Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEM- END SEMESTER EXAMINATIONS

SUBJECT: PE-III : INDUSTRIAL WASTEWATER ENGINEERING

[CHE 4057]

REVISED CREDIT SYSTEM

Date : 30/11/2022 **Time: 9 AM – 12 noon** **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A.	A wastewater flow of 10000 m^3/day is received at a sewage treatment plant. The population served is 40000 and are a few industries in addition. If the BOD_5 of the wastewater is 400 mg/l estimate the BOD due to (i) domestic sewage (ii) industries.	**(3 marks)**
1B.	A single source of BOD causes an oxygen-sag curve with a minimum downstream DO equal to 6.0 mg/l. If the BOD of the waste is doubled (without increasing the waste flow rate), what would be the new minimum downstream DO? In both cases assume that the initial oxygen deficit just below the source is zero and the saturated value of DO is 10.0 mg/l. Note that when the initial deficit is zero, the deficit at any point is proportional to the initial BOD.	**(3 marks)**
1C.	Derive a relationship for determination of sludge wastage from recirculation line for an ASP treatment unit.	**(4 marks)**
2A.	What are the major problems faced in ASP treatment unit? Explain the same.	**(3 marks)**
2B.	A conventional activated sludge process plant is in operation with a θ_c of 10 days. Reactor volume = 8000 m^3, MLSS = 3000 mg/l. Determine (i)Sludge production rate. (ii)Sludge wastage flow rate when wasting from the reactor. (iii)Sludge wastage flow rate when wasting from the recycle line. Assume concentration of suspended solids in the recycle line as 10000 mg/l Formula: $Q_w = V.x/\theta_c.x_r$ $p_x = V.x/\theta_c$ $Q_w = V/\theta_c$	**(3 marks)**

2C. Design a bio-disc (Rotating biological contactor) for 600 persons to remove 90% of the BOD of 170 mg/l at the rate of 160 lpcd. Assume loading rate as 10 gm /m^3.day and volume of the tank as 40 m^3. Make the necessary check for the efficiency. **(4 marks)**

$$Se = \left[\frac{-Ka.A}{2.Q} \pm \sqrt{\left(\frac{Ka.A}{2.Q}\right) + S_0}\right]^2$$

where, Ka = 2.3

3A. Determine the liquid volume before and after digestion and the percentage reduction for 300 kg on dry basis of primary sludge with the following characteristics: **(4 marks)**

	Primary sludge	Secondary/Digested sludge
% of solids	5	10
Volatile matter(%)	50	50
Specific gravity of fixed solids	2.5	2.5
Specific gravity of volatile solids	1.0	1.0

3B. Explain the disinfection process for wastewater treatment and compare the advantages and disadvantages of using chlorine, ozone and UV for wastewater disinfection **(4 marks)**

3C. Draw the flow diagram of the following treatment systems: **(2 marks)**
(i)Combined Trickling filter and ASP process
(ii)Secondary treatment with contact filtration, carbon adsorption and reverse osmosis

4A. A municipal wastewater having a BOD of 250 g/m^3 is to be treated by a 2 stage trickling filter.The desired effluent quality is of 25 g/m^3 of BOD. If both of the filter depth are to be 1.83 m and recirculation ratio is 2 :1. Find the required filter diameter. **(4 marks)**
Flow rate = 7570 m^3/day
Wastewater temperature = 20°C
BOD removal in the primary sedimentation = 35%
and $E_1 = E_2$

NRC Equation

Single stage

$$V.F = \frac{W1}{5.08}\left(\frac{E1}{1-E1}\right)^2$$

Second stage

$$V.F = \frac{W2}{5.08}\left(\frac{E2}{(1-E1)(1-E2)}\right)^2$$

$$F = \frac{1+R}{(1+0.1R)^2}$$

4B.	What is sludge digestion? What are the principal methods of processing and disposal of sludge?	**(3 marks)**
4C.	Write short notes on the following: (i) UASB reactor (ii) Fluidized Bed reactor (iii)Anaerobic filter	**(3 marks)**
5A.	Describe the levels of wastewater treatment and classify the treatment process according to the level of advancement.	**(4 marks)**
5B.	What is the importance of using Total organic carbon analyser in industrial wastewater laboratory.	**(3 marks)**
5C.	Compare Electro-dialysis with reverse osmosis and mention the advantages and disadvantages of Electro-dialysis	**(3 marks)**