Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. - SEMESTER – VI • EXAMINATION – WINTER 2012

Subject code: 161304 **Date: 05/01/2013**

Subject Name: Biological Process for Wastewater Treatment

Time: 02.30 pm - 05.00 pm **Total Marks: 70**

Instructions:

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

Q.1 **(a)** In determining the BOD_5 of a sample, an analyst added 2, 5 and 10 mL of sample to three different 300-mL BOD bottles and filled them with seeded dilution water. The analyst also prepared three blank bottles with the same dilution water and incubated the set at 20°C for 5 days. Dissolved-oxygen (DO) measurements were made on the samples before and after with the following results. **07**

Sample size in bottle, mL	Initial DO, mg/L	Final DO, mg/L
2	8.1	5.6
5	8.0	1.7
10	8.1	0.0
Blank average	8.2	8.0

What is BOD_5 for the sample?

(b) Explain oxidation ditch in detail. **07**

Q.2 **(a)** An anaerobic reactor, operated at 35°C, processes a wastewater stream with a flow of 3000 m^3/d and a bsCOD concentration of 5000 g/m^3. At 95 percent bsCOD removal and a net biomass synthesis yield of 0.04 g VSS/g COD used, what is the amount of methane produced in m^3/d? **07**

(b) A sample of wastewater was incubated for 7 days at 20°C and BOD results is 490 mg/L. BOD rate constant K = 0.1 day^{-1}. Calculate (i) 5 – day BOD (ii) 10 – day BOD and (iii) Ultimate BOD. **07**

OR

(b) Explain biochemistry of carbohydrates. **07**

Q.3 **(a)** Enlist and explain the basic steps involved in the overall anaerobic oxidation of a waste. **07**

(b) Explain with a neat block diagram municipal wastewater treatment plant. **07**

OR

Q.3 **(a)** Define: Mean Cell Residence Time (MCRT), Rate of oxygen uptake, Maximum substrate utilization rate. **06**

(b) Determine the values of bio-kinetic constants (K, *K*s, Y, K_d and μ_{max}) using the data in the following table, derived from the laboratory experiments **08**

carried out on the CFSTR model of an activated sludge process with recycle.

Model No.	Influent substrate conc., S_0 mg/L	Reactor substrate conc., S mg/L	MCRT, Θ_c, days	Reactor biomass conc., X mg/L	Detention time (HRT) Θ, days
1	350	08	7.0	3900	0.18
2	350	12	4.5	2050	0.18
3	350	18	3.0	2850	0.18
4	350	48	1.6	1025	0.18
5	350	98	1.2	650	0.18

Q.4 **(a)** Explain in detail: Oxygenation and mixing requirement for aerator **07**

(b) Explain role of microorganisms in wastewater treatment. **07**

OR

Q.4 **(a)** Enlist various anaerobic digesters used for sludge digestion and explain any one in detail. **07**

Q.4 **(b)** Compute the mean cell residence time, recirculation ratio, and volume of a reactor from the following data to design a conventional activated sludge process. Compare the recirculation ratio if the effluent biomass concentration of 15 mg/L is considered in the mass balance analysis. **07**

Given data:

- Daily average wastewater flow, Q_{avg} = 20 MLD
- Sludge wasting flow, Q_w = 140 m^3/d
- Biomass concentration in reactor, X = 4000 mg/L
- Returned sludge concentration, X_r = 10000 mg/L
- Hydraulic retention time, Θ = 4 hours

Q.5 **(a)** Write a short note on systems with packaged (pre-engineered) treatment plants. **07**

(b) Discuss the fundamental considerations in the application of natural treatment systems. **07**

OR

Q.5 **(a)** Explain wastewater collection system for small communities. **07**

(b) Write a short note on constructed wetlands. **07**

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