

M.E. CHEMICAL ENGINEERING FIRST YEAR SECOND SEMESTER – 2025, 1st Year, 2nd Semester

POLLUTION CONTROL AND SAFETY IN PROCESS INDUSTRIES

Answer any Four Questions

Full marks –100

1. i. An activated sludge plant is designed to reduce 90% of influent BOD of 250 mg/L. Compute (a) net sludge (solids) produced per day, (b) mean cell residence time, (c) hydraulic retention time and (d) the F/M ratio for the annual design data given below:
 Wastewater flow: 2 MLD, Volume of aeration tank: 500 m³, MLVSS in aeration tank: 2500 mg/L, Kinetic coefficients: $Y=0.5$, $K_d 0.08 \text{ d}^{-1}$.
 $U = K_d/Y = K S$, where U = specific substrate utilization rate, K =specific substrate utilization rate, K_d = decay coefficient, Y is true yield coefficient 20
- ii. Briefly describe Screen chambers and its application in wastewater treatment. 5
2. i) Briefly describe sanitary landfill 5
 - ii) Assuming the food to micro-organism ratio equal to 0.22 and hydraulic residence time (Volume/wastewater flow) of 5 hours, compute a) volume of reactor, b) the value of MLVSS (mg/L) to be maintained in the reactor of a conventional activated sludge plant designed to treat 4 MLD settled wastewater with 180 mg/L of BOD₅ 10
 - iii) Determine the amount of methane produced from 1 kg of BOD_L stabilized. Assume that the BOD contribution is due to glucose 5
 - iv) Briefly describe fault tree and event tree analysis of fire in a plant. 5
3. i) Briefly describe Bag Filters and its application in air pollution controlling. 6
 - ii) Design a conventional activated sludge plant to treat 20000 kl/d of settled sewage of BOD is 200 mg/l. The effluent BOD is 20 mg/l. F/M ratio is 0.22, MLSS is 3000 mg/l. Adopt diffusion aeration system $SVI = 90$. Air required is 100 m³/d/kg of BOD removed. Standard diffusion plates of 0.3 m x 0.3 m x 25 mm and pore size is 0.3 mm. 12
 - iii) Define hazard and types of hazard in process Industries 4
 - iv) Define BOD and COD 3
4. i) Briefly describe anaerobic Upflow Blanket reactor. 5

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ii) Determine the values of bio-kinetic constant using the data given in table derived from the laboratory experiments carried out on the CFSTR model of an activated sludge process without recycle. 20

Table:

Sl No	Influent substrate conc, (mg/L)	Reactor substrate concentration, (mg/L)	Detention time, Days	Reactor biomass concentration (mg/L)
1	300	12	3.8	132
2	300	20	2.6	130
3	300	34	1.6	132
4	300	60	1.2	123

5. i) Assuming suitable design criteria design a trickling filter to treat domestic wastewater flow of 7.5 MLD having influent BOD₅ is equal to 220 mg/L. The desired effluent BOD₅ is 30 mg/L or less. Maximum treatment efficiency of a single two stage trickling filter system is not more than 80%. Recirculation ratio 2. 15

ii) For Petroleum Industry, which type of Pollution Control Equipment are used and which type of safety measurements are considered. 5

iii) In case of anaerobic reactor, which type of organisms are used. Write down the steps and mechanism for degradation of organic compounds in anaerobic reactor. 5