digital)• Refrigerators / Deep freezer (for media and culture storage)• Anaerobic jar with gas pack system• Spectrophotometer (for growth curve experiment)• MPN test apparatus (fermentation tubes, Durham's tubes, racks)• Filtration assembly (membrane filtration unit + vacuum pump)• Glassware for dilution and plating• Soil sampling kits• Petri dish sedimentation setup for air microbiology• Air sampler	1 to 14



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Environmental Engineering

Subject Code : DI04013071

Subject Name : Environmental Microbiology

Suggested Project List:

- a) Prepare a report on Comparative study of water quality from different sources (tap, borewell, pond, packaged water).
- b) Perform analysis and Prepare a report on Effectiveness of natural coagulants (like Moringa seeds, alum, neem extract) in reducing microbial load in wastewater.
- c) Study the Effect of organic manure vs chemical fertilizer on soil microbial count and prepare a report.
- d) Prepare a report on Oil spill bioremediation using native soil microbes.
- e) Perform Air sampling in different environments (classroom, laboratory, open area) and microbial colony count.
- f) Prepare a report on Antimicrobial effect of herbal extracts (garlic, neem, tulsi, turmeric) against common bacteria.
- g) Prepare a report on Use of algae for removal of nutrients from wastewater (phycoremediation).

Suggested Activities for Students:

- a) Seminar Presentations on topics like bioremediation, wastewater microbiology, antimicrobial resistance, biosensors.
- b) Poster / Chart Making on nitrogen cycle, microbial cell structure, waterborne diseases, and wastewater treatment microbes.
- c) Build working models of composting, anaerobic digester, or biofilm reactor.

* * * * *