Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – SUMMER 2016

Subject Code: 2163509 **Date: 13/05/2016**

Subject Name: Liquid Effluent Treatment - II

Time: 10:30 am – 01:00 am **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 (a) Design a Tube Settler Module of a Square Cross section with the following data: **07**

1) Avg output required from settle = 6 MLD
2) Loss of water in desludging = 2% of output
3) Diameter of tube = 0.05 m
4) Angle of inclination = 60
5) Kinematic viscosity = 1.01 x 10^{-6} m^2/s
6) Critical settling velocity = 120 m/day
7) Length of tube = 1 m
8) C.S Sq area of tube = 0.05m x 0.05m

(b) Design a clarifier with a flow of 2 MLD with following data. **07**

1) HRT = 3 hrs.
2) Height of clarifier = 6
3) C-C distance between notches = 20 cm

Q.2 (a) 1) Trickling filter has a diameter of 20 m and a liquid depth of 2.5 m. Calculate the organic loading rate for an influent of 10.0 MLD having 220 mg/l of BOD. **04**

2) The cumulative flow of wastewater reaching at the end of time period to a treatment plant in a day varies as shown below. Determine the capacity of an equalization tank for the given flow variation. **03**

Time (h)	0	2	4	6	8	10	12	14	16	18	20	22	24
Cumulative Flow (m^3)	0	25	50	75	100	120	130	140	150	160	170	198	225

(b) Design two identical bar rack screens for a treatment plant handling the peak flow of 210 MLD. Assume the other conditions as follows: **07**

1) Velocity through screen at peak flow = 1.2 m/s
2) Clear spacing between the bars = 25 mm
3) Bar size = 10 mm x 50 mm
4) Angle of bars with inclination = 80
5) Peak factor = 2
6) Depth of flow in chamber = 1.1 m
7) K = 1.43
8) G = 9.8 m/s^2

OR

(b) Assuming suitable design criteria, design an aerated grit chamber for an average municipal wastewater flow of 10 MLD. Take peaking factor as 2.5 and 5 minutes as a detention time. **07**

1) Liquid Depth = 2.0 m
2) Width-Depth ratio = 1.5 : 1
3) Air supply rate = 0.3 m^3/min-m
4) Grit settling rate = 0.015 m^3/1000 m^3 of flow

Q.3 (a) Design an oil and grease trap to remove 160 mg/l of oil and grease from a flow of 50000 m^3/d of domestic wastewater. **07**

(b) Find the terminal settling velocity of the spherical particle with diameter 0.05 mm of specific gravity 2.65 settling through water having kinematic viscosity 1.004 x 10^{-6} m^2/s. **07**

OR

Q.3 (a) Enlist the different types of methods used to remove Amonical Nitrogen from the wastewater stream. Explain any one in detail. **07**

(b) For an activated sludge process system with recycle, calculate the MCRT for the given data. **07**

1) Daily average wastewater flow = 10 MLD
2) Effluent flow rate of wastewater = 9.92 MLD
3) Sludge wasting flow = 0.08 MLD
4) HRT = 6 hrs
5) Active biomass conc in the reactor = 3000 mg/l
6) Biomass conc in the effluent = 20 mg/l
7) Biomass conc in the return line = 9000 mg/l.

Q.4 (a) If BOD_5 of a sample measured at 20 ˚C is 250 mg/l and the reaction constant k is 0.35 d^{-1}, calculate the ultimate and the 3 day BOD at 20℃. **07**

(b) If 1 MLD flow of domestic wastewater with settled BOD_5 of 250 mg/l is treated in the convectional activated sludge plant reactor at 0.3 F/M ratio to obtain 85% of BOD removal efficiency, estimate the net surplus sludge produced per day. Assume Y = 0.6 & K_d = 0.06 d^{-1} **07**

OR

Q.4 (a) Assuming food to microbes ratio equal to 0.25 and hydraulic residence time of 6 hours, compute the value of MLVSS to be maintained in the reactor of a convectional activated sludge plant designed to treat 5 MLD settled wastewater with 200 mg/l of BOD_5. **07**

(b) 1) Assuming the diameter of the clarifier to be 20 m and the wastewater flow rate of 10 MLD. Calculate the detention time and surface loading rate of the clarifier having a wastewater depth of 2.5 m. **03**

2) For a circular diameter of 20 m diameter, determine the weir loading rate for a wastewater flow rate of 10 MLD. **03**

3) A floating sticks travels a distance of 15 m in 30 seconds in a reactor tank having 2 m width and 1.5 m depth. Determine the flow and flow through velocity. **01**

Q.5 (a) Enlist the different types of methods used to remove Biological Phosphorus from the wastewater stream. Explain any one in detail. **07**

(b) Define the following: 1) Surface overflow rate 2) Weir overflow rate 3) Detention time 4) Flow through velocity 5) Volumetric Loading rate 6) Endogenous decay constant 7) MCRT **07**

OR

Q.5 (a) Design a Primary settling tank to treat domestic wastewater flow of a town having 500000 population. **07**

1) Average rate of water supply = 250 lpcd
2) Wastewater generation rate = 80% of water supplied
3) Suspended solids in water = 250 mg/l
4) BOD_5 of wastewater = 200 mg/l
5) SLR = 40 m^3/m^2*day (at average flow), 100 m^3/m*day (at peak flow)
6) Detention time = 2 hr
7) Solids concentrations of sludge = 6 %

(b) Raw sewage with BOD of 220 mg/l is applied to a convectional sewage treatment plant based on activated sludge process. If the primary treatment units remove 25% of BOD, determine the MLVSS to be maintained in the reactor to control an F/M ratio of 0.6, assuming a wastewater flow rate of 0.5 MLD. **07**

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