Ref No: **Ex/CE/PC/B/T/321/2023**

B.E. Civil EngineeringThird Year Second Semester 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) Define waste water (WW).

b) Name different types of sewerage systems.

c) Name the factors on which selection of design frequency to calculate design storm waterrunoff depends.

d) What is time of concentration?

e) What should be the minimum 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 odour as a physical WW characteristic.

b) Name a biologicalWW characteristic and its significance.

c) Why is chemo-heterotrophic organism so named?

d) What is NOD?

e) What is symbiotic algal bacterial WW treatment?

2x5=**10**

[Turn over

Ref No: **Ex/CE/PC/B/T/321/2023**

B.E. Civil Engineering Third Year Second Semester 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

3. (**CO1**) a) How is waste treatment placed in the pyramid of Hierarchy of Waste Management and why?

c) Write very brief note on (i) sullage (ii) advanced WW treatment (iii) disposal of waste

b) Calculate the velocity of flow and discharge in a sewer of circular section having diameter of 1.05 meter, laid atagradient 1 in 500. Manning's coefficient of roughness may be taken as 0.012. Assume that the sewer running half full. 3+6+6=**15**

Or

4. (**CO1**) 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 may be assumed as 0.8 (iv) n=n′=0.013 (v) diameter=1.05m

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

Ref No: **Ex/CE/PC/B/T/321/2023**

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

Environmental Engineering II

Time: Three Hours
Marks: 100

Full

Use separate answer script for each part

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

Part-I

5. (**CO2**) a) Mention utilities of COD test with respect to BOD test in details.

b) What is Theoretical Oxygen Demand (ThOD)? What are its utilities?

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

(i) glucose = 200 mg/L (ii) benzene = 25 mg/L 4+5+6=**15**

Or

6. (**CO2**) a) Compare ThOD, BOD, BOD_5, COD and TOC in details

b) 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. 5+10=**15**

Ref No. –Ex/CE/PC/B/T/321/2023

B.E. CIVIL ENGG. 3rd YEAR 2nd SEMESTER 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. Discuss about the different steps of anaerobic digestion.

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

III. Write short note on oxidation ditch.

IV. Describe with neat sketch the symbiotic relationship and function of a facultative stabilization pond.

Q.2.

a) Draw a typical sketch (plan and section) of two compartment septic tank showing inlet, outlet, partition wall, baffle wall etc. for population over 50.

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

(CO3) 5+5

Q.3.

A grit chamber system (2W+2S) is equipped with proportional flow weir as control device and considers very good settling basin performance. Design the grit chamber system to treat peak design flow of 72 MLD of wastewater to remove grit particles up to size 0.18mm and the specific gravity is 2.6. The design kinematic viscosity of wastewater is 1.138×10^{-6} m^2/s. Compute the settling velocity, surface overflow rate, the dimensions of grit chamber and proportional flow weirs. Provide sketches.

(CO4) 14

Q.4.

Find out the following design requirements of a conventional activated sludge process from the given data. Average inflow of raw wastewater is 65 MLD having BOD_5 of 260 mg/l and suspended solids of 425 mg/l. Minimum and maximum temperatures are 18° C and 32° C. Primary sedimentation tank efficiency for BOD_5 and suspended solids removal are 30% and 73% respectively. In primary and secondary excess sludge, solids concentrations are 3.9% and 1.1%. Assume the MLSS concentration within a range from 1950 to 2050 mg/l and oxygen transfer efficiency of aeration equipment under standard condition is 1.8 kg O_2 / kWh. Find the aeration tank volume, excess sludge amount, amount of sludge recirculation, oxygen requirement and amount of total sludge generated.

(CO4) 14

Q.5.

Design a Waste Stabilization Pond system in India with an anaerobic pond followed by a facultative pond. Wastewater inflow is 12000 m^3/d having BOD_5 of 370 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. Also comments on the requirement of the maturation ponds to meet the BOD_5 discharge standard, if the BOD_5 removal efficiency of the maturation pond is 30%.

(CO4) 14