GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Biotechnology (04)
SUBJECT NAME: Environment Biotechnology
SUBJECT CODE: 2170409
B.E. 7th SEMESTER

Type of course: B.E. (Biotechnology)

Prerequisite: Basic concepts of Environment science and Biotechnology applications for it.

Rationale: It is one of the core subjects of Biotechnology. It involves understanding of environment and applications of biotechnology for preservation. It also involves various environment problems and various methods of biotechnology to control them.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Sr. No.	Content	Total Hrs	% Weightage
UNIT I	What is Environmental Biotechnology? Concept of environment and importance of its preservation. Bacterial Metabolism in Wastewater Treatment Systems, Industrial Wastewater Sources and Treatment Strategies, Activated Sludge Process, Basics of Modeling of Aerobic Wastewater Treatment Processes, overview of High-rate Anaerobic Wastewater Treatment, overview of Biogas Reactors, Bioreactors for environmental cleanup (aerobs and effluent)	18	28.12%
UNIT II	**Biotechnology and waste** Composting of Organic Waste, Anaerobic Fermentation of Wet and Semidry Garbage Waste Fractions, Process Engineering of biological waste gas Purification, Commercial Applications of biological waste gas Purification, Perspectives of waste water, waste, off-gas and soil treatment	10	15.62%
UNIT III	**Pollution Control** Cleaner Technologies (Fermentation Technology, Paper Industry, Plastic Industry),ISO 14000 and EMS (Environment Management	10	15.62%

	System),Reducing Environment Impact of Industrial Effluents(Treatment of distillery effluent, Reducing heavy metal's pollution caused by industrial effluents, Biodegradation of pollutants, Toxic site reclamation)		
UNIT IV	**Bioremediation** **a.** Bioremediation using naturally occurring microorganism, **b.** Removal of spilled oil and grease deposits (Use of oleophilic fertilizers, Use of a mixture of bacterial strains,Use of genetically engineered microbes) **c.** Reducing environment Impact of agricultural practices (Weed control and herbicides, Pest control and biopesticides, Eco-friendly strategy to check soil borne diseases: soil solarization, Biofertilizers) **d.** Biosensor to detect environmental pollutants (In situ bioremediation of both soil and ground water contamination, Bioremediation of contaminated soil only, Bioremediation of contaminated surface waters (pits, ponds and lagoons) only, Treatment of toxic wastes before they reach environment, Conservation of soil city wastes,SPCI's strategy on biotreatment **e.** Bioremediation using Genetically Engineered Microbes (GEM) (GEM for detecting PAHs in the soil,GEM for treating oil spills,GEM for sequestering of heavy metals) **f.** Phytoremediation (Bioavailability of metals, Plant biology of heavy metal accumulation, Naturally occurring plants for Phytoremediation, Transgenic plants for Phytoremediation, Bioremediation Market)	16	25%
UNIT V	**Environment and Energy** **a.** Renewable sources of Energy Biomass production and its utilization for energy(Waste materials for energy,Biogas production,Large scale growing of energy crops,Cellulose as a source of energy), Energy and Fuel using microorganism(Hydrogen production,Hydrocarbon production).Conservation of Energy **b.** Restoration of Degraded Lands: Reforestation through micro propagation, Casuarina for Tropical reforestation on adverse sites, Development of stress tolerant plants, Use of Mycorrhizae in reforestation, Use of microbes for improving soil fertility(Nitrogen fixing bacteria for nodulation in legumes, Nitrogen fixing bacteria for nodulation in non legumes, Nitrogen fixing actinomycetes: Frankia for nodulation in non	10	15.62%

	legumes),Restoration of Soils contaminated with heavy metalsLand fill Systems, Sanitary Land filling of solid wastes, and longterm problems with Leachate, Sanitary Landfills : Long-term stability and Environmental Implications		

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
21	**28**	**7**	**7**	**7**	**-**

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.

Reference Books:

1. Environment Biotech ,Edited by : Hans-Jonchim Jorbening and Joseph Winter, Wiley-VCH Verlag GmbH & Co.
2. A Textbook of Biotechnology, R.C.Dubey, S.Chand Co ltd.
3. Biotechnology and Genomics,P.K.Gupta,Rastogi Publications
4. Environmental Biotechnology-Theory and Applications, Gareth M.Evans and Judith Furlong,WILEY.
5. Environmental Biotechnology, Bimal Bhattacharya and Rintu Banerjee, Oxford University Press

Course Outcome:

After learning the course the students should be able to:

1. Develop fundamental understanding of Applications of Biotechnology in Environment science and Environmental related problems
2. Understand the Concept of environment and importance of its preservation.
3. Understand the Concept of pollution and methods to control it.
4. Understand the Concept of Bioremediation and its applications.
5. Understand many types of energy sources.

List of Experiments:

1. Study of Sampling Technique and Sample Preservation.
2. Collection of Grab And Composite Sample
3. A) To Estimate Total Hardness of Water
   B) To Estimate Calcium Hardenss of Water

4. To Estimate The Total Solids (Ts), Total Dissolved Solids (TDS) And Suspended Solids (SS) In The Given Water Sample.
5. To Estimate Dissolved Oxygen Content Of Wastewater.(DO)
6. To Estimate Chemical Oxygen Demand of The Given Sample(COD)
7. To Estimate Biological Oxygen Demand (BOD)
8. To Measure The Concentration of Chloride In The Given Sample
9. To Estimate The Amount of Ammonical Nitrogen In The Given Sample
10. To Estimate The Amount of Nitrate Nitrogen
11. To Estimae The Amount of Nitrite Nitrogen
12. To Estimate The Amount of Phosphorus Phosphate In The Given Sample
13. To Measure The Sulfite ($SO3^{-2}$) Content In The Given Sample By Iodometric Titration.
14. To Find Out Acidity of The Given Sample.
15. To Find Out The Most Probable Number of Coliforms In The Given Water Sample
16. Practical on soil Bioremediations
17. Visit to waste water treatment plant

Design based Problems (DP)/Open Ended Problem:

Open Ended Problem:

Students are free to select any project related to clean up of environment and its applications in the field of Biotechnology. Some of the suggested projects are:

- Reduction of COD/BOD/TDS/TSS etc from wastewater (effluent)
- Design some technology of bioreactor which is more efficient than existing, say, secondary and tertiary treatment of wastes.
- Think and design new equipments for measurements of air pollution and steps to reduce it

Major Equipment:

The major equipments required for experimentation include COD digester, BOD incubator, Colorimeter, Spectrophotometer, Digital Balance, Digital pH meter, Water bath, Centrifuge, Micro-pipette, etc.

List of Open Source Software/learning website:

Students can refer to video lectures available on the websites including NPTEL. Students can refer to the CDs which are available with some reference books.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.