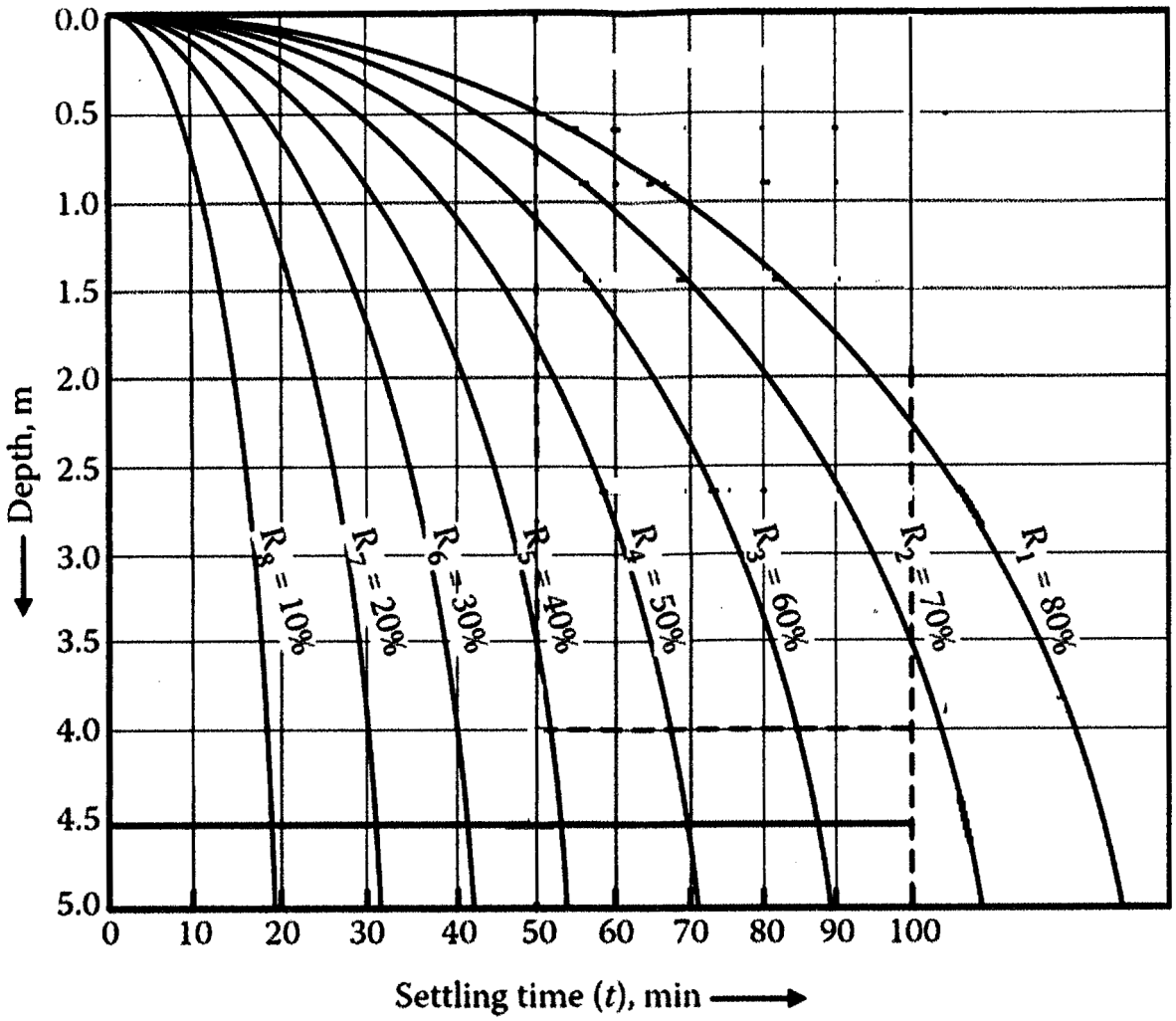
Ref. No.: **Ex/CE/PE/B/T/421F/2024**

B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER EXAM 2024
SUBJECT: ADVANCED WATER AND WASTEWATER TREATMENT
Time: 3 hours **Full Marks: 100**

