

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2023

Subject Code: 2171306

Date: 01-12-2023

Subject Name: Wastewater Engineering

Time: 10:30 AM TO 01:30 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) Write the empirical formulas used for calculation of head loss through coarse screen and fine screen. **03**
- (b) Enlist the characteristics of domestic wastewater, municipal wastewater and industrial wastewater. **04**
- (c) Design an aerated grit chamber for the treatment of Municipal waste water. The average flow rate is 50 MLD and the peaking factor is 2. **07**
- Q.2** (a) Write design criteria for coarse screen. **03**
- (b) Differentiate between Domestic wastewater and Industrial wastewater. **04**
- (c) Design a bar rack (mechanically cleaned) for an average flow 20 MLD flow condition in incoming sewer is given by: **07**
- a. Diameter of sewer = 1.5 m
 - b. Depth of flow at peak flow = 1.18 m
 - c. Velocity at peak design flow = 0.85 m/s
 - d. Drop to screen chamber flow with respect to sewer invert is 0.08
 - e. Peaking Factor = 2

OR

- (c) For the flow rate data given in the table below, find out the volume of equalization tank: **07**

Time Period	8-11	11-14	14-17	17-20
Volume of W/W, m ³	22.3	43.2	16.8	41.1
Time Period	20-23	23-2	2-5	5-8
Volume of W/W, m ³	39.6	11.1	11.1	8.1

- Q.3** (a) Write down design criteria of Oil and Grease Trap, also draw a neat diagram of it. **03**
- (b) Enlist and explain the operational problems of Primary Sedimentation Tank. **04**
- (c) Enlist the various types of Rapid Mixers used for wastewater treatment. Differentiate between Rapid Mixing & Flocculation. **07**

OR

- Q.3** (a) Enlist and explain the operational problems of chemical unit processes. **03**
- (b) Explain the concept of flocculation and enlist the different types of flocculators. **04**
- (c) A city need to design sludge drying bed to dewater digested sludge produce from Sequencing bed reactor based municipal wastewater treatment plant for 55000 populations. Dry solid concentration in digested sludge is 70 g/capita/day. Assuming suitable design criteria design sludge drying bed. **07**
- Q.4** (a) Explain volumetric organic loading, up-flow velocity and gas collection system. **03**
- (b) It is proposed to treat a wastewater flow of 500 m³/d having 150 mg/L soluble BOD by an extended aeration system. Assuming following design criteria determine the reactor volume: Biomass concentration in aeration tank = 4000 mg/L, True yield coefficient, $Y = 0.4$, Endogenous decay coefficient, $K_d = 0.03 \text{ d}^{-1}$ and specific substrate utilization constant, $K = 0.01 \text{ L/mg-d}$. **04**

- (c) Explain the phases of SBR operational cycle with neat sketch. **07**

OR

- Q.4** (a) Write the Eckenfelder equations (with & without recirculation) for Bio tower design. **03**
(b) Write a short note on Bio Tower and explain how it is differ than Trickling Filter. **04**
(c) If 1.5 MLD flow of domestic wastewater with settled BOD₅ of 300 mg/L is treated in the conventional activated sludge plant at 0.3 F/M ratio to obtain 90% BOD removal efficiency, estimate the net surplus sludge produced per day. Assume suitable reaction constants. **07**

- Q.5** (a) Describe the removal mechanism of organic content in wastewater in a rotating biological contactor. **03**
(b) Enlist and explain different aeration system can be used in wastewater treatment. **04**
(c) Design a bio-tower to treat a wastewater flow of 15 MLD having settled BOD₅ equal to 250 mg/L. The depth of modular plastic media to be used is 6.0 m. The treatability constant determined at 20°C is found to be 0.06 min⁻¹ and the treated effluent is to be discharged into surface water. The desired concentration of effluent BOD₅ is 20 mg/L or less. Assuming a recirculation ratio of 2. **07**

OR

- Q.5** (a) Explain briefly about basic processes for sludge treatment. **03**
(b) Write down the design procedure of Up-flow Anaerobic Sludge Blanket reactor. **04**
(c) Assuming suitable design criteria and following characteristics of domestic wastewater, design a UASB reactor system to treat an average 7 MLD flow of wastewater. Assume up flow velocity = 0.5 m/h. Given data: Influent BOD = 350 mg/L, Influent COD = 880 mg/L, Influent TSS = 450 mg/L, Influent VSS = 350 mg/L and desired effluent BOD = 100 mg/L or less. **07**
