

**M.E. BIO-PROCESS ENGINEERING FIRST YEAR SECOND SEMESTER - 2024****Subject : ENVIRONMENTAL BIOTECHNOLOGY****Full Marks : 100**

Assume any missing data

1. An activated sludge plant is designed to reduce 95% of influent BOD of 200 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: 400 m<sup>3</sup>, 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, [25]

**or**

Design a conventional activated sludge plant to treat 20000 kl/d of settled solid of BOD is 320 mg/l. The effluent BOD is 30 mg/l. F/M ratio is 0.24, MLSS is 2000 mg/l. Adopt diffusion aeration system  $SVI = 80$ . Air required is 120 m<sup>3</sup>/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. [25]

2. Assuming suitable design criteria design an oxidation ditch to treat 0.75 MLD flow of wastewater with an influent BOD<sub>5</sub> is 220 mg/L to have the desired effluent BOD of 30 mg/L.  $F/M = 0.2$  per day; MLVSS in tank = 2500 mg/L. Assume oxygenation capacity of the cage rotor at 16 cm immersion and 75 rpm equal to 2.5 kg/hr/m length of the rotor [20]

**Or,**

It is proposed to design an activated sludge plant to treat 7 MLD of domestic wastewater, reducing the concentration of settled BOD<sub>5</sub> from 220 mg/L to 20 mg/L at 20°C. Find the volume of aeration tank & hydraulic detention time if  $F/M=0.3\text{d}^{-1}$ . At 30°C temperature, calculate  $X_{MLVSS}=3000\text{mg/L}$ ,  $Q=2200\text{m}^3/\text{d}$  [Flow of activated sludge from the secondary settling tank] [20]

3. Briefly describe biosensors and its applications [10]

**Or**

Briefly describe Bioplastic and plastic degradation [10]

4. For a new effluent treatment plant of a petrochemical Industry, which type of effluent treatment unit you suggest to be used (with brief description) and what will be the possible biodegradable product (with mechanism). With a net diagram describe the removal mechanism for anaerobic biological system with possible products. [15+10]

**or**

[ Turn over

Briefly describe the packed bed and upflow anaerobic sludge blanket reactor. Write down the factors affecting biodegradation. Briefly describe the mechanism of biodegradation pathways of aliphatic and aromatic compounds..

[10+5+10]

5. 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	10	3.75	132
2	300	20	2.65	130
3	300	32	1.62	132
4	300	58	1.25	123