



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**

**Subject Code: 3150410**

**SUBJECT NAME: Concepts in Environmental Biotechnology**

**B.E. 5<sup>th</sup> 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<br>C | Examination Marks |        |                 |        | Total Marks |
|-----------------|---|---|--------------|-------------------|--------|-----------------|--------|-------------|
| L               | T | P |              | Theory Marks      |        | Practical Marks |        |             |
|                 |   |   |              | ESE (E)           | PA (M) | ESE (V)         | PA (I) |             |
| 2               | 0 | 2 | 3            | 70                | 30     | 30              | 20     | 150         |

| Sr. No.       | Content  | Total Hrs | % Weightage |
|---------------|--|-----------|-------------|
| <b>UNIT I</b> | <p><b>Introduction:</b><br/>What is Environmental Biotechnology?<br/>Concept of environment and importance of its preservation-<br/>Biotechnology view point.<br/>Technology and Environment- Interference</p> <p><b>Environment and Energy</b></p> <p><b>a.</b> Renewable sources of Energy<br/>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</p> <p><b>b.</b> Restoration of Degraded Lands:<br/>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</p> | 7         | 22.58%      |



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|                 |   |   |        |
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|                 | legumes, Nitrogen fixing bacteria for nodulation in non legumes, Nitrogen fixing actinomycetes: Frankia for nodulation in non legumes), Restoration of Soils contaminated with heavy metals Land fill Systems, Sanitary Land filling of solid wastes, and longterm problems with Leachate, Sanitary Landfills : Long-term stability and Environmental Implications  |   |        |
| <b>UNIT II</b>  | Bacterial Metabolism in Wastewater Treatment Systems, Wastewater treatment methods.<br>Overview of Modeling of Aerobic Wastewater Treatment Processes and high-rate Anaerobic Wastewater Treatment, Bioreactors for environmental cleanup (aerobs and effluent)   | 7 | 22.58% |
| <b>UNIT III</b> | <b>Biogas production-</b> reactors (Indian Models), advantages, disadvantages etc.<br><b>Biotechnology and waste</b><br>Composting of Organic Waste, Anaerobic Fermentation of Wet and Semidry Garbage Waste Fractions, Idea of biological waste gas Purification.<br><b>Bioplastics</b> -Introduction and review of research papers on it.   | 5 | 16.12% |
| <b>UNIT IV</b>  | <b>Pollution Control</b><br>Cleaner Technologies (Fermentation Technology, Paper Industry, Plastic Industry),<br>ISO 14000 and EMS (Environment Management System),<br>Reducing Environment Impact of Industrial Effluents<br><b>Global Environmental Issues:</b> Climate change, acid rain, ozone depletion, Greenhouse gases.<br>Current protocols and strategies to mitigate global pollution  | 6 | 19.35% |
| <b>UNIT V</b>   | <b>Bioremediation</b><br><b>a.</b> Bioremediation using naturally occurring microorganism,<br><b>b.</b> Removal of spilled oil and grease deposits (Use of oleophilic fertilizers, Use of a mixture of bacterial strains, Use of genetically engineered microbes)<br><b>c.</b> 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)<br><b>d.</b> Biosensor to detect environmental pollutants<br><b>e.</b> Bioremediation using Genetically Engineered Microbes (GEM)<br><b>f.</b> Phytoremediation | 7 | 22.58% |

**Suggested Specification table with Marks (Theory):**

| Distribution of Theory Marks |         |         |         |         |         |
|------------------------------|---------|---------|---------|---------|---------|
| R Level                      | U Level | A Level | N Level | E Level | C Level |



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|           |           |           |          |          |          |
|-----------|-----------|-----------|----------|----------|----------|
| <b>28</b> | <b>31</b> | <b>00</b> | <b>4</b> | <b>4</b> | <b>3</b> |
|-----------|-----------|-----------|----------|----------|----------|

**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. Compare various methods and its need for preservation of environment and generate sources of energy
2. Perceive the significance of Industrial Standards and methods for abatement of pollution.
3. Infer and comprehend the concept of environment as well as pollution and methods to control the pollution.
4. Apprehend the role of biotechnology for environment and use biotechnological methods for restoration of polluted environment.

## List of Experiments:

1. Study of Sampling technique and sample preservation.
2. Collection of Grab And Composite Sample
  - A) To Estimate Total Hardness of Water
  - B) To Estimate Calcium Hardness of Water
3. To Estimate the Total Solids (Ts), Total Dissolved Solids (TDS) And
4. 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 Nitrate Nitrogen
10. To Estimate the Amount of Nitrite Nitrogen



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11. To Estimate the Amount of Phosphorus Phosphate In The Given Sample
12. To Measure the Sulfite ( $\text{SO}_3^{-2}$ ) Content In The Given Sample By Iodometric Titration.
13. To Find out Acidity of The Given Sample.
14. To Find out The Most Probable Number of Coliforms In The Given Water Sample
15. Soil Bioremediations-study and review through a small set up

### Design based Problems (DP)/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 etc.

### List of Open Source Software/learning website:

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