GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Biotechnology (04)
SUBJECT NAME: Biotechnology for Waste and Wastewater Treatment
SUBJECT CODE: 2170410
B.E. 7thSEMESTER

Type of course: B.E. (Biotechnology)

Prerequisite: Basic concepts of waste & waste water and applications of Biotechnology for treatment.

Rationale: Biotechnology for waste and wastewater treatment is essential in the field of water treatment. It involves understanding of waste & wastewater. It also involves various methods of biotechnology to treat the waste and wastewater.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	100

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction:** Movement of Pollutants , Effluent Discharge , Different Treatment Procedures	5	0.78%
2	**Aerobic and Anaerobic Bioreactors**: Aerobic Degradation , Anaerobic Degradation , Comparison between Aerobic and Anaerobic Degradation Pathways , Aerobic Reactors , Anaerobic Reactors , Membrane Reactors , Mode of operation	17	26.56%
3	**Mathematical Models for Bioreactors :** Basic Reactor Model , Reaction Kinetics, Oxygen Transfer Rates , Mass transfer and Diffusion Coefficients , Activated Sludge Process , Ponds and Lagoons, Transport in Solis , Diffusion and Transport of Gases in Air	15	23.43%
4	**Treatment of Waste from Organic Chemical Industries** : Introduction, Bio-treatment, Phytoremediation **Chlorinated Hydrocarbons and Aromatics , and Dioxins :** Introduction, Occurrence , Aerobic Degradation Anaerobic Degradation , Poly-nuclear Aromatic Hydrocarbons(PAH) , Halogenated Organic Compounds , Chlorinated Aliphatic Compounds , Chlorinated Aromatic Compounds	17	26.56%

5	**Biodegradation of Pesticides**: Introduction, Insecticides, Fungicides ,Herbicides, Biodegradation of Pesticides, Degradation of Dyes **Textile Effluent:** Physical treatment, Biodegradation, Bio-sorption, Combined treatment, Reactors.	10	15.62%

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	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

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. "Biotreatment Of Industrial Effluents" by Anil Kumar Mukesh Doble.
2. Handbook of Water and Wastewater Treatment Technologies by Nicholas P. Cheremisinoff.
3. Waste Water Engineering by Metcalf and Eddy. Publisher: Tata McGraw hill
4. Principles of Environmental Engineering by Gilbert Masters.

Course Outcome:

After learning the course the students should be able to:

1. Develop fundamental understanding of Applications of Biotechnology for waste and wastewater treatment.
2. Understand the Concept of waste and wastewater.
3. Understand the technological advancements in water and wastewater treatment technology.
4. Understand the various bioreactors and their principles used for treatment.

List of Experiments:

1. Study of Sampling Technique and Sample Preservation.
2. To Estimate Dissolved Oxygen Content Of Wastewater.(DO)
3. To Estimate Chemical Oxygen Demand of The Given Sample(COD)
4. To Estimate Biological Oxygen Demand (BOD)
5. To Measure The Concentration of Chloride In The Given Sample
6. To Estimate The Amount of Ammonical Nitrogen In The Given Sample
7. To Estimate The Amount of Nitrate Nitrogen
8. To Estimae The Amount of Nitrite Nitrogen
9. To Estimate The Amount of Phosphorus Phosphate In The Given Sample
10. To Measure The Sulfite (SO_3^{-2}) Content In The Given Sample By Iodometric Titration.
11. To Find Out Acidity of The Given Sample.
12. To Find Out The Most Probable Number of Coliforms In The Given Water Sample

13. Practical on soil Bioremediations
14. Visit to waste water treatment plant.
15. Collection of Grab And Composite Sample
    A) To Estimate Total Hardness of Water
    B) To Estimate Calcium Hardenss of Water
16. To Estimate The Total Solids (Ts), Total Dissolved Solids (TDS) And Suspended Solids (SS) In The Given Water Sample.

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.