Ref No. –EX/CE/T/322/2018

B.CIVIL ENGG. 3rd YEAR 2nd SEMESTER EXAMINATION 2018

WASTE WATER ENGINEERING

Full Marks 100
(60 marks for this part)

Time: Three hours

Use a separate Answer-Script for each part

Part-I

Answer all questions

(Assume any data, if required, reasonably)

[CPHEEO Wastewater manual graphs (figure) are allowed]

[Provide sketches wherever possible]

Q.1. Answer the following (any four): (4×5) = 20

I. Discuss about the 'toxicity', 'persistence', and 'bioaccumulation factor' for analyzing potential environmental impact of pollutants.

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

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

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

VI. 'Oxidation ditch' versus 'oxidation pond'.

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

Q.2.

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

OR

Draw a typical plan and longitudinal section of a (2W+1S) system of screen chamber. 6

Q.3.

Design a secondary sedimentation tank system (2W+1S) to treat effluent from activated sludge plant with the following design data. Average wastewater flow is 107 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.

OR

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. 12

Q.4.

What are the differences between aerobic and anaerobic biological processes?

Find out the following design requirements of a conventional activated sludge process from the given data. Average inflow of raw wastewater is 71 MLD having BOD_5 of 255 mg/l and suspended solids of 420 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 12 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. 3+11

OR

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

Design a mechanical sludge dewatering system (Centrifuge) considering the following data. Sludge volume is 55 m^3/d; total quantity of solids in the sludge is 2400 kg/d; density of sludge is 1030 kg/m^3; operating days are 5 days/week; operating hours are 6 h/day; moisture in the sludge cake is 75%; density of sludge cake is 1100kg/m^3; solids capture for the centrifuge is 90%. Find out capacity and number of centrifuge, amount of sludge cake, amount and quality of centrate. 5+9

Q.5.

Design a Waste Stabilization Pond system with anaerobic pond followed by facultative pond. Wastewater inflow is 12000 m^3/d having BOD_5 of 260 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. 8

OR

Discuss the importance of septage treatment in Indian scenario. Discuss about the two pit latrine.

4+4

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(BCE 3rd Year 2nd semester)

Waste Water Engineering

me: Three Hours

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Use separate answer script for each part

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

Part-II

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

Answer the following questions very briefly:

a) 'Sullage is less objectionable than domestic waste water (WW)'-explain.

b) What are the differences between sanitary WW and combined WW?

c) Mention the steps to calculate peak domestic waste water flow.

d) 'For starting manhole, time of concentration is equal to inlet time'-explain.

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

Answer the following questions very briefly:

a) Name two WW parameters (along with their mode of expressions) which are not expressed in mass/volume basis.

b) Comment about the biodegradability of the natural organic substances present in municipal WW.

c) 'Threshold concentration of formaldehyde is 1500mg/L'-explain.

d) Mention the importance of temperature as a waste water parameter.

e) Explain the importance of photo-autotrophy in waste water treatment. **2x5=10**

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Time: Three Hours | Full Marks:

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Part-II

3. a) What are the product and by-products of municipal WW treatment plants?

   b) Why is it difficult to achieve the goal of sustainable development through treatment of waste only?

   c) A circular sewer of 2m diameter has to carry a flow of $2m^3/s$ when flowing full. Calculate the minimu slope required to have that flow. Manning's 'n' value may be taken as 0.015. Develop the relevant equation from Manning's Equation 2+3+5 =

Or

4. For a sanitary sewer following data are given:

   (i) ultimate peak flow=500lps (ii) present peak flow=400lps (iii) ultimate peak flow may be assumed as full fl

   (iv) n=n′=0.013

   Find S, V, Q and v at ultimate peak flow and v for present peak flow. Comment on your result. Notations hav their usual meaning. Develop the relevant equations from Manning's Equation, if needed. Following table g 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

a) State all the reasons for selection of '5 day' as standard incubation period for BOD test.

b) In a BOD determination test, 6mL septic WW is taken in a standard BOD bottle and mixed with dilution water having DO value 9.1 mg/L. After 5 days of incubation at 20°C, the DO content of the mixture is 2.8 mg/L. Calculate the BOD of the WW sample.

c) Establish the relation between reaction constant K (base e) and K (base 10).

d) Compare the COD and BOD values of a municipal WW sample.

2+4+2=2=10

Or

a) What may be the COD/TOC ratio for glucose? Is it a constant value for all organic compounds?

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

BOD_5 = 400mg/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