Ref. No.: Ex/CE/PE/B/T/421F/2023

B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER – 2023

SUBJECT;- ADVANCED WATER AND WASTEWATER TREATMENT

Time : Three hours | Full Marks : 100

(50 Marks for each Part)
Use separate answer script for each Part

PART I (50 Marks)

QNO No.	Question	CO	Marks
1.	Justify the necessary and importance of the aeration process for treatment of sub - surface water. Describe the stripping process of carbon di –oxide from water in the light of Two –film process.	[CO1]	[2+4]
2.	Describe cascade aeration process for removal of soluble iron Fe 2+ from ground water. Justify the usefulness of multiple nos of fall in cascade aeration .	[CO1]	[2+4]
3.	Answer any one: Either A Or B A) i) In an aeration experiment , on the removal of NH_4 from water by spray aeration , into the air in droplet of size 3mm diameter, the initial super saturation of the water with the gas was found to be 6.5 mg/l . After 10 secs to exposure the concentration was reduced to be 0.35mg/l. Determine the gas transfer co-efficient (K_{La}).Assume any relevant data if necessary ii) A settling column of 2.0 m depth yields the following results. Time, Min: - 0 60 80 100 130 200 240 420 Concn, mg/L :- 300 189 180 156 128 111 78 27 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 **B)** i) Compute the terminal settling velocity of a spherical particle with diameter 0.45 mm and specific gravity 2.65 settling through water at 20 ^oC temperatures. Given kinetic viscosity of water = 0.98 centistoke Solve the above problem upto 3rd trial ii) A clean water is passed through a bed of uniform sand at a filtering velocity of $1.4x10^{-3}$ m/sec. The sand grains are of 0.4mm in dia and shape factor =0.85,sp .gr =2.65 with bed porosityis 0.40. Find the head loss in the bed in mm. Assume K=5.Take v= $1.01x10^{-2}$ m2/sec. Compute the head loss at 0^0 C and 20^0 C. v_0= $1.79x\ 10^{-2}$ m2/sec.	[CO2] [CO2]	[10+10]
4.	Answer any one from the following A) OR B) OR C)	[CO3]	[8]

[Turn over

5.	A)Derive an equation for computing the head loss through filter bed under clean condition with necessary assumption and using conventional symbol of hydraulic and media parameters. B)Derive the equation .for gas transfer in following form:- $Log_e C_S - C_T / C_S - C_O = - 0.4343 K_{La} t$ C)Explain briefly the importance of velocity gradient (G) in mixing unit in chemical sedimentation unit. Deduce an expression of determining 'G' using a volume element of water Design a rapid gravity sand filter plant to treat 80 MLD capacity allowing 3.5% of filtered water for back washing . The period of backwashing is 45 min on daily basis. The rate of filtration is 5000 lit / m^2 /hr. The stand by allowance is 25 %. The strainer diameter is 13 mm. The operating periods of the plant is 20 hrs. Calculate the number of filter units and under drainage system. Draw also a neat sketch. Assume suitable data and guidelines as per Jenks	[CO4]	[10]

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Time: 3 hours **Full Marks: 100**
Instructions: Use Separate Answer scripts for each part.

Part - II (50 Marks)

Sl. No.	Question	CO	Marks
1	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 0.4 m^3/s, 3.0, and 1/3, respectively. The horizontal and settling velocity, and detention time are 0.35 m/s, 1.5 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** 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.	[CO2]	[15]
2	A settling column study was conducted on a wastewater sample. The column depth was 4.5 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 4.5 m (b) Surface overflow rate ($m^3/m^2 \cdot d$) corresponding to 60min detention time and desired water depth of 4.5 m (c) Percent removal of particles at a water depth of 3.5m and 70 min detention time, (d) Detention time for 20% removal of particles at a water depth of 2.5 m, and (e) Side water depth for 50% removal of particles at a detention time of 60 min.	[C02]	[15]
3	An average operating data for conventional activated sludge process is as follows: Inflow of wastewater = 30000 m^3/d Volume of aeration tank = 10000 m^3 Influent BOD = 270mg/L Effluent BOD = 25mg/L MLSS = 2700 mg/L Effluent SS = 40mg/L Waste SS = 9500mg/L Quantity of waste sludge = 230 m^3/d Determine: a) Aeration period (h) b) F/M (Kg BOD per day/ Kg MLSS) c) % Efficiency of BOD removal d) Sludge age (days)	[C04]	[10]

4	With derivations show that for rectangular weir a parabolic channel is required to control flow velocity in Grit chamber.	[C02]	[10]