



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Science (Industrial Biotechnology)

Level: PG Semester-3

Course / Subject Code: IB03001021

Course / Subject Name : Environmental Biotechnology

## 1. Learning Outcomes

Learning Outcome Component	Learning Outcome (Learner will be able to)
Theoretical and practical understanding of Environmental Biotechnology	<ul style="list-style-type: none"><li>At the end of the course the students will have an understanding of the fundamentals of ecology.</li><li>Students will be able to analyse the purity of portable water by different techniques like BOD and COD.</li></ul>
Value applications of Environmental Biotechnology in biological research as well as in biotech-industries	<ul style="list-style-type: none"><li>Understand concepts of PGPR and solid waste management techniques.</li><li>Describe mineral phosphate solubilization for production of fertilizers.</li></ul>
Effective Communication	<ul style="list-style-type: none"><li>Communicate concepts and ideas effectively.</li></ul>
Professional & Ethical Behaviour	<ul style="list-style-type: none"><li>Transparency, honesty and ethical reasoning in handling cells and biomolecules.</li></ul>

## LO – PO Mapping: Correlation Levels:

1 = Slight (Low); 2 = Moderate (Medium); 3 = Substantial (High), “-“= no correlation

Sub Code: 1330102	PO1	PO2	PO3	PO4	PO5	PO6	PO7
LO1: Theoretical and practical understanding of Environmental Biotechnology	2	3	2	2	2	3	2
LO2: Value applications of Environmental Biotechnology in biological research as well as in biotech-industries	2	2	3	3	2	3	2
LO3: Effective communication	3	2	2	2	3	3	2
LO4: Professional & Ethical Behaviour	2	2	2	2	3	2	3

2. Course Duration: The course duration is 45 sessions of 60 minutes each.

## 3. Course Contents:

Module No:	Module Content	No. of Sessions	70 Marks (External Evaluation)
1	<b><u>Biological nitrogen fixation</u></b> Physiology and biochemistry of nitrogen fixing organisms, genetics and regulation of gene expression, signaling factors and molecular interaction in establishing rhizobia legume symbiosis.	5	9



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2	<b><u>Biofertilizers</u></b> Phosphate Solubilizing Microorganisms, inorganic phosphate solubilization and its mechanisms, phosphate mineralizers-phytate and organic phosphate hydrolyzing bacteria, Ecto- and Endo- Mycorrhizae.	3	9
3	<b><u>Plant growth promoting rhizobacteria (PGPR)</u></b> PGPR in improving plant growth, mechanism in plant growth promotion, factors affecting rhizosphere colonization.	5	7
4	<b><u>Environmental problems and monitoring</u></b> Pollution and its classification; Effluent standards- examination of wastewater, characteristics, municipal and industrial waste water; Global environmental problems, global warming, acid rain, ozone depletion; Sampling and analysis; Environmental monitoring and audit; Environmental laws and policies in India.	5	10
5	<b><u>Biotreatment kinetics and reactor design</u></b> Principles of biological treatments; Biological treatment-composting, suspended growth systems, attached growth systems; Bioreactor design- activated sludge process, trickling filters, fluidized bed and packed bed reactor, rotating biological contactors, oxidation ponds and ditches, lagoons, anaerobic reactors.	6	9
6	<b><u>Bioremediation and biodegradation</u></b> Bioremediation principles and processes, Biosorption, bioaccumulation, bioconversion, biotransformation, bioleaching, biodegradation, detoxification, activation, accumulation and co-metabolism; Strategies and techniques of bioremediation <i>in situ</i> and <i>ex situ</i> of hydrocarbons, pesticides and dyes; GMOs in bioremediation and biodegradation, Microbial enhanced oil recovery.	6	10



