Ref No: Ex/CE/PC/B/T/321/2024

B.E. Civil Engineering Third Year Second Semester Examination 2024

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) Can you provide an example to illustrate importance of the word 'use' in defining wastewater (WW)?

b) Why is it called a 'separate sewerage system'?

c) 'Selection of the design frequency for calculating storm water runoff depends mainly on the available funding and importance of the area', - Could you explain this further?

d) Define 'time of concentration' with a sketch.

e) At which value of d/D is q/Q maximum and why? (Notations have their usual meaning)? 2X5=10

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

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

b) With the help of a sketch compare $BOD_{ultimate}$, BOD_5, ThOD, COD and TOC.

c) Write a very brief note on chemo-heterotrophic bacteria.

d) Draw a sketch to show second stage BOD of an old wastewater sample.

e) Draw a growth pattern of mixed culture of microorganisms based on cell mass.

2x5=10

[Turn over

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Part-I

3. (CO1) a) Correlate the terms (i) sullage (ii) disposal (iii) offsite treatment (iv) grey water (v) black water with their respective meanings.

b) What are the different methods for calculating ground water infiltration and could you specify the values associated with these methods?

c) A circular sewer laid at a slope of 1 in 400 and it is running half full and with a velocity of 1.9 m/s. Find its diameter and discharge. Any relevant data may be assumed. **5+4+6 = 15**

Or

4. (CO1) a) Which of the following statement is NOT correct and why? Why other three are correct? Give reasons.

(i) In combine sewerage system, single sewer line is laid for both sanitary WW and storm water

(ii) In separate sewerage system, the design of sewage system is economical

(iii) As the sewage is diluted by storm water in combined sewerage system, cost of treatment is low

(iv) In separate system, self-cleansing velocities are easily available

b) The drainage of a town is 12 hectare. The classification of the surface of the area is as follows:

Percent of total surface area	Type of surface	Coefficient of runoff
25	Hard pavement	0.85
20	Roof surface	0.80
15	Unpaved street	0.20
40	Garden and lawn	0.20

If the time of concentration for the area is 30 minutes, calculate maximum runoff. Intensity of rainfall may be taken as $(200.1 * F^{0.375})/t^{0.96}$. Two month design frequency may be considered.

c) Define self-cleansing velocity. What should be the self-cleansing velocities in sanitary and storm sewers respectively? **5+6+4 = 15**

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Part-I

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B.E. CIVIL ENGG. 3rd YEAR 2nd SEMESTER EXAMINATION 2024

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) (3×5) = 15

I. Discuss about the importance of the 'Anaerobic pond' in the design of a 'Waste Stabilization Pond system' in India.

II. Develop the relation between the 'specific substrate utilization rate' and the 'mean cell residence time' for conventional activated sludge process.

III. Discuss about the advantages and disadvantages of the 'extend aeration system' in wastewater treatment system.

IV. Discuss that in 'single stage anaerobic digester' which step / steps in the three step processes is / are the main controlling factor of the digestion.

Q.2.

Draw a typical flow diagram and discuss about the functions of the different components of a typical sludge treatment system of Municipal wastewater treatment plant.

(CO3) 9

Q.3.

Design a bar rack screen chamber system (1 working + 1standby) for a peak flow. Given – average flow = 55 MLD; Peak factor = 2.8; Depth of incoming flow = 1.05 m; Incoming velocity =1.2 m/s; Width of rectangular bars = 12mm; Depth of rectangular bars = 56mm; 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 the downstream of bar rack and also design the depth of critical flow, critical velocity and height of outlet weir. (CO4) 13

Q.4.

a) What are the design principles of 'aerated grit chamber' and 'vortex type grit chamber'?

b) Discuss with neat sketches the process mechanism of aerobic attached growth system. In which condition sloughing takes place? (CO4) 6+7

Q.5.

Design a septic tank for a population of 186 persons having municipal water supply of 200 lpcd. Consider 10% is water loss. 90% of the available water supply is wastewater flow. It is two stack system and 45% of the wastewater is reaching the septic tank. The rate of deposition of sludge is 30 liter/capita/year. Compare the volume of septic tanks considering the period of cleanings as 2 years and 3 years.

(CO4) 13