Ref. No. : Ex/FTBE/PC/B/T/421/2024

B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING
FOURTH YEAR SECOND SEMESTER – 2024

WASTE TREATMENT ENGINEERING

Time: 3 hrs **Full Marks: 100**

Part-I

Use Separate Answer scripts for each Part

Group-A

Write short note on any one **1×5 = 5**

(a) Rotating Biological Contractor

(b) What are the different steps of waste water treatment? Present with diagram.

Group-B

Answer any three questions **3×15 = 45**

1. (a) Write the basic principle of activated sludge reactor.
   (b) Design a completely mixed activated sludge system (volume, return sludge pumping rate; oxygen requirement) to serve 60000 people that will give a final effluent that is nitrified and has 5-day BOD not exceeding 25 mg/l. The following design data is available.
   Sewage flow = 150 l/person-day; BOD_5 = 54 g/person-day; BOD_u = 1.47 BOD_5; Total kjeldahl nitrogen (TKN) = 8 g/person-day; Phosphorus = 2 g/person-day; winter temperature in aeration tank = 18°C; Yield coefficient Y = 0.6; Decay constant K_d = 0.07 per day; Specific substrate utilization rate = $(0.038\ mg/l)^{-1}\ (h)^{-1}$ at 18°C.
   Assume 30% raw BOD_5 is removed in primary sedimentation, and BOD_5 going to aeration. 3+12 = 15
2. (a) What are the different types of sedimentation tank? Give there schematic diagram. Write the design criteria of sedimentation tank.
   (b) Design a rectangular sedimentation tank (dimensions) to treat 2.4 million litres of raw water per day. The detention period may be assumed to be 3 hours. (5+5)+5 = 15
3. (a) Write short note on UASB.
   (b) Design a low rate filter to treat 6.0 Mld of sewage of BOD of 210 mg/l. The final effluent should be 30 mg/l and organic loading rate is 320 $g/m^3/d$. 7+8 =15
4. (a) Briefly describe the different steps of anaerobic treatment of waste.

   (b)A fruit and vegetable processing unit generates 1t of solid waste that's needs to be stabilized aerobically. Estimate the amount of oxygen required to oxidize the waste. It may be assumed the initial composition of the biodegradable organic material to be decomposed is $[C_6H_7O_2(OH)_3]_5$ and the final composition of the residual organic matter is $[C_6H_7O_2(OH)_3]_2$. After oxidation process 40% of the material is available as compost. 9+6 = 15

[Turn over

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B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING FOURTH YEAR

SECOND SEMESTER – 2024

Subject : Waste Treatment Engineering

Time: 3hr **Full Marks: 100**

Part II (Total Marks 50)

Instructions : Use Separate Answer scripts for each part

Answer any **five** questions from the following: 5x10=50

1. What do you mean by Theoretical oxygen demand? Calculate the Theoretical oxygen demand value of a solution of 500 mg/L lactose solution. What is the composition of total solid and how these components can be separated from waste water? (2+3)+5=10 (CO1)

2. Derive a relationship between BOD_5 and BODu. How temperature affects the BOD test? 5+5=10 (CO1)

3. Describe any two methods for measurement of oxygen demand of waste water. 5+5=10 (CO3)

4. Describe the effect of following on BOD test: 5+5=10 (CO3)

i. The process of acclimation

ii. Presence of algae in waste water

5. What do you mean by nitrification? Deduce a combined relationship of combined oxygen demand process. 2+8=10 (CO1)

6. Find an expression of particle settling velocity. Deduce the expression of growth yield for a single bacterial species in a batch culture. 4+6=10 (CO1)