Ref No. –EX/CE/T/322/2019

B.E. CIVIL ENGG. 3rd YEAR 2nd SEMESTER EXAMINATION 2019

WASTE WATER ENGINEERING

Time: Three hours

Full Marks 100
(60 marks for this part)

Use a separate Answer-Script for each part

Part-I

Answer all questions

(Assume any data, if required, reasonably)

[Selected (class teacher signature) CPHEEO Wastewater manual graphs (figure) are allowed]

[Provide sketches wherever possible]

Q.1. Answer the following: (4×5) = 20

I. Discuss about the quantitative environmental impact assessment

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

III. Discuss about the Twin-pit Pour Flush Latrines.

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

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

Q.2.

Draw a typical plan and longitudinal section of a (1W+1S) system of velocity control grit chamber.

OR

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

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Q.3.

Design a bar rack screen chamber system (1 working + 1standby) for a peak flow. Given – average flow = 50 MLD; Peak factor = 3; Depth of incoming flow = 1.05 m; Incoming velocity =1.18 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

Discuss about the importance of grit chamber. What are the different types of grit chambers? What are the advantages of 'aerated grit chamber'? What is proportional flow weir? 12

Q.4.

Discuss with neat sketches the process mechanism of aerobic attached growth system. In which condition sloughing takes place?

Design a low rate anaerobic digester from the following data. Amount of influent sludge is 125 m^3/d having 3% suspended solids. The approximate % of volatile matter in the influent sludge is 70%. Approximate % digestion of volatile matter is 50%. Assume % of solids in the digested sludge is 5%. Gas generation per kg destruction of volatile matter is 0.9 m^3. Find out the volume of the digested sludge, volume of the supernatant, volume of the digester considering sludge storage during rainy season, volume of total gas generation and the volume of methane.

5+9

OR

Find out the following design requirements of a conventional activated sludge process from the given data. Average inflow of raw wastewater is 70 MLD having BOD_5 of 260 mg/l and suspended solids of 430 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 70% respectively. In primary and secondary excess sludge, solids concentrations are 4% and 1%. Assuming the MLSS concentration within a range from 1950 to 2050 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.

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Q.5.

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

5+3

OR

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 380 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%.

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Bachelor of Civil Engineering Examination 2019

(BCE 3rd Year 2nd semester)

Waste Water Engineering

Time: Three Hours

Full Marks: 100

Use separate answer script for each part

(Part I 60 and **Part II 40**)

Part-II

Answer **all Questions.** Answers should be **brief.** Any **relevant data** may be assumed, if necessary.

1. Answer the following questions very briefly:

   a) Define waste water (WW).

   b) Why is separate sewerage system preferred?

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

   d) When is time of concentration equal to inlet time?

   e) What should be the minimum d/D (notations have usual meanings) for designing a sewer and why?

2X5=**10**

2. Answer the following questions very briefly:

   a) Name a physical WW characteristic and its significance.

   b) Name a chemical WW characteristic and its significance.

   c) What is a chemo-heterotrophic organism?

   d) What is 1st stage BOD?

   e) What is symbiotic algal bacterial WW treatment?

2x5=**10**

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Part-II

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

   b) Calculate the velocity of flow and discharge in a sewer of circular section having diameter of 1 meter, laid at a gradient 1 in 500. Manning's coefficient of roughness may be taken as 0.012. Assume that the sewer running half full. 4+6=**10**

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 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

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Part-II

5. a) Mention utilities of COD test with respect to BOD test.

   b) What is Theoretical Oxygen Demand (ThOD)? What is its utility?

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

   (i) glucose = 200 mg/L (ii) benzene = 25 mg/L 2+3+5=**10**

Or

6. a) Compare ThOD, BOD, BOD_5, COD and TOC

   b) The following data have been obtained from a WW characterization:

   BOD_5 = 500mg/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. 3+7=**10**