Reg.No.										

MANIPAL UNIVERSITY

Seventh Semester B.Tech. (Chemical Engineering)
END SEMESTER EXAMINATION – Nov/Dec 2015
Elective (II): INDUSTRIAL WASTEWATER ENGINEERING (CHE 427)

Time : 3 hrs **Max Marks: 100**

- **Answer any FIVE full questions and all questions carry equal marks.**
- **Missing data, if any, may be assumed suitably.**

1A	A mechanically cleaned bar screen has bars of 8 mm thick and 30 mm clear spaces between the bars. If the flow rate is 0.20 m^3/s, velocity through the bars is 0.90 m/s, determine the approach velocity, head loss through the screen and effective cross-sectional area.	**(7 marks)**
1B	Explain the physical, chemical and biological characteristics of wastewater	**(5 marks)**
1C.	Just below the point where a continuous discharge of pollution mixes with a river, the BOD is 10.9 mg/l and DO is 7.6 mg/l. The river and waste mixture has a temperature of 20°C, a deoxygenation constant of 0.20 day-1, an average flow speed of 0.30 m/s and an average depth of 3.0 m. (i) Find the time and distance downstream at which the oxygen deficit is a maximum (ii) Find the minimum value of DO	**(8 marks)**
2A.	An Activated sludge process system is to be designed to treat a wastewater flow of 5 m^3/min. BOD_5 of settled wastewater is 200 mg/l, net effluent BOD_5 of 30 mg/l and suspended solid of 30 mg/l. Assume Y = 0.65, θ_c = 10 days. Find (i) the reactor volume (ii)Quantity of sludge that must be wasted each day (iii)Sludge wasting rate (iv) F/M ratio.	**(8 marks)**
2B.	Design a biodisc (Rotating biological contactor) for 600 persons to remove 90% of the BOD of 170 mg/l at the rate of 160 lpcd. Assume loading rate as 10 gm /m^3.day and volume of the tank as 40 m^3. Make the necessary check for the efficiency using K_a as 2.3.	**(8 marks)**
2C.	Explain the following terminologies: (i)Organic loading (ii) Biological solids retention time	**(4 marks)**
3A.	What are the major problems encountered in ASP systems?	**(6 marks)**
3B.	Design a stabilization pond for the following: Population = 5000 BOD_5 = 54 g/capita/day Wastewater production= 200lpcd Minimum and maximum solar radiation = 110 Langley and 225 Langley Sky Clearance Factor = 85% Conversion efficiency = 6% Energy required for algae = 6 kcal/gm	**(10 marks)**

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<tr><td>3C.</td><td>Show with a flow diagram the combined process of secondary treatment with contact filtration, carbon adsorption and reverse osmosis.</td><td>(4 marks)</td></tr>
<tr><td>4A.</td><td>A municipal wastewater having a BOD of 250 g/m^3 is to be treated by a two stage trickling filter.The desired effluent quality is 25 g/m^3 of BOD. If both of the filter depth are to be 1.83 m and the recirculation ratio is 2:1.Find the required trickling filter diameter. Data are given below:
Flow rate = 7570 m^3/day, Wastewater temperature = 20°C and $E_1 = E_2$</td><td>(10 marks)</td></tr>
<tr><td>4B.</td><td>Design a facultative aerated lagoon to serve 20000 persons with 50 gm/capita/day of BOD, Effluent BOD = 30 mg/l. Assume k_a at 20°C as 1 day^{-1} and design temperature of 25°C. Calculate number of aerators at a capacity of 1.75 kg of O_2/hr/HP with an efficiency of 75%.</td><td>(10 marks)</td></tr>
<tr><td>5A.</td><td>What are the important operating parameters of anaerobic digestion process and explain them?</td><td>(8 marks)</td></tr>
<tr><td>5B.</td><td>Explain Anaerobic Contact process and UASB with a neat flow diagram?</td><td>(12 marks)</td></tr>
<tr><td>6A.</td><td>Determine the liquid volume before and after digestion and the percentage reduction for 300 kg on dry basis of primary sludge with the following characteristics:
<table>
<tr><td></td><td>Primary sludge</td><td>Secondary/Digested sludge</td></tr>
<tr><td>% of solids</td><td>5</td><td>10</td></tr>
<tr><td>Volatile matter(%)</td><td>50</td><td>60</td></tr>
<tr><td>Specific gravity of fixed solids</td><td>2.5</td><td>2.5</td></tr>
<tr><td>Specific gravity of volatile solids</td><td>1.0</td><td>1.0</td></tr>
</table></td><td>(8 marks)</td></tr>
<tr><td>6B.</td><td>Explain the recent developments in membrane filtration and Reverse Osmosis.</td><td>(12 marks)</td></tr>
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