Ref. No. : Ex/CE/PE/B/T/421F/2022

B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER EXAM 2022

ADVANCED WATER AND WASTEWATER TREATMENT

Time: 4 hours | Full Marks: 70

Use separate answer scripts for each part

(35 marks for each part)

Part-I

1. Design a bar rack and screen chamber for fully cleaned condition. Also sketch a hydraulic profile through bar rack. Given the following data: Peak design flow = 120 MLD; Average sewage flow = 40 MLD; Diameter of incoming sewer = 1.40 m; Depth of flow in sewer at peak flow = 1.05 m; Velocity in sewer at peak design flow = 1.16 m/s; Drop of screen chamber floor to invert of incoming sewer = 0.08 m; Bar size = 10 mm x 50 mm; Clear spacing between bars = 25 mm; Bar Shape factor=2.42; Velocity of flow through screen = 0.9 m/s; Angle of screen = 75°. Assume any other suitable data as necessary. 20

2. Design a conventional activated sludge process with diffused aeration system for treating domestic sewage with the given data: Average sewage flow = 40 MLD; BOD_5 of sewage = 300mg/L; BOD_5 removed in primary treatment = 20%; Overall BOD_5 reduction required = 90%; F/M = 0.4 - 0.3; MLSS = 1500 – 3000 mg/L; HRT = 4 – 8 h; SRT = 5 – 8 days; Q_R/Q = 0.25 – 0.5; Air requirement = 40 - 100 m^3/Kg BOD_5 removed. Assume any other suitable data as necessary. 15

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No. of Questions	Part II(Marks:35)	Marks
	Answer any Three (3) questions. Two (2) marks are reserved for neatness and to the point answer. Assume relevant data if necessary	
Q1. a)	Draw a neat flow diagram showing different unit operations for treatment of water considering ground water is the source of supply. Justify the provision of each unit.	(5)
b)	Why aeration is required for treatment of groundwater?	(2)
c)	Iron is present in water as 2.7 mg/L. Aeration constant to the common base is 70cm/hr for diameter of droplet 20mm and saturation constant of oxygen is 7.90 mg/L.The removal is to done with spraying in an aerator. Find the time of aeration if the permissible limit of iron is 0.3 mg/L.	(4)
Q 2.	Calculate the initial head loss in the sand filter of cross-section of 100 cm2 of uniform sand size of 0.5mm diameter and depth 600 mm, when operated at the filtration rate of 100L/min. and temperature of 20°C. Assume shape factor is 7.25. K=5, sp.gr = 2.65,$\nu = 1.01 \times 10^{-2}$ cm2/sec. Derive also the equation to be used for solving the problem.	(11)
Q 3. a)	A settling column analysis of a discrete particle suspension yields the following results collected at 150 cm depth. Time, Min: - 0 60 80 100 130 200 240 420 Concn, mg/L :- 280 190 180 165 145 110 75 25 What will be the basin efficiency of the settling tank with a loading rate of 20M ^{3}/M^2/day? Use graphical method for solving the problem	(6)
b)	Compute the terminal settling velocity of a spherical particle with diameter 0.5 mm and specific gravity 2.5 settling through water at 22 °C temperatures. Given kinetic viscosity of water = 0.962 centistoke	(5)
Q4.	Solve the above problem upto 3rd trial	

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No. of Questions	Part II(Marks:35)	Marks
	A city requires to supply for a population of 12, 75,000 with 135 lpcd potable water for which rapid gravity filter is to be installed. The backwash water is 2% of the total requirement. The operation time is 20 hrs a day out of which 30 minutes are kept for service time. Determine the following components of the filtration unit. a) No.of filter bed including 25% extra as stand bye. b) Size and No. of Laterals. c) Nos and spacing of orifices (use 15mm dia) d) Spacing of Laterals. e) Size of Manifold. f) Size of Back washwater troughs. Assume other relevant data.	(11)