



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3161304

Semester – VI

Subject Name: Biological Processes for Wastewater Treatment

Type of course: Professional Core Course

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)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Measurement of Organic Pollutants of wastewater: Parameters - BOD, COD & TOC, Factors affecting BOD test, BOD equations, methods of estimating BOD, Thomas method, Fujimoto method, Least square method, Numericals based on each method, Biological v/s Physicochemical analysis	06
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.	02
3	Reactions and Reactors Concept of Reactions: Types of reactions and reaction rates; Temperature effects and enzyme reactions Concept of reactors : Types of reactors and reactors in series	04
4	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. Laboratory procedure for determination of biokinetic constants, numerical on estimation of biokinetic constants.	06
5	Biological Treatment Systems: Aerobic biological oxidation, process description, environmental factors Aerobic Suspended Growth Processes: 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 Processes : Introduction to attached growth systems, Tricking Filter, Oxygen transfer and utilization, Rotating biological contactors (RBC), Bio-Towers. Anaerobic Suspended and Attached Growth Processes : Mechanism of anaerobic fermentation, Microbiology and biochemistry of anaerobic processes, Factors affecting anaerobic treatment, UASB, Anaerobic baffled reactor, Anaerobic filters, standard rate and high rate digesters	18
6	Natural Treatment Systems: Development of natural treatment systems, fundamental consideration in the application of NTS Aquatic treatment methods: Ponds, lagoons and floating plant system	06



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Sr. No.	Content	Total Hrs
	Wetland treatment methods: Natural and Constructed wetlands Terrestrial treatment methods: Irrigation, Slow rate infiltration, Rapid infiltration, Root zone system Application of NTS: Decentralized Wastewater Treatment System (DEWATS)	

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	15	10	15	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 & Georgia A. Sincero (Prentice Hall of India).

Course Outcomes:

Sr. No.	CO statement	Marks Weightage
CO1	Measure and estimate the organic content of wastewater and its correlation with the oxygen demand.	15
CO2	Apply fundamental concepts of microbiology in biological treatment processes of wastewater by developing the reaction rate kinetics	30
CO3	Distinguish between Aerobic and anaerobic treatment processes and their key features	40
CO4	Classify and explain different natural treatment methods	15

Practicals:

1. Determination of COD of given wastewater sample.
2. Determination of BOD of given wastewater sample.
3. Determination of TOC of given wastewater sample.
4. To find BOD reaction rate constant for given sample.
5. To find rate of re-aeration of tap water.
6. Determination of biokinetic constants for aerobic suspended growth treatment
7. Determination of biokinetic constants for aerobic attached growth treatment

Assignments (Partial list):

1. Examples on BOD.
2. Numericals based on Thomas method, Fujimoto method, least square method
3. Numericals on estimation of biokinetic constants
4. Assignment on classification of biological treatment



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5. Assignment on different aerobic suspended growth biological treatments
6. Assignment on different aerobic attached growth biological treatments
7. Assignment on different anaerobic treatment methods
8. Natural treatment system and small wastewater treatment system

Major Equipment:

1. COD digestion apparatus
2. BOD incubator
3. TOC analyser
4. Monopan balance