

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**Environmental Engineering**  
**B. E. SEMESTER: VI**

Subject Code: 161304

Subject Name: **Biological Process for Wastewater Treatment**

Sr. No.	Course Contents	Total Hrs
1.	<p><b>Biochemical Concepts:</b></p> <p>Chemistry of carbohydrates, liquids proteins, fats and nucleic acids; enzymes and inhibitions, photosynthesis and symbiosis, enzyme kinetics.</p>	8
2.	<p><b>Measurement of Organic Pollutant:</b></p> <p>Parameters - BOD, COD &amp; TOC, Factors affecting on BOD, BOD equations, methods of estimating BOD, Biological v/s Physicochemical analysis</p>	8
3.	<p><b>Microbial Growth Kinetics:</b></p> <p>Microbial Growth Kinetics terminology, rate of utilization of soluble substrates, other rate expression for the utilization of soluble substrate, rate of soluble substrate production from biodegradable particulate organic matter, 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.</p>	8
4.	<p><b>Biological Treatment:</b></p> <p>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, Municipal wastewater treatment, Unit operations of Pre and primary treatment.</p>	4
5.	<p><b>Aerobic Suspended Growth Biological Treatment Systems:</b></p> <p>Aerobic biological oxidation, process description, process description, stoichiometry, environmental factors, plug flow activated sludge, Complete Mix activated sludge, Extended Aeration system, Oxidation Ditch systems, Intermittently aerated and decanted systems, Oxygen activated sludge, Principles of aeration, factors affecting oxygen transfer, Oxygenation and mixing requirements, Final clarification.</p> <p>Aerobic attached Growth Biological Treatment systems, Introduction to attached growth systems, Mass transfer limitations, trickling filtrations, Oxygen transfer and utilization, Applications rotating biological contactors, Bio-Towers, Process design considerations.</p>	16

6.	<b>Anaerobic Decomposition:</b> 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.	8
7.	<b>Natural Treatment Systems:</b> 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	4
8.	<b>Small Wastewater Treatment Systems:</b> Special problems faced by small communities, small systems flow rate and wastewater characteristics, types of small wastewater management system, onsite system for Industrial residences and other community facilities in un-sewered areas, selection and design of onsite systems, wastewater collection system for small communities, small systems for clusters of home and very small communities, system with package (Pre-Engineered) treatment plant, Individually designed treatment facilities, Sepatage and septage design.	8

### Practical:

1. Determination BOD, COD, TOC.
2. To find BOD reaction rate constant for given sample.
3. To find rate of re-aeration of tap water.

### Tutorial:

1. Examples on BOD.
2. Examples of Aerobic suspended attached growth.
3. Anaerobic Treatment of wastewater.
4. Design examples of Aerobic Treatment of wastewater – ASP, TF and RBC.
5. Natural treatment system and small wastewater treatment system.
6. Design examples for anaerobic reactor such as standard rate and high rate anaerobic digesters.

### 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 & Gecjoria A. Sincero (Prentice Hall of India).