Ref No: Ex/CE/PC/B/T/321/2023(S)

B.E. Civil Engineering Third Year Second Semester Supplementary Examination 2023

Environmental Engineering II

Time: Three Hours

Full Marks: 100

Use separate answer script for each part

(Part I 50 and Part II 50)

Part-I

Answer **briefly. Notations** used have their usual meanings. Any **relevant data** may be assumed, if necessary.

1. (CO1) Answer the following questions very briefly:

a) What is waste water (WW)?

b) Why is separate sewerage systems preferred over combined sewerage systems?

c) How is design frequency selected to calculate design storm water runoff?

d) What is the difference between duration of rainfall and time of concentration?

e) What should be the d/D (notations have usual meanings) for designing a sewer and why? 2X5=**10**

2. (CO2) Answer the following questions very briefly:

a) Mention the significance of taste as a physical WW characteristic.

b) Why BOD test, a bioassay test cannot be replaced by COD test?

c) Why is photo-autotrophic organism so named?

d) What is 1^{st} stage BOD and why is it called 1^{st} stage?

e) What is inland surface water effluent standard?

2x5=**10**

[Turn over

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(**Part I 50** and Part II 50)

Part-I

3. a) Draw a sketch of the pyramid of Hierarchy of Waste Management

c) Write very brief note on (i) sewage (ii) preliminary WW treatment (iii) dilution, a method of disposal

b) Calculate the velocity of flow and discharge in a sewer of circular section having diameter of 1050mm, laid at a gradient 1 in 500. Manning's coefficient of roughness may be taken as 0.015. Assume that the sewer running half full. **3+6+6=15**

Or

4. a) Discuss different methods to calculate ground water infiltration.

b) For a sanitary sewer following data are given:

(i) ultimate peak flow=500lps (ii) present peak flow=400lps (iii) d/D at ultimate peak flow = 0.75

(iv) n=n′=0.015 (v) diameter=1050mm

Find S, V, Q and v at ultimate peak flow and v for present peak flow. Comment on your result. Notations have their usual meaning. Develop the relevant equations from Manning's Equation, if needed. Following table giving hydraulic properties of circular section (n=n′) may be required.

d/D	v/V	q/Q
0.9	1.124	1.066
0.8	1.140	0.988
0.7	1.120	0.838
0.6	1.072	0.671
0.5	1.000	0.500

5+10=15

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Part-I

5. a) Mention significance of following related with BOD test

(a) stoppering (b) seeding (c) dilution

b) What is Theoretical Oxygen Demand of $C_aH_bO_cN_d$?

c) Compute the ThOD of a WW sample that contains the followings:

(i) glucose = 300 mg/L (ii) benzene = 20 mg/L 6+3+6=15

Or

6. The following data have been obtained from a WW characterization:

BOD_5 = 450mg/L

K(base e) =0.29/day

NH_3 = 80mg/L

Estimate total quantity of oxygen in mg/L , that must be furnished to completely stabilize the WW. Also, Calculate the COD and ThOD of the WW sample. 15

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B.E. CIVIL ENGG. 3rd YEAR 2nd SEMESTER SUPPLEMENTARY EXAMINATION 2023

ENVIRONMENTAL ENGINEERING II

Time: Three hours | Full Marks 100 (50 marks for this part)

Use a separate Answer-Script for each part

Part-II

Question no. **1** and **2** are compulsory

And answer any **two** from the rest

(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 three): (CO3) (3×4) = 12

I. Describe with neat sketch the symbiotic relationship of a facultative stabilization pond.

II. "$1/\theta_c = Y\ U - k_d$" - deduce this relationship with usual notations for activated sludge process.

III. Discuss about the design features of 'low rate', 'high rate' and 'super rate' trickling filter.

IV. Why and how the proportional flow weir is used at the outlet of the grit chamber?

Q.2. (CO3) 6+6 = 12

I. Municipal wastewater treatment plant including sludge management - draw a typical flow diagram.

II. Draw a typical sketch (plan and section) of two compartment septic tank for population over 50.

Q.3.

Design a secondary sedimentation tank to treat effluent from activated sludge plant with the following design data. Average wastewater flow is 53 MLD; MLSS concentration in influent is 3100 mg/l; peak flow factor is 2.3; Surface loading rate may be considered as ~21 $m^3/m^2.d$ at average flow. Find out the surface area, diameter and depth of tank, detention period, weir loading rate.

(CO4) 13

Q.4.

Find out the following design requirements of a conventional activated sludge process from the given data. Average flow 52,000 m^3/d; raw wastewater BOD_5 260 mg/l and suspended solids 430 mg/l. θ_c at minimum temperature of 15° C is 7 days. Primary sedimentation tank efficiency for BOD_5 and suspended solids removal are 35% and 75% respectively. Primary and secondary excess sludge concentrations are 40 and 10 kg/m^3. Assuming the MLSS concentration of 2100 mg/l. Find the aeration tank volume, excess sludge amount, amount of sludge recirculation, and the amount of total sludge generated. (CO4) 13

Q.5.

Design a Waste Stabilization Pond system in India with an anaerobic pond followed by a facultative pond. Wastewater inflow is 11000 m^3/d having BOD_5 of 350 mg/l. The design temperature is 25° C and the net evaporation rate is 5 mm/d. Comments on the effluent quality after facultative pond, if the treated effluent has to be discharge in the inland surface water.

(CO4) 13