

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 BOD₅ 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 BOD₅ 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 m³/d and a bsCOD concentration of 5000 g/m³. 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 m³/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 $K = 0.1 \text{ day}^{-1}$. 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 $\mu_{\max}$) 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, $Q_w = 140$ m³/d
- Biomass concentration in reactor, $X = 4000$ mg/L
- Returned sludge concentration, $X_r = 10000$ mg/L
- Hydraulic retention time, $\theta = 4$ 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**