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7	<b><u>Principles of microbial diversity</u></b> Evolution of life, principles and concept of microbial diversity, ecological diversity, structural and functional diversity; Methods of studying microbial diversity- Morphological, biochemical/physiological and molecular techniques; Microbial classification and taxonomy; Phenetic, phylogenetic, and genotypic classification, numerical taxonomy, taxonomic ranks, phylogenetic tree, techniques for determining microbial taxonomy and phylogeny- classical and molecular characteristics.	6	7
8	<b><u>Fundamentals of ecology</u></b> Ecosystem, energy in ecological systems, energy participating in food chains and food webs; Interactions among microbial populations, interaction between microbes and plants and between microbes and animals.	9	9
9	<b><u>Practicals</u></b> <ol style="list-style-type: none"><li>1. Assay for dissimilatory nitrate reductase activity</li><li>2. Estimation of nitrogenase activity of free living bacteria in soils</li><li>3. Study of biooxidation of ferrous and sulphur by chemolithotrophic bacteria.</li><li>4. Adaptation of soil bacteria to metals.</li><li>5. Biosorption of heavy metals from industrial effluents.</li><li>6. Enrichment and isolation of Azodye degrading bacteria and their application in treatment of dye containing effluents</li><li>7. Enrichment and isolation of 2,4-D degrading bacteria</li><li>8. Study of microbial mineral phosphate solubilisation activity</li><li>9. Enrichment and isolation of naphthalene degrading bacteria</li><li>10. Analysis of biosurfactant production by hydrocarbon degrading organisms</li></ol>	-	(30 marks)



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	<p>11. Estimation of microbial activity of soil by dehydrogenase assay</p> <p>12. Waste water treatment:</p> <p>a) Biological Oxygen Demand, Chemical Oxygen Demand measurement</p> <p>b) Running of anaerobic and aerobic fluidized bed reactors</p> <p>c) Upflow Anaerobic Sludge Blanket reactor startup and running</p> <p>d) Analysis of reactor operation.</p>		
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#### 4. Pedagogy:

- ICT enabled Classroom teaching
- Practical / live assignment
- Interactive classroom discussions

#### 5. Evaluation:

Students shall be evaluated on the following components:

	Internal Evaluation	(Internal Assessment – 20 Marks)
A	• Assignments	10 marks
	• Class Presence	5 marks
	• Record maintenance	5 marks
B	Mid-Semester Examination	(Internal assessment-30 Marks)
C	End-Semester Examination	(External assessment-70 Marks)

#### 6. Reference Books:

No	Author	Name of the Book	Publisher	Year of Publication / Edition
1	Atlas R.M and Bertha, R	Microbial Ecology	Pearson Education.	4 <sup>th</sup> Edition
2	Maier, R.M., Pepler I.L and Gertha C.P.	Environmental Microbiology	Academic Press.	2 <sup>nd</sup> Edition
3	Olum E.P and Barrett G.W	Fundamental of Ecology	Cenegage learning.	5 <sup>th</sup> Edition



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4	Wiley J.M., Sherwood, L.M and Woolverton C.J. Prescott, Harley and Klein	Microbiology	McGraw Hill.	7 <sup>th</sup> Edition
5	Garrity, G.M, Brenner, D.J, Kreig M.R. and Staley J.T.	Bergey's Manual of Systematic Bacteriology	Springer	2 <sup>nd</sup> Edition
6	Lawrence K. W, Volodymyr Ivanov, Joo-Hwa Tay, Yung-Tse Hung	Environmental Biotechnology, Vol 10, Handbook of Environmental Engineering	Springer	Latest Edition
7	Hans-Joachim Jordening, Josef Winter	Environmental Biotechnology: Concepts and Application	John Wiley & Blackwell	Latest Edition
8	Christon Hurst, Ronald L.C, Guy R. K, Miachael J.M, Linda D. S	Manual of Environmental Microbiology	ASM press	2 <sup>nd</sup> Edition

Note: Wherever the standard books are not available for the topic appropriate print and online resources, journals and books published by different authors may be prescribed.

## 7. List of Journals/Periodicals/Magazines/Newspapers / Web resources, etc

- <https://www.researchgate.net/publication/43451458> Environmental microbiology A laboratory manual
- <https://www.sciencepublishinggroup.com/journal/index?journalid=384>

## Course Outcomes:

On completion of this course, students should be able to:

- Gain understanding of the basic microbiological, molecular and analytical methods extensively used in environmental biotechnology.