B.E. CIVIL ENGG. 3rd YEAR 2nd SEMESTER EXAMINATION 2022

ENVIRONMENTAL ENGINEERING II

Time: Three hours

Full Marks 100
(50 marks for this part)

Use a separate Answer-Script for each part

Part-I

Answer all questions

(Assume any data, if required, reasonably)

[CPHEEO Wastewater manual graphs (figure) [with my signature] are allowed]

[Provide sketches wherever possible]

Q.1. Answer the following (any four): (CO3) (4×4) = 16

I. Deduce the relationship $VX = [\theta_c Y Q (S_0 - S)]/ (1 + k_d \theta_c)$ with usual notations for activated sludge process.

II. 'Aerated grit chamber' versus 'velocity control grit camber'.

III. Denitrification for reducing the energy consumption in NBOD in biological treatment of wastewater.

IV. Discuss the significance of 'pond depth' in different types waste stabilization ponds.

V. Discuss about the different types of settling and their predominant occurrence.

Q.2.

Draw a typical flow diagram of Municipal wastewater treatment plant including sludge management.

OR

Discuss the design consideration of septic tank as per CPHEEO manual.

(CO3) 6

Q.3.

Design a bar rack screen chamber system (2 working + 1standby) for a peak flow. Given – peak flow = 300 MLD; Depth of incoming flow = 1.15 m; Incoming velocity =1.22 m/s; Width of rectangular bars = 10mm; Depth of rectangular bars = 50mm; Clear spacing between bars = 25 mm; Coefficient of expansion = 0.3. With this data, design the bar rack; actual depth of flow and velocity before bar rack; velocity through clear opening of bar rack; head loss through bar rack; determine depth & velocity of flow at downstream of bar rack and also design the depth of critical flow, critical velocity and height of outlet weir.

OR

Design a secondary sedimentation tank system (2W+1S) to treat effluent from activated sludge plant with the following design data. Average wastewater flow is 110 MLD; MLSS concentration in tank influent is 3200 mg/l; peak flow factor is 2.5; the range of surface loading rate may be considered as 15 - 35 $m^3/m^2.d$ and range of solid loading rate may be considered as 70 - 140 $kg/m^2.d$ at average flow. Find out surface area, diameter, depth, detention period, weir loading and number of 90° V notches @ 175mm c/c. Provide sketches. (CO4) 10

Q.4.

Find out the following design requirements of a conventional activated sludge process from the given data. Average inflow of raw wastewater is 72 MLD having BOD_5 of 260 mg/l and suspended solids of 410 mg/l. Minimum and maximum temperatures are 20° C and 35° C. Primary sedimentation tank efficiency for BOD_5 and suspended solids removal are 35% and 75% respectively. In primary and secondary excess sludge, solids concentrations are 40 kg/m^3 and 10 kg/m^3. Assuming the MLSS concentration within a range from 1900 to 2100 mg/l, find the aeration tank volume, excess sludge amount, amount of sludge recirculation, amount of total sludge generated and SVI and SDI of the mixed sludge.

(CO4) 10

Q.5.

Design a Waste Stabilization Pond system with anaerobic pond followed by facultative pond. Wastewater inflow is 11000 m^3/d having BOD_5 of 250 mg/l. The design temperature is 20° C; latitude of the place is 22.5 ° N and the net evaporation rate is 5 mm/d. The 'surface BOD loading' should be selected on the basis of temperature.

(CO4) 8

Ref No. –Ex/CE/PC/B/T/321/2022

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SUBJECT: ENVIRONMENTAL ENGINEERING II

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No. of Questions	Part II(Marks:50)	Marks
	Answer all the Questions. Assume any relevant data if not given.	
Q1.		
	Answer any four (4) only	
a)	What is the significance of partially separated sanitary sewer ?	
b)	What are the limitations of using stone ware pipe for conveying domestic sewage?	
c)	What is crown corrosion in concrete sewer? How it appears?	
d)	How you can recognize a stale sewage?	
e)	Under what condition intercepting sewer is provided?	(4x 2 =8)
f)	Prove that 1.0 gram of pure Dextrose releases 1.07 gm of B.O.D.	
g)	Justify the necessary of providing Inverted siphon as appurtenances in sewage collection ?	
Q 2.		
a)	What are the limiting velocities in sewer? What is its justification?	(3)
b)	Prove that for a circular sewer, proportionate discharge can be expressed as following form $q/Q = [\ \alpha/360 - \sin\alpha/2\pi\ ]\cdot[\ 1 - 360\sin\alpha/2\pi\alpha\ ]$	(6)
c)	A city sewer is proposed to carry sewage of 2 lakh population @ 180 lit/cap/day water supply. The sewage factor is 0.80. The sewer runs 70% running full condition .Determine the size of the circular sewer. Assume slope 1in 900.n= 0.013.peak factor 2.5.lean factor 0.30. Check the velocities in all flow conditions.	(5)

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No. of Questions	Part II(Marks:50)	Marks
Q3.		
.a)	Under what condition drop manholes are provided? Draw a neat labeled sketch of a drop manhole.	(6)
b)	In a BOD test, 6 ml of sample sewage with 0 D.O. is mixed with 294 ml of dilution water with 8.5 mg/l of dissolved oxygen .After 5 days incubation, at 20 degree Celsius, mixture content shows DO value as 5.1 mg/l.What is the value of B.O.D in mg/l ?	(4)
c)	First stage B.O.D is obtained as 52 mg/l.B.O.D after 5 days at 20^0 C, is found to be as 42 mg/l. What will be the rate reaction constant (k) for base 10 at 30 ^{0}C?	(4)
Q4.		
a)	What are the different types of solids measured for wastewater characteristics ?Enumerate them In chart form,	(4)
b)	A crucible and a filter paper are dried and gave a mass 25.438 gm.200 ml. of a well shake representative sample of wastewater is passed through the whatman 42 filter paper. The crucible, filter paper are removed and dried to a constant mass of 25.662 gm.100 ml of above filtrate sample is poured in a dish of preweighted mass of 276.420 gm.Tle filtrate sample is evaporated the in oven at 103 ^{0}C to dryness and the dish and residue are weighed as 276.237 gm.both the crucible and dish are placed in a muffle furnace ai 600 ^{0}C for 2 hours .After cooling the mass of the crucible is obtained as 25.516gm, and that for dish was 276.108gm. Determine a) Total solids mg/l b) Volatile solids in mg/l c) Filterable solids mg/l d) The organic fraction of the non filterable solids in mg/l	(6)
c)	A storm sewer receives a peak run off from a catchment area of 100 ha. Run off coefficient is 0.50.the time of concentration is 32 minutes Calculate the size of storm sewer . Assume running full velocity is 0.60 m/sec,a = 75, b= 10 for intensity calculation in the necessary equation.	(4)