

Bachelor of Engineering (Civil Engineering) Examination 2019

(4th Year 1st Semester)

Waste Water Engineering

Time: Three Hours

Full Marks: 100

Use separate answer script for each part (50 marks for each part)

Part-1Answer **Question No. 1** and any **Two** from the rest. Any relevant data may be assumed, if needed.

1. Answer the followings very briefly:

- a) Why is Municipal waste water (WW) treated?
- b) Write a 'number by volume' unit used in expressing one WW Characteristic.
- c) Correlate bioaccumulation with biomagnifications.
- d) What is the source of energy for chemo-heterotrophic bacteria?
- e) Name a fraction of Total Solid that is expressed in 'vol/vol'.
- f) Correlate suspended solid and turbidity.
- g) Why are nutrients sometimes added to waste water?
- h) What is the full form of Surfactants?
- i) Why is ThOD generally more than COD?
- j) Name the most common attached growth system.
- k) Name a biological unit where sewage treatment is accomplished by algae-bacteria symbiosis.
- l) What is endogenous phase?
- m) What should be the colour of glass of the BOD bottle?
- n) What is a bioassay test?
- o) What is 'first stage' BOD?
- p) What is 'inland surface water standard'?
- q) What may be the ground water infiltration rate for calculation of design sanitary WW flow?
- r) Which parameter is not predicted in Rational Method to calculate Design Storm Water Runoff?
- s) How is time of flow calculated?
- t) What should not be the value of d/D (liquid depth/diameter of sewer) ratio?

1x20=20

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2. a) Following data has been found from analysis of solids of a WW sample:
- Weight of dry filter = 1.1798 gm
- Weight of filter and dried solids = 1.1944 gm
- Volume of sample = 500 ml
- Weight of filter and solids after ignition = 1.1818 gm
- Calculate total suspended solids and volatile suspended solids in mg/L.
- b) 6 mL WW sample is taken in a standard BOD bottle and diluted. The dissolved oxygen (DO) of the mixture was initially 7 mg/L and after 5 days of incubation 3 mg/L. The BOD rate constant may be taken as 0.35/day. What may be the BOD_{ultimate}?
- c) If COD of a waste water sample is 400 mg/L, what would be the size of sample for BOD test? Any data may be assumed relevantly. 5+6+4=15
3. a) Determine the ThOD of a waste water sample containing 100 mg/L glycine ($\text{CH}_2(\text{NH}_2)\text{COOH}$).
- b) Write brief note on (i) population equivalent (ii) relative stability
- c) Write all the relevant equations to explain crown corrosion phenomenon.
- d) Write all the equations to explain the activity of nitrifying bacteria. 5+4+3+3=15

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4. a) Develop the expressions for discharge and velocity for circular pipe 'flowing full' conditions from Manning's Equation.
- b) Following database for analyzing an existing sewer are given:
- (i) Ultimate peak flow = 500 lps (ii) Present peak flow 400 lps (iii) Dia = 1050mm (iv) $n = n' = 0.013$
- (v) d/D at ultimate peak flow = 0.80

Calculate Q , V , S , and v at ultimate peak flow and v at present peak flow. Following table may be needed:

d/D	v/V	q/Q
1.000	1.000	1.000
0.900	1.124	1.066
0.800	1.140	0.988
0.700	1.120	0.838
0.600	1.072	0.671
0.500	1.000	0.500
0.400	0.902	0.337

All the notations used in this problem have usual meanings.

- c) Explain the steps to calculate design storm water runoff very briefly.

4+6+5 = 15

Use a separate Answer-Script for each part

No. of Question	Part-II	Marks
Q.1)	<p style="text-align: center;">Answer Question-1 and 2 and any two from the rest</p> <p>A. Fill in the blanks with appropriate word(s):</p> <p>a. The treatment units where removal of pollutants occurs through physical forces are called -----.</p> <p>b. Small screen has opening size smaller than ----- mm.</p> <p>c. Removal of non-biodegradable organics usually occurs in the ----- treatment units.</p> <p>d. In activated sludge process the value of sludge age varies in the range of ----- days.</p> <p>e. Sludge Volume Index is expressed in the unit of -----.</p> <p>f. Oily matters when combine with detergent form-----.</p> <p>g. Growth of ----- in upper reaches of a trickling filter adds oxygen to the percolating wastewater.</p> <p>h. ----- equation is used for calculating efficiency of a trickling filter.</p> <p>B. State whether the under-mentioned statements are True or False with necessary justifications:</p> <p>a. Efficiency of a skimming tank can be increased considerably by passing chlorine gas along with air bubbles.</p> <p>b. In activated sludge process solid retention time is usually less than hydraulic retention time.</p> <p>c. Sloughing in trickling filter is only a function of organic loading rate of the filter.</p>	<p>(1*8)=8</p> <p>(2*3)=6</p>
Q.2)	<p>a) What are the adverse effects that will be caused if a bar screen is not provided in the sewage treatment plant?</p> <p>b) What do you mean by i) F/M ratio and ii) Solid Retention Time (SRT)</p> <p>c) What do you mean by "Settleability of Sludge"? How it is expressed and measured?</p> <p>d) Describe the phenomenon called "Sloughing".</p>	<p>3</p> <p>2+2</p> <p>2+3</p> <p>4</p>

SUBJECT: WASTEWATER ENGINEERING

(Name in full)

Full Marks:100

Time: Two hours/Three hours/Four hours/ Six hours

(50 marks for each part)

No. of Question	Part-II	Marks
Q.3)	<p>a. What do you mean by Grit Particles? What are the significances of velocity control sections in the design of Grit Chambers?</p> <p>b. A grit chamber is to be designed to remove particles having mean diameter 0.2mm and specific gravity of 2.65. The mean temperature of operation assumed to be 25°C. A flow through velocity of 0.3m/sec will be maintained proportional flow weir. Determine the channel dimensions for a peak sewa flow of 13,500m³/ day.</p>	2+3 5
Q.4)	<p>a) Discuss with the help of a neat diagram on the significance of “Overflow Rate” in the context of design of a continuous flow primary clarifier.</p> <p>b) Design a primary clarifier for an activated sludge process for a maximum water demand of 14 million-litre per day (MLD) and detention period of 2 hours. The horizontal flow through velocity is given as 0.3 m/sec. Consider a rectangular tank provided with mechanical cleaning equipment and 80% of supplied water converted into sewage.</p>	5 5
Q.5)	<p>A township having a population of 73,000 persons is producing domestic sewage @ 125 lpcd having an average 225 mg/l of BOD₅. Design a high rate single stage trickling filter for treating the sewage. Assume that the primary clarifier removes 38% of BOD.</p> <p>Given:</p> <p>i) Organic Loading rate = 6422 Kg/hect-m/day</p> <p>ii) Surface Loading rate = 124 million-litre/hect/day (including re-circulated sewage)</p> <p>iii) Recirculation Ratio = 1.20</p> <p>iv) Desired BOD₅ in the final effluent = 30 mg/l.</p>	10