

BACHELOR OF ENGINEERING (CIVIL ENGINEERING) FIFTH YEAR SECOND SEMESTER SUPPLEMENTARY EXAM - 2023

SUBJECT: ADVANCED WATER & WASTE WATER TREATMENT (CE/5/T/505C)

Time: 3 hours

Full Marks: 100

Instructions: Answer any five questions.

Sl. No.	Question	Marks
1	Design a two stage Trickling filter to treat a domestic sewage of flow 20 MLD having influent BOD ₅ is 250 mg/l and desired effluent BOD strength is as per Indian standard. Also design the distribution system for the first stage TF. No need to design the under-drainage system. Assume any relevant data if needed.	[20]
2	Design a conventional activated sludge process with a flow of 40000 m ³ /day, influent BOD ₅ is 250 mg/l, TSS is 400 mg/l, Minimum and maximum temperature is 18°C and 32°C respectively. Primary sedimentation tank BOD and SS removal efficiency is 40% and 70% respectively. Suspended Solid concentration in primary and secondary sludge is 35 Kg/m ³ and 10 kg/m ³ . Total BOD ₅ and SS in the treated effluent should be ≤ 25 mg/l and ≤ 20 mg/l respectively. Assume Y = 0.5 and K _a = 0.06 day ⁻¹ . Assume sludge age is 7 day. Assume any relevant data if needed.	[20]
3	Design a tube settler module of square cross section with following data: Average design flow: 260 m ³ /hr; Cross-section of square tubes: 50 mm × 50 mm; Length of the tubes: 1 m; Thickness of the tube: 1.5 mm; Angle of inclination of the tube with horizontal: 60°; Dia of particle to be removed 100% is 0.04 mm; Specific gravity of particles: 2.65; Kinematic viscosity: 1.055 centistoke Also compare size and retention time for a rectangular tank with same efficiency.	[20]
4	A) Find the terminal velocity at 20°C of spherical particle of 1.1 mm diameter, 2.65 specific gravity. Flow is 10 MLD and kinematic viscosity at 20°C is 1.01 centistoke. B) Determine the % of HOCl in an aqueous solution, OCl ⁻ and [HOCl] at a temperature 20°C, pH = 8.5, K _{OCl} = 2.5 × 10 ⁻⁸	[15+5]
5	A) The analysis of a hard water shows the following compositions: Free carbon-di-oxide: 4 mg/l; Alkalinity: 65 mg/l; Non-carbonate hardness: 90 mg/l; Total magnesium: 15 mg/l; Assume that it is possible to remove all but 30 mg/l of carbonate hardness with lime and that the treated water is to have a total hardness of 80 mg/l. Determine the amount of hydrated lime and soda required for treatment per million liters of raw water. B) <i>Discuss with necessary equation:</i> De-mineralisation process of water softening.	[11+9]

[Turn over

6	<p>A) Well water containing some coliform organisms is to be irradiated by UV light ($\lambda=2573 \text{ \AA}$), as it flows through a channel of 2.5 m length and 0.6 m wide at a depth of 7.62 cm, if 30 germicidal lamp is located above the channel, so that average intensity at the water surface = $610 \mu\text{watt}/\text{cm}^2$. At what rate (MLD) can the water be made to flow through the channel to obtain 99.9997% removal of coliform organism. Given: coefficient of absorption at well water is 0.0561 cm^{-1}. 1 watt = 14.34 calorie/min.</p> <p>B) At 20°C the partial pressure (saturated) of chloroform CHCl_3 is 20 mm of mercury in a storage tank. Determine the equilibrium concentration of chloroform in water assuming that gas and liquid phases are ideal. Assume that heat absorbed in evaporation of 1 mole of gas from solution at 20°C and a total pressure of 1 atm is 4000 kcal/kmol and empirical constant J is 9.10.</p>	[10+10]
7	<p>A) Find out capacity of storage reservoir to supply a flow of 250 m³/hr to a city by graphical method. City power is not available from 6 a.m. to 10 a.m. daily. 12 hrs of pumping is done during 4 am to 10 am and 12 noon to 6 pm. Peak water demand is during i) 6 a.m. to 10 a.m. , ii) 1 p.m. to 2 p.m., 5 p.m. to 6 p.m. Assume a peak factor of 2.25.</p> <p>Other than peak hours hourly demands are as follows:</p> <ol style="list-style-type: none"> i. 20% of average hourly demand : 11 pm to 4 am ii. 40% of average hourly demand : 4 am to 5 am and 10 pm to 11 pm iii. 60% of average hourly demand : 12 noon to 1 pm iv. 70% of average hourly demand : 2 pm to 5 pm and 8 pm to 10 pm v. 80% of average hourly demand : 5 am to 6am vi. 90% of average hourly demand : 6 pm to 8 pm vii. 100% of average hourly demand: 10 am to 12 noon. <p>Water supply is continuous.</p> <p>B) Discuss the electrical double layer theory in connection with colloidal stabilization and destabilization.</p>	[14+6]
8	<p>Design a spray aerator given the following data: Design flow 200 m³/hr, Iron present in the water: 1 mg/L, Manganese present in the water: 0.5 mg/L, saturation concentration of O₂: 7.92 mg/L, Aeration constant (base 10): 70 cm/hr. Wind velocity is 6 kmph.</p>	[20]