

GUJARAT TECHNOLOGICAL UNIVERSITY

ENVIRONMENTAL ENGINEERING (13) BIOLOGICAL PROCESSES FOR WASTEWATER TREATMENT SUBJECT CODE: 2161304 B.E. 6th SEMESTER

Type of course: Applied Science

Prerequisite: Knowledge of subjects Environmental Sciences I and II

Rationale: To learn the principles and theories behind the treatment of wastewater by biological processes

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
				PA	ALA	ESE	OEP			
4	2	0	6	70	20	10	30	0	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Measurement of Organic Pollutant: Parameters - BOD, COD & TOC, Factors affecting BOD test, BOD equations, methods of estimating BOD, Biological v/s Physicochemical analysis	08	14
2	Introduction to Biological Treatment: Overview of biological wastewater treatment, objectives of the treatment, role of micro-organisms, types of biological processes for wastewater treatment, suspended and attached growth systems.	06	10
3	Microbial Growth Kinetics: Microbial Growth Kinetics terminology, rate of utilization of soluble substrates, other rate expression for the utilization of soluble substrate, rate of biomass growth with soluble substrate, rate of oxygen uptake, effects of temperature, total volatile suspended solids and active biomass, net biomass yield and observed yield.	10	18
4	Aerobic Suspended Growth Biological Treatment Systems: Aerobic biological oxidation, process description, environmental factors, Modifications of ASP: Complete Mix activated sludge, Extended Aeration system, Oxidation Ditch systems, Intermittently aerated and decanted systems, Oxygen activated sludge, Oxidation ponds, stabilization ponds Aerobic attached Growth Biological Treatment systems:	10	18

	Introduction to attached growth systems, Trickling Filter, Oxygen transfer and utilization, Applications rotating biological contactors, Bio-Towers.		
5	Anaerobic Decomposition: Mechanism of anaerobic fermentation – a multistep process, Microbiology and biochemistry of anaerobic processes, substrate inhibition, optimal anoxic environment, kinetic constants, stuck reactors, standard rate, high rate and multistage anoxic digesters.	14	25
6	Natural Treatment Systems: Development of natural treatment systems, fundamental consideration in the application of NTS, Slow Rate systems, rapid infiltration systems, Overland flow systems, constructed wetlands, Floating aquatic plant treatment systems	08	15

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	15	15	15	10	0

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. Waste water Engineering Treatment & Reuse by Metcalf and Eddy.
2. Wastewater treatment for pollution control by Soli J Arceivala (Tata McGraw-Hill).
3. Biological Process Design for wastewater treatment by Larry D. Benefield & Clifford W. Randall (Prentice Hall).
4. Anaerobic biotechnology for Industrial waste by R. E. Speece (Archae press).
5. Environmental Engineering – A design approach by Arcadio P. Sincero & Grejoria A. Sincero (Prentice Hall of India).

Course Outcome:

After learning the course the students should be able to:

1. Apply fundamental concepts of microbiology in biological treatment processes of wastewater.
2. Develop the reaction rate kinetics for biological treatment.
3. Compute the dimensions of biological treatment units.
4. Quantify the Organic pollutants present in waste water.
5. Give differences between aerobic and anaerobic treatment, process, Suspended growth and attached growth processes.
6. Design onsite system including septic tanks and pack edge treatment plants.

List of Tutorials:

1. Determination of COD of given wastewater sample.
2. Determination of BOD of given wastewater sample.
3. To find BOD reaction rate constant for given sample.
4. To find rate of re-aeration of tap water.
5. Examples on BOD.
6. Examples of Aerobic suspended attached growth.
7. Anaerobic Treatment of wastewater.
8. Design examples of Aerobic Treatment of wastewater – ASP, TF and RBC.
9. Natural treatment system and small wastewater treatment system.
10. Design examples for anaerobic reactor such as standard rate and high rate
 - i. anaerobic digesters.

Major Equipment:

1. COD digestion apparatus.
2. BOD incubator
3. Monopan balance

List of Open Source Software/learning website: <http://nptel.ac.in/>

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.