MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
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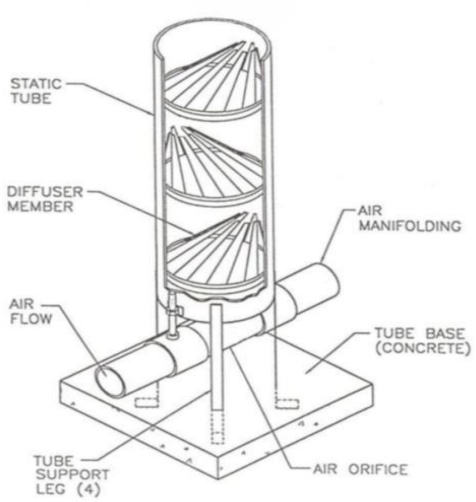
DEPARTMENT OF BIOTECHNOLOGY
II SEMESTER M.TECH. INDUSTRIAL BIOTECHNOLOGY
END SEMESTER EXAMINATIONS, MAY 2024
SUBJECT: ENVIRONMENTAL BIOTECHNOLOGY [BIO5212]

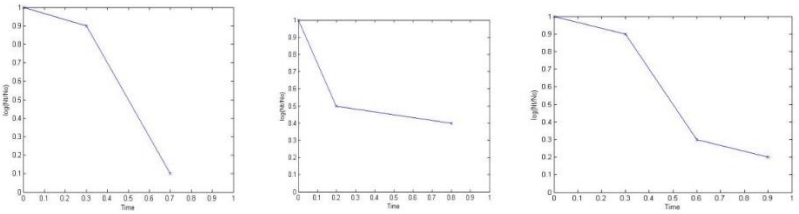
Time: 3 Hours **MAX. MARKS: 50**

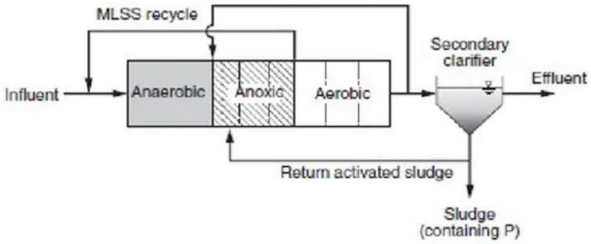
Instructions to Candidates:

- Answer **ALL** the questions.
- Any data not provided may be suitably assumed.

Q. No	Question	M	CO	PO	BL
1A	A primary effluent has an expected BOD_5 of 280±150 mg/L. Determine the number of tests and the volume of sample, seeded dilution water and unseeded dilution water that would be required for each test to measure BOD_5 of the sample. $\mathbf{BOD}, \frac{\mathbf{mg}}{\mathbf{L}} = \frac{(\mathbf{D_1}-\mathbf{D_2})-(\mathbf{B_1}-\mathbf{B_2})\mathbf{f}}{\mathbf{P}}$ $(\boldsymbol{seeded})$; $= \frac{(\mathbf{D_1}-\mathbf{D_2})}{\mathbf{P}}$ $(\boldsymbol{unseeded})$; D1 and D2 are DO of diluted sample immediately after preparation and after incubation resp, mg/L, B1 and B2 are DO of seed control before and after incubation f and P are fraction of seeded dilution water to seeded dilution in seed control and fraction of wastewater sample to total combined volume, respectively.	3	1	1,2,3	3
1B	A wastewater sample is diluted by a factor of 10 using seeded dilution water. Time, d / Diluted sample, DO mg/L / Seeded sample, DO mg/L 0 / 8.65 / 8.75 1 / 5.35 / 8.60 2 / 5.12 / 8.56 3 / 4.45 / 8.50 4 / 3.75 / 8.48 5 / 2.80 / 8.44 6 / 2.2 / 8.37 determine the k and UBOD by Fujimoto method.	5	1	1,2,3	3

