Ref. No. : Ex/FTBE/PC/B/T/421/2025

B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING FOURTH YEAR SECOND SEMESTER SUPPLEMENTARY EXAM – 2025

Subject : WASTE TREATMENT ENGINEERING Time : 3 hr Full Marks : 100

Part I (50 marks)

Use Separate Answer scripts for each Group

Answer any <u>five</u> questions from the following:

1. Derive a relationship between BOD_5 and BOD_u. What is the effect of temperature and pH on BOD test? 5+5=10

2. What do you mean by nitrification? Derive a relationship of oxygen demand for a combined process of carbonaceous oxygen demand and nitrification. 2+8=10

3. In the process of sedimentation derive an expression of settling velocity. What classes of material are responsible for oxygen demand of wastewater? 5+5=10

4. Explain the effect of seeding and acclimation of seed on BOD test? How the presence of algae effect BOD test? What do you mean by Total Oxygen Demand (TOD)? 7+8+5=20

5. What do you mean by Theoretical oxygen demand? Calculate the Theoretical oxygen demand value of a solution of 900 mg/L glycine solution using the following equation.

$$CH_3NH_2CHCOOH + 3O_2 \rightarrow 3CO_2 + NH_3 + 2H_2O$$

What is the composition of total solid and how these components can be separated from waste water? (2+3)+5=10

6. The maximum daily demand at a water purification plant has been estimated as 12 million liters per day. Design the dimensions of a suitable sedimentation tank for the raw supplies assuming detention period of 6 hours and the velocity of flow as 20 cm per minute. Assume water depth as 3m. 10

7. Deduce the expression of growth yield for a single bacterial species in a batch culture. What do you mean by Volatile Suspended Solids? How the quantity of it in wastewater is measured? 6+2+2=10

8. How BOD of a wastewater sample is estimated? Deduce the expression of BOD. The BOD of a waste water is to be determined? 10 ml of waste water is placed in a 300 ml bottle which is filled up with dilution water. A 300 ml control bottle is run in parallel with sample bottle. Both bottles are incubated for 5 days at 20 °C. Initial DO of sample is 2.0 mg/L. Final DO of sample is 3.5 mg/L. Final DO of control is 8.0 mg/L. Determine BOD_5. 4+3+3=10

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B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING
FOURTH YEAR SECOND SEMESTER EXAM 2025

WASTE TREATMENT ENGINEERING

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

Part-II (50 marks)

Group-A

Answer any one question **1×10 = 10**

1. Describe the any five terms along-with their significance (i) F/M ratio (ii) MLSS (iii) MLVSS (iv) Hydraulic detention time (v) Hydraulic Loading (vi) Sludge age or mean residence time.
2. Write short note on RBC and upflow anaerobic sludge blanket reactor.

Group-B

Answer any two questions **2×20 = 40**

3. (a) Describe in short an Activated Sludge Process. Sketch a principal scheme of an ASP. What are the various factors affecting the operation of trickling filter? 4+3+3 = 10

   (b) A wastewater stream A with 200 m^3 /h of flow rate and BOD of 300mg/l mixes with stream B having flow rate of 400m^3 /h and BOD 225mg/l. A completely mixed activated sludge process is used to treat the mixture. BOD of effluent stream is 10 mg/l. Given Y= 0.5, k=5 day^{-1}, K_d=0.06 day^{-1}; K_s=100 mg/l and MLVSS= 2000 mg/l. Find (a) BOD and flow rate of mixture (b) Mean residence time. 10
4. (a) Write the working principle of trickling filter. What are the operating equations for design of trickling filter?

   (b) It is desired to reduce the BOD of the wastewater from 100 mg/L to 20 mg/L in a single stage trickling filter with depth 5 m and 4 m radius. The flow rate of wastewater is 4000 m^3 /d with TKN 25 mg/L. Calculate volumetric BOD and TKN loading. 10+10 = 20
5. (a) Write short note on different steps of anaerobic digestion process.

   (b) Using the provided data estimate theoretically the volume of biogas that can be produced by anaerobic treatment of 100 kg of solid waste. (a) organic material (VS) in SW = 80% (including moisture (ii) moisture content in VS = 30% (iii) biodegradable VS = 95% (dry basis) (iv) chemical formula of BVS = $C_{60}H_{95}O_{40}N$ (v) specific weight of methane and carbon-dioxide = 0.7112 and 1.9607 respectively. 8+12 = 20