



Gyanmanjari
Innovative University

Syllabus
Gyanmanjari Science College
Semester-7 (B.Sc.)

Subject: Environmental and Agriculture Microbiology - BSCMB17403

Type of course: Major

Prerequisite: Students should have a basic understanding of: General Microbiology, Basic Biology, Fundamentals of Chemistry, Basic knowledge of soil and plant biology.

Rationale: It is an important branch of biology that deals with microorganisms in soil, water, air, and their role in agriculture and the environment. It helps students understand how microbes contribute to soil fertility, nutrient cycling, plant growth promotion, and decomposition of organic matter. It explains beneficial microbial interactions such as nitrogen fixation, phosphate solubilization, and mycorrhizal associations, which improve crop productivity in a natural and sustainable way. In addition, it introduces microbial diversity in different environments and their adaptations, which are useful in biotechnology and environmental protection.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
CI	T	P		C	SEE		CCE		
			Theory		Practical	MSE	LWA/V	ALA	
3	0	2	4	75	25	30	20	50	200

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

3 Credits * 25 Marks = 75 Marks (each credit carries 25 Marks) Theory
 1 Credits * 25 Marks = 25 Marks (each credit carries 25 Marks) Practical
 SEE 100 Marks will be converted in to 50 Marks
 CCE 100 Marks will be converted in to 50 Marks
 It is compulsory to pass in each individual component.



Course Content:

Unit No	Course content	Hrs	% Weightage
1	Environmental Problems and Monitoring <ul style="list-style-type: none"> • Pollution and its classification, Effluent standards: examination of waste water 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. 	10	25
2	Bioremediation and Biodegradation <ul style="list-style-type: none"> • Bioremediation principles and Processes: Biosorption, Bioaccumulation, Bioconversion, Biotransformation, Bioleaching, Biodegradation, Detoxification, Activation, Acclimatization and Co-metabolism, strategies and techniques of bioremediation: in situ and ex situ, of Hydrocarbons, Pesticides and Dyes, GMOs in bioremediation and biodegradation. 	10	25
3	Molecular Biology and Ecology of Archaea and Extremophiles <ul style="list-style-type: none"> • Ecology, Archaeal cell walls and membranes, genetics and molecular biology, metabolism, archaeal Taxonomy, Phylum Crenarchaeota, Phylum Euryarchaeota. • Habitat, diversity, physiology, survival and adaptation, and biotechnological potentials of: Cold and thermal environment, Saline and deep-sea environment, Anaerobic environment, Osmophilic and xerophilic environment, Alkaline and acidic environment. 	10	25



4	<p>Rhizosphere Microbiology: Plant Growth Promotion and Nutrient Mobilization</p> <ul style="list-style-type: none"> ● PGPR in improving plant growth, Mechanism in plant growth promotion, Factors affecting rhizosphere colonization. ● Physiology and Biochemistry of Nitrogen fixing organisms, ● Genetics and regulation of nif gene expression, signaling factors and molecular interaction in establishing Rhizobia legume symbiosis. ● PSMs, Inorganic phosphate solubilization and its mechanisms, Phosphate mineralizers – phytate and organic phosphate hydrolyzing bacteria, and Ecto- and Endo Mycorrhizae 	15	25
---	--	----	----

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	<p>Field-Based Investigation Students will prepare a mini case study report on a local environmental issue (such as a river, lake, industrial area, or urban waste site) and upload the presentation on the GMIU web portal.</p>	10
2	<p>Creative Task Students will design a flowchart or infographic illustrating different bioremediation processes and their applications in environmental cleanup, and upload it on the GMIU web portal.</p>	10
3	<p>Presentation Students will prepare a presentation on extremophiles and their importance and upload it on the GMIU web portal.</p>	10
4	<p>Mini Project: Students will perform the isolation and screening of plant growth-promoting rhizobacteria, prepare a detailed report, and upload it on the GMIU web portal.</p>	10
5	Attendance	10
Total		50



Suggested Specification table with Marks (Theory):75

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	40%	30%	10%	-	-

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course, the students should be able to:	
CO1	Understand environmental pollution, its types, monitoring techniques, and the role of environmental laws and policies in addressing global environmental problems.
CO2	Describe various bioremediation mechanisms and techniques and explain their application in the degradation and detoxification of environmental pollutants.
CO3	Explain the molecular, physiological, and ecological adaptations of archaea and extremophiles that enable survival in extreme environments and explore their biotechnological significance.
CO4	Analyze the interactions between rhizosphere microorganisms and plants, focusing on nutrient cycling, symbiosis, and microbial processes that enhance soil fertility and plant productivity.

List of Practical:

Sr. No.	Descriptions	Unit No.	Hrs.
1.	Measurement of biochemical oxygen demand (BOD) of wastewater.	1	2
2.	Determination of total dissolved solids (TDS) and total suspended solids (TSS).	1	2
3.	Estimation of phosphate levels in water bodies.	1	2
4.	Biodegradation of organic pollutants using soil bacteria.	2	4
5.	Comparison of bacterial vs fungal dye degradation efficiency.	2	4



6.	pH tolerance range determination of microbial cultures.	3	2
7.	Effect of temperature on microbial growth.	3	2
8.	Effect of PGPR on seed germination rate.	4	4
9.	Isolation of Plant Growth Promoting Rhizobacteria (PGPR) from rhizosphere soil.	4	4
10.	Isolation of phosphate-solubilizing microorganisms (PSM).	4	4
Total		30	

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.

Reference Books:

1. Madigan, M.T. and Martinko, J.M. Brock Biology of Microorganisms, 11th edition, Pearson Prentice Hall, 2006.
2. Cavicchioli, R. Archaea – Molecular and Cellular Biology, ASM Press, Washington, 2007.
3. Dworkin, M., Falkow, S., Rosenberg, E., Schleifer, K.H., Stackebrandt, E. (Eds.). The Prokaryotes. Vol. I – VII, Springer, 2006.
4. Alexander, M. Biodegradation and Bioremediation, Academic Press, 1994.
5. Atlas, R.M. and Bartha, R. Microbial Ecology, 4th edition, Pearson Education, 2009.
6. Dworkin, M., Falkow, S., Rosenberg, E., Schleifer, K.H., Stackebrandt, E. (Eds.). The Prokaryotes. Vol. I – VII, Springer, 2006.
7. Hurst Christon J., Manual of Environmental Microbiology, ASM Press, Washington DC, 2007.
8. Pepper, I.L. and Gerba, C.P. Environmental Microbiology – A Laboratory Manual, 2nd edition, Elsevier Academic Press, 2005.