Sl. No.	Question	CO	Marks
1	i) What advantages does tube settlers provide during sedimentation over conventional settling tanks? ii) Design a tube settler module of square c/s with following data: Avg. design flow = 270 m^3/hr c/s of square tubes = 50mm x 50mm Length of tube = 1 m Thickness of tube = 1.5mm Angle of inclination of tube with horizontal = 60° Dia of particle to be removed 100% = 3mm Sp. gravity of particle = 2.60 Kinematic viscosity of water = 1.025 centistoke Also compare the sizes of detention time of the above system with an ideal horizontal flow rectangular sedimentation tank which will provide the same removal efficiency as the tube settler module. **OR** i)Discuss Breakpoint Chlorination with the help of a neat sketch. ii) Laboratory test data shows that 99% kill of organisms in a sample of water could be obtained at a chlorine concentration of 6mg/L with a contact time 25 min. Assuming coefficient of dilution = 1.2, find out: (i) Contact time at 6mg/L concentration for 99.95% kill (ii) Concentration for 99% kill at 20 min contact time (iii) Chlorine concentration for 99.95% kill at 20 min contact time.	[CO1]	[5+15] [10+10]
2	Design a velocity-controlled rectangular grit removal facility for peak design flow. The design average flow, peaking factor, and ratio of minimum to average flow are 0.5 m^3/s, 3.0, and 1/3, respectively. The horizontal and settling velocity, and detention time are 0.32 m/s, 1.3 m/min, and 80s, respectively. At this settling velocity, the minimum discrete particle of 0.18 mm diameter will be fully removed. Also find out the head over the weir, weir length, depth of flow and velocity in the channel corresponding to the peak flow, average flow, minimum flow when a proportional weir is provided at the downstream of the grit chamber. Assume that the weir length is less than the channel width and weir crest by 2 cm from channel bottom. **OR** (i) Design grit chamber for Peak wet weather flow = 1.321 m^3/s and Minimum flow = 0.22 m^3/s. Maintain constant Velocity of 0.3 m/s through the grit chamber by providing Parshall flume at the downstream end. Settling velocity in grit chamber = 0.015 m/s. (ii) With derivations show that for rectangular weir a parabolic channel is required to control flow velocity in Grit chamber.	[CO2]	[20] [10+10]
3	i) Design the approximate dimension of a set of rapid gravity filters for treating water required for a population of 100,000; the rate of supply of 200 litres per day per person. The filters are rated to work 5000 litres per hour per sq. m. Assume whatever data are necessary, and not given.	[C03]	[10+10]

[Turn over

	ii) A filter unit is 5 m by 10 m. After filtering 10,000 m^3/day in 24-hour period, the filter is back washed at a rate of 10 litres per second per m^2 for 15 minutes. Compute the average filtration rate, quantity and percentage of treated water used in washing and the rate of wash water flow in each trough. Assume 4 troughs.		
4	i) Why do we perform a Batch Settling Column Test for PST of Wastewater treatment plant? ii) A settling column study was conducted on a wastewater sample. The column depth was 4.0 m, and initial TSS concentration of the sample was 300 mg/L. The particle isoremoval graph is given. Determine (a) Overall percent TSS removal at 60-min detention time and desired water depth of 4.0 m (b) Surface overflow rate ($m^3/m^2 \cdot d$) corresponding to 60min detention time and desired water depth of 4.0 m (c) Percent removal of particles at a water depth of 2.5m and 57 min detention time, (d) Detention time for 60% removal of particles at a water depth of 2.5 m, and (e) Side water depth for 40% removal of particles at a detention time of 48 min.	[C02]	[5+15]
5	i) With a neat sketch write the expression for the Biomass Mass Balance for a completely mixed Activated Sludge process with sludge recycling. ii) An average operating data for conventional activated sludge process is as follows: Inflow of wastewater = 31000 m^3/d Volume of aeration tank = 11000 m^3 Influent BOD = 280mg/L Effluent BOD = 35mg/L MLVSS = 3000 mg/L Effluent SS = 30mg/L Waste SS = 10000mg/L Quantity of waste sludge = 250 m^3/d Determine: a) Aeration period (h) b) F/M (Kg BOD per day/ Kg MLVSS) c) % Efficiency of BOD removal d) Sludge age (days)	[C04]	[10+10]


0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Depth, m
0
10
20
30
40
50
60
70
80
90
100
Settling time (t), min
R8 = 10%
R7 = 20%
R6 = 30%
R5 = 40%
R4 = 50%
R3 = 60%
R2 = 70%
R1 = 80%