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MANIPAL UNIVERSITY Second Semester M.Tech. (IPC) END SEMESTER EXAMINATION – Nov/Dec 2015 SUBJECT: INDUSTRIAL WASTEWATER ENGINEERING (CHE 557)



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)		
1R	Explain the physical chamical and biological characteristics of wastewater			
1D 1C	Lust below the point where a continuous discharge of pollution mixes with a			
10.	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			
	Find the minimum value of DO			
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, $\theta_c = 10$ 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	(8 marks)		
	$10 \text{ gm}/\text{m}^3$.day and volume of the tank as 40 m^3 . Make the necessary check			
	for the efficiency using K_a as 2.3.			
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:			
	$POD_{i} = 54 g/conite/day$			
	$BOD_5 = 54 \text{ g/capita/day}$			
	Minimum and maximum solar radiation -110 I angley and 225 I angley	(10 marks)		
	Sky Clearance Factor = 85%	(10 mar 15)		
	Conversion efficiency = 6%			
	Energy required for algae = 6 kcal/gm			

3C.	Show with a flow diagram the combined process of secondary treatment					
	with contact filtration, carbon adsorption and reverse osmosis.					
4A.	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 $E_1 = E_2$					
4B.	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%.					
5A.	What are the important operating parameters of anaerobic digestion process					
	and explain them?					
5B.	Explain Anaerobic Contact process and UASB with a neat flow diagram?					
6A.	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:					
		Primary sludge	Secondary/Digested			
			sludge			
	% of solids	5	10			
	Volatile matter(%)	50	60			
	Specific gravity of	2.5	2.5			
	fixed solids					
	Specific gravity of	1.0	1.0	(8 marks)		
	volatile solids					
6B.	Explain the recent developments in membrane filtration and carbon					
	adsorption in detail.					