Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII • EXAMINATION – SUMMER • 2015

Subject Code: 181303 Date: 13/05/2015

Subject Name: Treatment Process Design & Drawing

Time: 10.30am-01.00pm 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)** Enlist the site selection criteria of a wastewater treatment facility. **07**

(b) Enlist and explain the different types of Aeration systems used for wastewater treatment. **07**

Q.2 **(a)** Design a Tube-settler module of square cross-section with the following data: **07**

1) Average output required from the settler = 6 MLD
2) Loss of water in desludging = 2% of output
3) Cross-sectional square area = 50 mm * 50 mm
4) Length of tube = 1 m
5) Angle of inclination = 60º

(b) Explain the following terms: **07**

(1) Hydraulic loading rate (2) Surface overflow rate (3) Weir loading rate (4) Scour velocity (5) Volumetric loading rate (6) Sludge volume index (7) Transmembrane pressure

OR

(b) Enlist the flow measuring devices. And explain any two in brief. **07**

Q.3 **(a)** Determine the clean water head loss in a filter bed of 0.75 m depth with a size distribution given below for a filtration rate of 160 L / m^2. min. Use Rose equation and assume sand has porosity of various layers as 0.4 and a shape factor of 0.85. Take viscosity as 1.003 * 10^{-6} m^2 / s. calculate the Head loss through the clean sand. **07**

Fraction of sand retained	Geometric mean size (d_g) mm
0.01	2.18
0.03	1.83
0.16	1.30
0.16	0.92
0.30	0.71
0.22	0.50
0.12	0.35

(b) 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 30 mg/L. Assume 0.05 m^3/m^2day hydraulic loading and other suitable data if needed. **07**

OR

Q.3 (a) Design a conventional activated sludge plant to treat 28000 m^3/day of settled sewage of BOD is 220 mg/L. the effluent BOD is 15 mg/L. F/M ratio is 0.22, MLSS is 3000 mg/L and SVI is 90. Determine volume of aeration basin, hydraulic retention time, volumetric loading rate, air requirements and diffused air-aeration design. **14**

Q.4 (a) Design a clariflocculator for the flow of 10 MLD. **14**

OR

Q.4 (a) For the flow rate and BOD concentration data given in the following table, determine (i) the inline storage volume required to equalize the flow rate and (ii) the effect of flow equalization on the BOD mass-loading rate: **14**

Time	Avg. flow, m^3/s	Avg. BOD conc. mg/L
M-1	0.275	150
1-2	0.220	115
2-3	0.165	75
3-4	0.130	50
4-5	0.105	45
5-6	0.100	60
6-7	0.120	90
7-8	0.205	130
8-9	0.355	175
9-10	0.410	200
10-11	0.425	215
11-N	0.430	220
N-1	0.425	220
1-2	0.405	210
2-3	0.385	200
3-4	0.350	190
4-5	0.325	180
5-6	0.325	170
6-7	0.330	175
7-8	0.365	210
8-9	0.400	280
9-10	0.400	305

Time	10-11	11-M	Avg.
Avg. flow, m^3/s	0.380	0.345	0.307
Avg. BOd conc., Mg/L	245	180	-

Q.5 (a) Design a bar rack (mechanically cleaned) for a peak flow 80MLD flow condition in incoming sewer is given by: **14**

1) Diameter of sewer = 1.53 m
2) Depth of flow at peak flow = 1 m, d_1= 1 m
3) Velocity at peak design flow = 0.8 m/s
4) Drop to screen chamber flow with respect to sewer invert is 0.08 m, z_1=0.08 m

OR

Q.5 (a) Design a cyclone with following particle size distribution: **14**

% Passing	Avg. d_p (µm)	Mass % fraction (m_i)
>75	50	0.25
55-75	19	0.20
40-55	11.5	0.15
30-40	7.8	0.10
25-30	5.5	0.05
20-25	5.0	0.05
15-20	4.1	0.05
10-15	3.2	0.05
5-10	2.3	0.05
<5	1.3	0.05

Assume the following:

Density of particle = 1500 kg/m^3 Flow rate = 93690 m^3/hr

Temperature of gas = 100º C Viscosity of gas = 2.1 *10^{-5} kg/m.s

Density of gas = 0.9466 kg/m^3 Diameter of particle = 12 µm

Dust loading = 600 g/s

Calculate pressure drop and efficiency of the cyclone.

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