# SARVAJANIK UNIVERSITY
## Sarvajanik College of Engineering and Technology
### Master of Technology
### Environmental Engineering

**M. Tech. I Semester I**

**Subject Name:** Biological Processes **Subject Code:** MTEN13102

**Type of course:** Core II

**Prerequisite:** Students should have a basic understanding of Wastewater Treatment flow and different processes.

**Rationale:** To develop a basic knowledge about the biological treatment of wastewater and apply the same in the field application.

**Teaching and Examination Scheme:**

| TEACHING SCHEME | | | | Theory Marks | | | Practical Marks | | Total |
|---|---|---|---|---|---|---|---|---|---|
| L | T | P | C | TEE | CA1 | CA2 | TEP | CA3 | 150 |
| 3 | 0 | 2 | 4 | 60 | 15 | 25 | 30 | 20 | |

**CA1:** Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

**Content:**

| Sr. No. | Topics | Teaching Hrs. | Module Weightage |
|---|---|---|---|
| 1. | **Introduction to Biological Treatment**<br>Objectives of biological treatment, significance of aerobic and anaerobic treatment, kinetics of biological growth, Factors affecting growth, attached and suspended growth, Determination of Kinetics coefficients for organics removal, Biodegradability assessment, selection of process. | 06 | 15% |
| 2. | **Environmental Microbiology**<br>Microorganisms - classification, prokaryotic and eukaryotic cells structure, characteristics, nuclic acids, DNA, RNA.<br>Microbiology of biological treatment process. Aerobic microorganisms- Anaerobic microorganisms-their environment-Attached and suspended growth systems.<br>Hydrolysis - Acidogenesis - Acetogenesis - Methanogenesis - Rate of limiting steps Immobilization advantages - Difference between aerobic and anaerobic treatment.<br>Distribution of microorganisms, coliforms-faecal coliforms - E.coli, Streptococcus facalis and clostridium welchii, differentiation of coliforms significance- MPN index | 06 | 15% |
| 2. | **Kinetics of Biological Growth**<br>Nutrition and growth conditions, Effect of environmental conditions, Bacterial growth in terms of numbers and mass, Growth curve, Interpretation of curve, Substrate limited growth, Monod's expression, Substrate utilization and cell growth, Effect of | 06 | 15% |

| | | | |
|---|---|---|---|
| | Endogenous metabolism, Inhibition, Effect of temperature, Application of growth and substrate removal kinetics to biological treatment. | | |
| **3.** | **Aerobic Processes**<br>Suspended and attached growth systems, suspended growth systems, Activated sludge Process, Types and their design concepts, Different attached growth systems and their design, Concepts, Advanced Membrane Biological Processes | 10 | 20% |
| **4.** | **Anaerobic Treatment Processes**<br>Attached and suspended growth, Design of units - UASB, up flow filters, Fluidized beds - septic tank and disposal, Nutrient removal systems, Biological processes for nitrogen and phosphorus removal, Nitrification and De-nitrification Processes and their design concepts, Different pond treatment systems, Layout and Hydraulic profile - Recent advances. | 10 | 20% |
| **5.** | **Sludge Management**<br>Design of Sludge management facilities, sludge thickening, sludge digestion, Biogas generation, sludge dewatering (mechanical and gravity) - upgrading existing plants - ultimate residue disposal - Recent Advances | 07 | 15% |

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

| % Distribution of Marks | | | | | |
|---|---|---|---|---|---|
| **R Level** | **U Level** | **A Level** | **N Level** | **E Level** | **C Level** |
| 20% | 25% | 25% | 10% | 10% | 10% |

**Legends: R:** Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **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 Text Books:**

| Sr. No. | Title of book /article | Author(s) | Publisher and details like ISBN | Year of publication | Publication Edition |
|---|---|---|---|---|---|
| 1. | Basic Principles of Wastewater Treatment | Marcos von Sperling | IWA Publishing House, ISBN: 1 84339 162 7, ISBN 13: 9781843391623 | 2007 | 1st |
| 2. | Wastewater Engineering: Treatment and Reuse | Metcalf and Eddy Inc | Tata McGraw Hill, New Delhi | 2007 | 4th |
| 3. | Biological Process Design for Wastewater | Benefield L.D. and | Prentice Hall, New Delhi | 1980 | 1st |

| | | | | | |
|---|---|---|---|---|---|
| | Treatment | Randall C.W. | | | |
| 4. | Water Treatment Unit Processes – Physical and Chemical | Hendricks, D. | CRC Press, New York | 2006 | 1st |
| 5. | Biological Reaction Engineering: Dynamic Modelling Fundamentals with Simulation Examples | Dr. Irving J. Dunn, Professor Dr. Elmar Heinzle, Dr. John Ingham, Dr. Jiří E. Přenosil | John Wiley & Sons<br>ISBN:9783527307593 | 2003 | 2nd |
| 6. | Biological Wastewater Treatment Processes: Mass and Heat Balances | Davide Dionisi | CRC Press<br>ISBN-10 1482229269<br>ISBN-13 978 1482229264 | 2017 | 1st |

**Course Outcome:**

| Sr. No. | CO Statement<br>After learning this subject, students will be able to | Marks % weightage |
|---|---|---|
| **CO-1** | Understand the importance of biological processes available for the wastewater treatment and selection criteria for the same. (U-Cognitive Level) | 20% |
| **CO-2** | Understand the basic microbiology, bacterial growth environment, reactions, its kinetics, types & characteristics. (R-Cognitive Level) | 20% |
| **CO-3** | Types and design concepts of Aerobic Process of treatment. (U & A-Cognitive Level) | 25% |
| **CO-4** | Types and design concepts of Anaerobic Process of treatment. (U & A-Cognitive Level) | 25% |
| **CO-5** | Sludge Management techniques and advancements. (R & U-Cognitive Level) | 10% |

**FOR LAB SESSIONS:**

**List of Tasks:**

- Assignments on the questions related to Conventional & modification of Activated Sludge Process, Types of aeration devices, Types of mixing devices, Flow measuring devices, Filtration systems
- Design problems on treatment units like clari-floculator, ASP, Trickling filter, Screen, UASB, RSF, Plant hydraulics

**List of Open Source/learning website:**

- https://nptel.ac.in/courses/105/105/105105178/
  - ASP as a Biological Treatment of Wastewater
- https://www.mlsu.ac.in/econtents/1817_NPTEL%20growth%20kinetics.pdf
  - Kinetics of Biological Growth
- https://nptel.ac.in/courses/105/106/105106119/
  - Different Aerobic & Anaerobic Treatments of Wastewater
- https://ocw.tudelft.nl/wp-content/uploads/Chapter_16_ Anaerobic_Wastewater_Treatment.pdf
  - Anaerobic Wastewater Treatment

- https://www.idfc.com/pdf/report/2011/Chp-20-Municipal-Wastewater-Management-In-India.pdf
    - Municipal Wastewater Management in India

**List of Open Source Software:**

- BioWin by EnviroSim Associates Ltd.
- STOAT
- CAPDET