Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII (NEW) - EXAMINATION – SUMMER 2018

Subject Code: 2183507 **Date: 04/05/2018**

Subject Name: Design of Treatment Plants

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.**

Q.1 **(a)** The catchment area is of 200 hectares. The surface cover in the catchment can be classified as given below. **07**

Type of cover	Coefficient of runoff	Percentage
Roofs	0.90	15
Pavements and Yards	0.80	15
Lawns and Gardens	0.15	25
Roads	0.40	20
Open grounds	0.10	15
Single family dwellings	0.50	10

Calculate the runoff coefficient and quantity of storm water runoff, if intensity of rainfall is 30mm/hr for rain with duration equal to time of concentration. If population density in the area is 350 person /hectare and rate of water supply is 200 LPCD, calculate design discharge for separate system, partially separate system and combined system.

(b) Explain philosophy of water quality between sources and sink for surface water sources. **07**

Q.2 **(a)** Determine the terminal settling velocity for a sand particle with an average diameter of 0.5 mm and a density of 2600 kg/m^{3}settling in water at 20^{0}C. Density and viscosity values are as ρw = 998 kg/m^3 , μ= 1.003 × 10^{-3} N.s/M^2 and Shape factor is ϕ = 0.85. **07**

(b) Design a continuous flow stir tank reactor (ASP) to treat 20 MLD domestic wastewater. BOD_5 of settled waste water to the reactor is 200mg/l and desired BOD of treated effluent is 30 mg/l. Assume that plat is operated at following conditions. **07**

1) Peak flow rate = 2.5 × daily average flow.
2) Influent biomass concentration , X0 = 0.0 mg/l
3) MLVSS in the reactor, X = 3500 mg/l
4) Recycled Sludge, Xr = 10000 mg/l
5) MLVSS is 80% of MLSS
6) Design Mean cell residence time , Θc =10d
7) Effluent contains 25 mg/l of biological solids of which 65% is biodegradable.
8) BOD_5 is 68% of UBOD
9) BOD rate constant K=0.1 per day, Y=0.5, Kd= 0.06d^{-1}

OR

(b) Write a note on different technique of scale up before commercial treatment plant inception. **07**

Q.3 **(a)** Using Rankin's equation, determine the treatment efficiency of a two stage trickling filter system designed for the following conditions. **07**

1) Average waste water flow, Q_0 = 1000 m^3/d
2) Concentration of applied BOD_5= 250 mg/l
3) Volume of first stage filter, V_1=800 m^3
4) Filter Depth, D = 2 m.

(b) Write a short note on Grit Chamber. **07**

OR

Q.3 **(a)** Waste water 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. Assume the following given data , design a dissolved air floatation system. **07**

Surface loading rate, SLR = 10 l/m^2 min.
Sludge Flow rate, Q = 0.6 m^3/min
Waste Water Temperature = 35^0C
Air Solubility at 35^0C, Sa' = 17.15 ml/L
Air to Solid ratio, A/S = 0.025 ml/mg
Fraction of air saturation, f = 0.80
Recycle system pressure = 500 kPa

(b) Write a short note on ZLD in Pharmaceutical Industry. **07**

Q.4 **(a)** Design a single effect evaporator for following design criteria. **07**

1) Total Number of Effects = 1
2) Feed Flow Rate = 2000 kg/hr
3) Caustic Soda Inlet Concentration = 0.25 mg/l
4) Caustic Soda Outlet Concentration = 0.3 mg/l
5) Steam Temperature= 100 C
6) Feed Temperature = 25 C
7) Temperature of product = 95 C
8) Assume Steam Economy, SE = 3.5
9) Latent Heat of steam at feed , λS = 539.92 Kcal/Kg
10) Latent Heat of Evaporate, λE= 546.22 Kcal/Kg
11) Specific heat of condensate, CC = 1.004 Kcal/Kg. C
12) Specific heat of Feed , CF = 0.95 Kcal/kg.C
13) Specific heat of product, CP= 0.91 Kcal/kg. C

(b) Explain Multieffect Evaporator and determine its rate equation and enthalpy equation for forward feed, three effects. **07**

OR

Q.4 **(a)** Assume suitable design criteria; design an aerated grit chamber for an average municipal waste water flow of 10 MLD. (Assuming the peaking factor as 2.5, depth of the tank 2 m, width to depth ratio of 1.5:1, air supply rate 0.3 m^3/min.m and assume that 0.015 m^3 of grit settles per 1000 $m^3$of flow.) **07**

(b) Explain factors affecting the water demand for sewage water treatment plant. **07**

Q.5 **(a)** Design an activated carbon Colum for sieve size of 0.9 mm of GAC. The liner velocity is 10m/hr, and pressure drop is 30 mbar, Pressure drop in disc is 3.5mbar for 30 mm disc size and factor of correction is 4.30 for original size of disc. **07**

(b) Explain mechanism of secondary clarifier. **07**

OR

Q.5 **(a)** Write a note on storm water. **07**

(b) Explain coagulation and flocculation. **07**

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