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Manipal Institute of Technology, Manipal

(A constituent Institute of Manipal University)

SECOND SEMESTER M.Tech. (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATION-MAY 2016

SUBJECT: INDUSTRIAL WASTE WATER ENGIEERING (CHE 530)

Time: 3 Hours **Max. Marks: 100**

Instructions to candidates:

- **Answer any FIVE FULL questions.**
- **Missing data, if any, may be suitably assumed**

1A	Explain the physical, chemical and biological characteristics of wastewater. Also discuss how these characteristics decide the treatment process to be implemented	10
1B	Categorize different types of anaerobic reactors used in industrial effluent treatment plants	10
2A	How would you justify the selection of an anaerobic reactor over an aerobic reactor for treating wastewater having high organic content	10
2B	Illustrate the working of an aerobic trickling filter with a neat sketch	10
3A	An industry produces 4000 m3 of wastewater every day having BOD value 140 mg/l, sBOD 90 mg/l and TSS 70 mg/l. It is expected to produce an effluent BOD value 20 mg/l, sBOD 8 mg/l and TSS 20 mg/l. Design a Rotating Biological Contactor for BOD removal only. The following data apply:- Hydraulic loading 0.08-0.16 $m^3/m^2.d$ Organic loading 4-10 g sBOD/m^2.d 8-20 g BOD/m^2.d Maximum 1st stage 12-15 g sBOD/m^2.d Organic loading 24-30 g BOD/m^2.d Hydraulic retention 0.7-1.5 h	20

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4A	Discuss the importance of primary treatment in wastewater treatment	8
4B	For an up-flow anaerobic sludge blanket treatment process treating an industrial wastewater determine a. Size and dimensions of the reactor b. Hydraulic retention time c. Methane gas production d. Energy available from biogas For 90% sCOD removal and 50% ssCOD and VSS removal The following data apply: Flow rate = 1300 m^3/d COD = 2350 mg/l sCOD = 1900 mg/l Volumetric Organic loading on sludge blanket = 0.3 – 10 kg COD / m^3.day Inlet points = minimum 1 point per 3.7 – 4 m^2 floor area Up-flow velocity = 0.5 – 1.2 m/h Gas production = 0.1-0.4 m^3 per kg COD removed Gas utilization = 1 m3 biogas with 75% methane content is equivalent to 1.4 kWh electricity	12
5A	Describe any tertiary treatment for wastewater in detail	10
5B	Determine the amount of benzene that can be stripped in a complete mix activated sludge reactor equipped with diffused air aeration system. The following data apply Waste water flow rate = 4000 m^3/d Aeration tank volume = 900 m^3 Depth of tank = 5.5 m Air flow rate = 50 m^3/min K_{LaO2} = 6.2 h^{-1}	10

	Benzene influent concentration = 100 $\mu g/m^3$ $H = 0.00549\ m^3.atm/mol$ n=1 Temperature = 20 ^oC $D_{O2} = 2.11 \times 10^{-5}\ cm^2/s$ $D_{Benzene} = 9.6 \times 10^{-6}\ cm^2/s$	
6A	Discuss the bacterial growth pattern in a batch reactor mentioning the importance of Monod equation	10
6B	Briefly explain 1. sequential batch reactor 2. contact stabilization process for aerobic treatment.	10