Reg. No.



## Manipal Institute of Technology,





(A Constituent Institute of Manipal University)

## IISEMESTER M.TECH (INDUSTRIAL BIOTECHNOLOGY) END SEMESTER EXAMINATIONS, MAY 2016 (REGULAR)

## BIO532- DESIGN AND DEVELOPMENT OF BIOLOGICAL TREATMENT PROCESSES

Time: 3 Hours

MAX. MARKS: 50

## **Instructions to Candidates:**

- ✤ Answer ANY FIVE FULL the questions.
- Missing data may be suitable assumed.

1A.	Write on the significance of Food to Microorganism(F/M) ratio during the Biological treatment of Industrial Waste water	2
1B.	Describe the Biological waste water treatment processes that use (i) Conventional Plug flow with step feed (ii) Contact stabilization	4
1C.	Write on the Orbal Process that is used for biological treatment of waste Water. Write any advantages of this process	4
2A.	You are asked to design the separate stage for denitrification process with completely mixed reactor behavior. The denitrifying bacteria has the following growth constants. Data for Denitrifying bacteria: $\mu_m=0.25d^{-1}$ , $K_d=0.04~d^{-1}$ , $Y=0.2$ , $K_{Dn}=0.4~mg/l$ , Influent The substrate concentration (NO <sub>3</sub> <sup>-</sup> N)=39 mg/l, Effluent Substrate concentration (NO <sub>3</sub> <sup>-</sup> N)=1 mg/l, Influent flow rate=12918 m <sup>3</sup> /d Calculate (i) Cell Residence time ( $\theta_C$ ) (ii) Hydraulic Residence time ( $\theta$ ) (iii) Amount of sludge discarded.	6
2B.	Estimate the time required for a 99.9 % kill for a chlorine dosage of 0.05 mg/l at a temperature of 20 °C and pH of 8.5, using Chick and Watson equation. The coefficients in the Chick and Watson equations are obtained from the batch reactor data obtained at 5 °C and are as follows. Die-off constant =10.48 Activation Energy E=26,800 J/mole Coefficient of dilution=1.28 R=8.3144 J/mole.K	4
3A.	Design the Sequential Batch Reactor (SBR) system to achieve both BOD removal and nitrification. The following data is available:	
	Influent BOD (soluble)=150 mg/l, Q=7500 m <sup>3</sup> /d, X=3500 mg/l, Xs=10,000 mg/l (sludge), Effluent BOD=10 mg/l For Nitrifies: $\mu_m^N$ =0.44 d <sup>-1</sup> , K <sub>N</sub> =0.5 mg N/l, Y <sub>N</sub> =0.12, K <sub>dN</sub> =0.05 d <sup>-1</sup>	10

	For Heterotrophs: $\mu_m$ =2.5 d <sup>-1</sup> , K <sub>s</sub> =50 mg BOD/l, Y=0.5, K <sub>d</sub> =0.05 d <sup>-1</sup>	
	Determine:	
	(i) Surface are of each SBR	
	(ii) Cell residence time	
	(iii) reaction time for nitrification and BOD removal process (3+4+3)	
4A.	A food processing wastewater rich in proteins and fats is degraded anaerobically. Draw and explain steps involved through a schematic diagram.	3
	The following BOD results were obtained on an untreated water sample at $20^{\circ}$ C. Determine UBOD and k by least square method and by Thomas method.	
4B.	time, 0 1 2 3 4 5 6 7 8 9 10   t, d	7
	BOD, mg/L   0   65   109   138   158   178   190   200   205   210   212	
5A	Using a schematic diagram, make an energy and mass balance for anaerobic degradation of glucose. Take basis as 400g.	3
	Calculate the theoretical biogas yield $(Nm^{3}/ton of wet waste)$ , methane $(Nm^{3}/ton of wet waste)$ and the composition of the biogas (% methane and % CO <sub>2</sub> ) for the following wastewater feed. Coefficient of Buswell equation for CO <sub>2</sub> is $1/8(4c-h+2o+3n+2s)$	
	Wet waste weight 1000kg	4
5B	Total Solids (TS)33% Wet wasteweight	4
	Volatile Solids 90% TS	
	(biodegradable)	
	solids	
5C	It was found that drinking water in a certain village was found to contain excessive amounts of fluorides. Describe all the steps involved in the Risk assessment and risk management.	3
6A	Using a flow diagram, explain the interrelationship between the various types of solids found in wastewater	2
6B	Compare the following nitrogen removal processes from the perspective of O <sub>2</sub> needed (g- O <sub>2</sub> /N), COD needed with and without assimilation (g-COD/N) and all other relevant factors. Provide relevant equations. (i) Nitrification-Dentrification (ii) Nitritation-Dentitritation	4
	(iii) Partial Nitritation-Annamox (iv) OLAND	
6C	Discuss the challenges for UASB operation with regard to startup and granulation	2
6D	It is desired to treat UASB effluent by SBR process. What are the salient features of the process?	2