1C	For the wastewater feed to the treatment plant (Hostel) visited, comment on the following i. sBOD ii. sCOD iii. pCOD iv. rbCOD v. N-BOD	**2**	**1**	1,2,3	**3**
2A	Explain the working, features, advantages and disadvantages of the following type of static tube aerator used in an activated sludge process.  	**3**	**2**	1,2,3	**3**
2B	Fertilizer urea is applied on the surface of agricultural field and also by burying deep inside the agricultural soil. Discuss the fate of applied nitrogen in both the cases, in detail. Consider water flows, O_2 availability, and soil characteristics in the analysis	**4**	**2**	1,2,3	**4**
2C	How does the mass transfer to biofilm and the process operation alter in RBC (Rotating Biological Contactor) if i. RPM of the disks are varied ii. Direction of rotation is frequently reversed	**3**	**2**	1,2,3	**4**
3A	Composting process for degradation of wet sludge consists of mixing bulking agents such as saw dust, rice husk etc. with sludge and aerobically degrading the mixture. Explain what factors control the degradation of the sludge.	**2**	**3**	1,2,3	**3**

3B	The following three types of departures from Chick's law are observed as given below in the figures. i ii iii  Y axis represents fitted values of log (N_t/N_o) and X axis represents time, where N_t = number of organisms at time t, N_0 = Number of organisms at time 0. Explain the reasons for the observed differences.	**3**	**3**	1,2,3	**4**
3C	Calculate the theoretical composition of biogas formed from wastewater whose elemental composition of sludge (weight %) has 55% (C) 10%(H), 30%(O), 4% (N) and 1%(S). Coefficients of CO_2 and CH_4 in the Buswell equation are 1/8(4c-h+2o+3n+2s) and 1/8(4c+h-2o-3n-2s) resp. Estimate the volume of CH_4 formed in Nm^3 from 100 kg of this waste, assume 80% biodegradation.	**5**	**3**	1,2,3	**3**
4A	A complete-mix activated sludge process (CMAS) is to be designed to treat 19,000 m^3/d of raw wastewater having a BOD5 of 200 mg/L. The regulation permit requires that the effluent BOD 5 and TSS concentrations should be 20 mg/L or less on an annual average basis. The following biokinetic coefficients obtained at 20ºC will be used in designing the process: Y = 0.6 mg VSS/mg BOD5, k = 4 d^{-1}, Ks = 50 mg/L BOD5 , and k_d = 0.05 d^{-1} . Assume that the MLVSS concentration in the aeration basin is maintained at 2800 mg/L and the VSS:TSS ratio is 0.70. The temperature of the wastewater during the winter months is expected to remain at 17ºC for extended periods. During the summer, the wastewater temperature may reach 28ºC for several weeks. Determine the following: a) Effluent soluble BOD5 (sBOD5) concentration in mg/L necessary to meet the effluent total BOD5 (TBOD5) requirement of 20 mg/L. b) Mean cell residence time MCRT (in d) necessary to meet the regulatory permit during the winter months. c) Volume of the aeration basin in cubic meters. d) Mean cell residence time (d) necessary to meet the regulatory permit during the summer months. e) Oxygen requirements (kg/d) assuming complete nitrification during the summer months and a TKN_0 = 30 mg/L. Data: $k_2 = k_1\theta^{T_2-T_1}$; θ=1.07;$\frac{dS}{dt} = \frac{kXS_e}{K_s+S_e}$; $\frac{1}{\theta_c} = Y\left(\frac{kS_e}{K_S+S_e}\right) - k_d$; $V = \frac{YQ(S_i-S_e)\theta_c}{(1+k_d\theta_c)X}$; $S_e = \frac{K_s(1+k_d\theta_c)}{\theta_c(Yk-k_d)-1}$;$X = \frac{Y(S_i-S_e)\theta_c}{(1+k_d\theta_c)\theta}$; O_2 requirement $= Q(S_i - S_0)(1 - 1.42Y) + 1.42k_dXV + Q(TKN_0)4.57$	**5**	**4**	1,2,3	**3**

4B	The following is called VIP (Virginia Initiative Plant) process for the removal of nutrients. Explain the salient features, advantages disadvantages of the process from your knowledge.  	**3**	**4**	1,2,3	**3**
4C	What is Phytoremediation? What are its features, advantages and disadvantages?	**2**	**5**	1,2,3	**3**
5A	List and explain all the six important factors of design considerations for UASB reactor.	**4**	**5**	1,2,3	**3**
5B	What is breakpoint chlorination? Compare the breakpoint chlorination in the case of (i) fish wastewater (ii) distillery wastewater	**3**	**5**	1,2,3	**3**
5C	Dairy wastewater is subjected to anaerobic degradation. With the help of flow diagram, if required, explain the microbiology.	**3**	**5**	**1,2,3**	**3**