

MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

(A constituent unit of MAHE, Manipal)

## VII SEMESTER B.TECH. (CHEMICAL ENGINEERING) END SEMESTER EXAMINATIONS, MARCH 2021

SUBJECT: PE – VI : INDUSTRIAL WASTEWATER ENGINEERING

## [CHE 4006] REVISED CREDIT SYSTEM

Date : 26/03/2021

Time : 9.00 AM- 12.00 PM

MAX. MARKS: 50

## **Instructions to Candidates:**

✤ Answer ALL the questions.

✤ Missing data may be suitably assumed.

1A	The wastewater has a BOD <sub>5</sub> equal to 180 mg/l and a reaction rate k equal to 0.22/day. It also has a Total Kjeldahl Nitrogen content (TKN) of 30 mg/l.										
	(ii)Find the ultimate nitrogenous oxygen demand (NBOD) (iii)Find the remaining BOD after 5 days have elapsed.										(3 marks)
1 <b>B</b> .	Describe the levels of wastewater treatment and classify the treatment process according to the level of advancement										(3 marks)
	Explain the following terminologies:										
1C.	(1)Hydraulic retention time (11)Flow through velocity (11)Solid retention time (iv)Settling velocity								(4 marks)		
2A.	A conventional activated sludge process plant is in operation with a $\theta_c$ of 10 days. Reactor volume = 8000 m <sup>3</sup> , MLSS = 3000 mg/l. Determine (i)Sludge production rate (ii)Sludge wastage flow rate when wasting from the reactor (iii)Sludge wastage flow rate when wasting from the recycle line. Assume concentration of suspended solids in the recycle line as 10000 mg/l								(5 marks)		
2B.	Estimate the dispersion number D/u.L for a small tertiary pond for 2.2 days theoretical detention time for which the tracer test results are given below for a										
	period of 9 hrs.										
	Time (hr)	1	2	3	4	5	6	7	8	9	
	Conc (mg/l)	43	43.5	45	46.5	48	51	47	46	45.4	(5 marks)
	Use both variance method and peak time technique										

3A.	Explain the major problems in ASP treatment systems							
3B.	Design a Trickling filter using an empirical method of US Tenstate standards for the following data. Calculate the corresponding value of $k_{f}$ in Eckenfelder equation. Data given are Sewage flow = 5000 m <sup>3</sup> /day, Raw BOD <sub>5</sub> = 200 mg/l, Efficiency = 85%, n = 0.5, Depth = 1.8 m. Assume FLR as 1.2 kg BOD/m <sup>3</sup> .day							
3C.	Design an extended aeration lagoon to operate as Inter-Air system serving 4000 persons using appropriate parameters. Assume $BOD_5 = 50$ g/person.day and average flow of Q = 150 l/person.day. Neglect nitrification and denitrification. Take F/M ratio as 0.1 kg BOD <sub>5</sub> /kg MLSS							
4A.	Explain any two types of high rate anaerobic reactors with a neat flow diagram							
<b>4B.</b>	What is sludge digestion? Explain the principal methods of processing and disposal of sludge.							
4C.	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	<i>.</i>			
		% of solids	5	10	(4 marks)			
		Volatile matter (%)	50	60				
		Specific gravity of fixed solids	2.5	2.5				
		Specific gravity of volatile solids	1.0	1.0				
5A.	Explain the disinfection process for wastewater treatment and compare the advantages and disadvantages of using chlorine, ozone and UV for wastewater disinfection.							
5B	Explain the recent developments in membrane filtration and Reverse Osmosis.							