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# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER– VII (New) EXAMINATION – WINTER 2019**

**Subject Code: 2171306** **Date: 03/12/2019**

**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.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | Write down operational problems with its solution occurred in aerated grit chamber. | **03** |
| | **(b)** | A wastewater flow of 0.60 $m^3$/min containing 150 mg/L of oil and grease is to be reduced to a concentration of 25 mg/L. Assuming the following data, design a dissolved air flotation system.<br>Surface loading rate (SLR) = 130 L/$m^2$-min; Wastewater temperature = 35℃; Air solubility at 35℃ ($S_a$`) = 17.15 ml/L; A/S = 0.025 (mL/mg); Fraction of air saturation (f) = 0.80 and Recycle system pressure = 500 kPa. | **04** |
| | **(c)** | Determine the size, dimensions and HRT of a UASB reactor which will be used for the treatment of an industrial effluent. The wastewater is mainly soluble, containing carbohydrate compounds and a granular sludge is expected. Suppose 90% soluble COD removal, 50% of the influent pCOD degraded and 90% of influent sulfate is reduced biologically. Methane production at 35°C = 0.40 L $CH_4$/g COD; Reactor volume effectiveness factor = 85%, density of methane at 30°C = 0.6451 g/L and height for gas collection = 2.5 m. Also determine total gas production (assuming 65% methane), energy available from methane and alkalinity requirements. | **07** |

| Item | Value |
|---|---|
| Flow Rate | 1000 $m^3$/day |
| COD | 2300 mg/L |
| sCOD | 2000 mg/L |
| Alkalinity | 500 mg/L as $CaCo_3$ |
| $SO_4$ | 200 mg/L |
| Temperature | 30°C |

| | | | |
|---|---|---|---|
| **Q.2** | **(a)** | Differentiate between domestic wastewater and industrial wastewater. | **03** |
| | **(b)** | Design a cylindrical flash mixing tank by determining the tank dimensions and required input power using following data: Design flow rate = 11.5 x $10^3$ $m^3$/d, Rapid Mix time= 5 s, Rapid mix G =600 $s^{-1}$ and μ = 1.5195 x $10^{-3}$ N/$m^2$.s.. | **04** |
| | **(c)** | Design a grit chamber having a rectangular cross-section and a proportional weir as the velocity control device, with the following supplied data:<br>Maximum flow = 12 MLD; Maximum temperature = 26°C; Minimum temperature = 15°C; Specific gravity of grit particles = 2.65 and Diameter of smallest grit particles to be removed = 0.02 cm. | **07** |
| | | **OR** | |
| | **(c)** | Assuming suitable design criteria, compute the dimensions of a rectangular settling tank to remove suspended flocculent particles from the average wastewater flow of 15000 $m^3$/d. A column test indicates that an overflow rate of 40 m/d will produce satisfactory removal of suspended floc at 3.5 m depth. | **07** |
| **Q.3** | **(a)** | Write down operational problems of UASB. | **03** |



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**(b)** Design a bio-tower system to treat a wastewater flow of 10 MLD having settled $BOD_5$ = 175 mg/L & to be operated at 25°C. The depth of modular plastic media to be used is 6.0 m & recirculation ratio will be 2:1. The treatability constant determined at 20°C = 0.06 $min^{-1}$ & desirable concentration of effluent is 20 mg/L. **04**

**(c)** Assuming suitable design criteria, design a trickling filter system to treat an average domestic wastewater flow of 10 MLD having influent $BOD_5$ equal to 250 mg/L. The desired effluent $BOD_5$ is 25 mg/L or less. **07**

**OR**

**Q.3** **(a)** Write the Eckenfelder equations (with & without recirculation) for Bio tower design. **03**

**(b)** Enlist and Explain the operational problems of chemical unit operations. **04**

**(c)** Estimate the size of digester required to treat the sludge from a primary treatment plant designed to treat 38000 $m^3$/d of wastewater. Check the volumetric loading, estimate percent stabilization and the amount of gas produced. For wastewater to be treated, it has been found that the quantity of dry volatile solids and biodegradable COD removed is 0.15 Kg/$m^3$ and 0.14 Kg/$m^3$, respectively. Assume that the sludge contains about 95% moisture and has a specific gravity of 1.02. Assume hydraulic regime of the reactor is complete mix. (SRT =10 days @ 35°C; Efficiency of waste utilization =0.70; Y =0.08 Kg VSS/Kg bCOD utilized; $k_d$ = 0.03 $d^{-1}$ and digester gas is 65% methane) **07**

**Q.4** **(a)** Explain the factors responsible for bulking of sludge. **03**

**(b)** An activated sludge plant is to be designed for 10 MLD domestic wastewater flow to operate at 10 days MCRT and 6 hours of HRT. Assuming $BOD_5$ 20°C as 175 mg/L in influent to the aeration tank, sludge wasting flow equal to 70 $m^3$/d and return sludge concentration equal to 8000 mg/L, determine the concentration of MLVSS to be maintained in the aeration tank to achieve effluent $BOD_5$ of 30 mg/L. Also determine the recirculation ratio at which plant should be operated. Assume the kinetic coefficients $K_d$ = 0.06 $d^{-1}$ and Y = 0.6. **04**

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

**OR**

**Q.4** **(a)** Write a short note on extended aeration. **03**

**(b)** Explain the working mechanism of Rotating Biological Contractor with neat sketch. **04**

**(c)** Design a rotating biological contactor to treat 10 MLD flow of municipal wastewater having $BOD_5$ concentration of 250 mg/L. The primary treatment removes 30 % raw $BOD_5$ and desired effluent $BOD_5$ is 250 mg/L. Assume 0.05 $m^3/m^2$-d hydraulic loading and other suitable data if needed. **07**

**Q.5** **(a)** Enlist and explain the types of filter presses. **03**

**(b)** Explain various methods of dewatering of sludge. **04**

**(c)** Design sludge drying beds to dewater the digested sludge produced from wastewater treatment plant based on the activated sludge process designed for 50000 population. Assume other suitable data. **07**

**OR**

**Q.5** **(a)** Define the following terms: (i) Sludge volume index, (ii) Mean cell residence time and (iii) Mixed liquor suspended solids **03**

**(b)** Explain various methods of thickening of sludge. **04**

**(c)** Write a short note on "Natural evaporation "as a treatment of wastewater. **07**

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