Enrolment No./Seat No_____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE- SEMESTER–VII (NEW) EXAMINATION – WINTER 2024**

**Subject Code:3171306 Date:04-12-2024**

**Subject Name: Wastewater Engineering**

**Time:10:30 AM TO 01:00 PM Total Marks:70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | Marks |
|---|---|---|---|
| **Q.1** | **(a)** | What are the primary differences between domestic, municipal, and industrial wastewater in terms of their characteristics and treatment requirements? | **03** |
| | **(b)** | Discuss the design considerations and operational significance of an equalization tank in a wastewater treatment plant. How does proper design contribute to improved process efficiency and performance? | **04** |
| | **(c)** | In a wastewater treatment plant, the primary sedimentation tank is a critical unit operation. Discuss the design considerations and operational challenges associated with primary sedimentation tanks. Explain how these tanks contribute to the overall efficiency of the treatment process and address potential issues that may arise during operation. | **07** |
| **Q.2** | **(a)** | Analyze the role of hydraulic retention time (HRT) in the design and performance of Upflow Anaerobic Sludge Blanket (UASB) reactors. | **03** |
| | **(b)** | Discuss the design considerations and importance of an oil and grease removal unit in a wastewater treatment plant. How does the proper design and operation of this unit contribute to overall treatment efficiency? | **04** |
| | **(c)** | Analyze the design features and operational challenges of Sequencing Batch Reactors (SBR) and how they compare to Complete Mix Activated Sludge Processes (CMASP) in treating municipal wastewater. | **07** |
| | | **OR** | |
| | **(c)** | Evaluate the effectiveness of Rotating Biological Contactors (RBCs) in comparison to Bio Towers in the treatment of industrial wastewater, focusing on their design aspects and operational challenges. | **07** |
| **Q.3** | **(a)** | Analyze the impact of temperature on the performance of anaerobic digesters, specifically focusing on the mesophilic and thermophilic ranges. | **03** |
| | **(b)** | Analyze the influence of biofilm thickness on the efficiency and operational challenges of Rotating Biological Contactors (RBCs). | **04** |
| | **(c)** | Analyze the operational challenges and design considerations required to maintain stability in Waste Stabilization Ponds (WSPs) under varying climatic conditions. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Analyze the implications of high influent solids concentration on the design and operation of primary sedimentation tanks in wastewater treatment plants. | **03** |
| | **(b)** | Analyze how the choice of aeration system affects the operational efficiency and energy consumption of the Complete Mix Activated Sludge Process (CMASP). | **04** |
| | **(c)** | Analyze the impact of high organic loading rates on the design and operational efficiency of Sequencing Batch Reactors (SBRs). | **07** |
| **Q.4** | **(a)** | Evaluate the impact of implementing a UASB (Upflow Anaerobic Sludge Blanket) reactor in industrial wastewater treatment regarding efficiency and environmental compliance. | **03** |

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| | **(b)** | Evaluate the impact of integrating an equalization tank into the design of a municipal wastewater treatment plant. | **04** |
| | **(c)** | Evaluate the effectiveness of Bio Towers versus Rotating Biological Contactors (RBCs) for small-scale wastewater treatment plants in terms of treatment efficiency, operational reliability, and cost. | **07** |

**OR**

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| **Q.4** | **(a)** | Evaluate the significance of using Waste Stabilization Ponds (WSPs) for wastewater treatment in regions with extensive land availability. | **03** |
| | **(b)** | Evaluate the use of septic tanks in rural wastewater management compared to centralized sewage treatment systems. | **04** |
| | **(c)** | Evaluate the advantages and disadvantages of using an advanced aeration system such as fine bubble diffusers in the Complete Mix Activated Sludge Process (CMASP) compared to traditional mechanical surface aerators. | **07** |
| **Q.5** | **(a)** | Discuss the role and design considerations of sludge drying beds in wastewater treatment plants. What are the key factors that influence the efficiency of sludge drying beds? | **03** |
| | **(b)** | Describe the design considerations and operational impacts of sludge digesters in a wastewater treatment plant. How does the proper design and operation of sludge digesters contribute to the overall effectiveness of sludge management? | **04** |
| | **(c)** | Evaluate the design and functional importance of a primary sedimentation tank in a wastewater treatment plant. Discuss how its performance affects the overall treatment process. | **07** |

**OR**

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| **Q.5** | **(a)** | Explain how the design of equalization tanks impacts the performance of a wastewater treatment plant. What are the key operational parameters to consider for these tanks? | **03** |
| | **(b)** | Explain the design parameters and significance of filter presses in the sludge dewatering process in wastewater treatment plants. How does effective design impact the dewatering efficiency and quality of treated sludge? | **04** |
| | **(c)** | Describe the design parameters and operational significance of an aerated grit chamber in a municipal wastewater treatment plant. How does its performance impact the overall treatment system? | **07** |

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