Ref No. –EX/PG/CE/T/111D/6/2017

MASTER OF CIVIL ENGINEERING 1st SEMESTER EXAMINATION, 2017

WATER SUPPLY & TREATMENT

Time: Three hours

Full Marks 100
(40 marks for part I)

Use a separate Answer-Script for each part

Part-I

Question no. **1** is compulsory
Answer any **two** from the rest
(Assume any data, if required, reasonably)

1. Answer the following questions (4+3+4+4+5) = 20

I. Describe the Indian standards for drinking water and health hazards of –
(a) Arsenic; (b) Fluoride; and (c) Nitrate

II. Discuss the importance of hydrogen bond in environmental engineering.

III. Discuss with reasons - the major quality differences between rain water, surface water and ground water.

IV. What are the differences between Langmuir Isotherm and Freundlich Isotherm? What is break-through curve in adsorption?

V. Illustrate the effect of common ion in fractional precipitation when 10^{-4} mole of $BaCl_2$ is added in 1 l of saturated $BaSO_4$ solution. Solubility of $BaSO_4$ is 1.1×10^{-5} mole/l.

2.

a) Develop appropriate half reactions, and from these construct the complete oxidation-reduction equation for reduction of NO_3^- to NO_2^- and oxidation of CH_3CH_2OH to CO_2. 4

b) To a solution containing 0.01M Ba^{2+} and 0.01M Ca^{2+}, SO_4^{2-} is added as Na_2SO_4 (90% pure) in small increments. Find the followings:

(i) At what $[SO_4^{2-}]$ will $BaSO_4$ start to precipitate?

(ii) At what $[SO_4^{2-}]$ will $CaSO_4$ start to precipitate?

(iii) What is the $[Ba^{2+}]$ in the solution when $CaSO_4$ start to precipitate?

(iv) What is the total amount of Na_2SO_4 needed when $CaSO_4$ start to precipitate?

(v) Over what $[SO_4^{2-}]$ range can Ba^{2+} be separated quantitatively from Ca^{2+} ?

Given: K_{sp} of $BaSO_4$ at 25°C = 1.0×10^{-10}

K_{sp} of $CaSO_4$ at 25°C = 1.0×10^{-5} 6

3.

a) A sample of water has a pH of 9.0. 200 ml of this sample water require 5.1 ml of 0.02 N H_2SO_4 to titrate it to the phenolphthalein endpoint and additional 21.9 ml of 0.02 N H_2SO_4 to titrate it further to the orange endpoint. What are phenolphthalein alkalinity and the total alkalinity in mg/L as $CaCO_3$? At what concentration of different 'alkalinity causing species' are present in the sample?

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b) Granular activated carbon (GAC) was tested for its ability to remove soluble organic nitrogen from treated wastewater. Different masses of GAC were added to 2 liters of wastewater having 0.91mg/l initial concentration of soluble organic nitrogen and contacted for 2.5h at 25°C and 7.5 pH. Using the data given in the table determine (i) the maximum capacity of GAC for soluble organic nitrogen (q_m) and (ii) measure of affinity of soluble organic nitrogen for GAC (K_{ads}) based on Langmuir Isotherm.

Sl. No.	Mass of GAC added (g)	C, mg/l of soluble organic nitrogen remaining
1	0.4	0.78
2	1.0	0.66
3	4.0	0.33
4	10.0	0.20
5	20.0	0.15
6	40.0	0.10
7	100.0	0.07

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4.

a) Explain 'Ostwald dilution law'. Find the amount of $[H^+]$ and pH of a 0.2 M HAc solution when K_A of HAc is 1.8×10^{-5}. By what amount is the $[H^+]$ decreased after adding 0.1M NaAc in the solution?

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b) Compute the ionic strength of a solution containing 40 mg/l NaCl, 65 mg/l Na_2SO_4 and 25 mg/l $Mg(NO_3)_2$. Also calculate the activity coefficient and activity of Na^+ and $SO_4^{=}$ ions in the solution.

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MASTER OF CIVIL ENGINEERING EXAMINATION, 2017
First(1st) Semester

SUBJECT: WATER SUPPLY AND TREATMENT

Full Marks ~~30~~/100

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

Use a separate Answer-Script for each part

No. of Questions	Part II (Marks:60)	Marks
	Answer All the Questions. Assume relevant data if not given.	
Q1. a)	A settling column of 2.0 m depth yields the following results. Time, Min: - 0 60 80 100 130 200 240 420 Concentration, mg/L :- 300 189 180 156 128 111 78 27 What will be the basin efficiency of the settling tank with a loading rate of 20M ^{3}/M^2 /day?. Use graphical method for solving the problem.	9
b)	Derive an expression for obtaining gas transfer coefficient on the basis of Two film theory. State the assumption for deducing the above equation	6
Q.2. a)	In an aeration experiment on the removal of CO2 from water by spray aeration , into the air in droplet of size 2mm diameter, the initial super saturation of the water with the gas was found to be 7.5 mg/l . After 5 secs to exposure the concentration was reduced to be 0.75mg/l. Determine the gas transfer co-efficient (K_{La}).	5 5
b)	Show how Two-film theory can be employed to calculate the effluent dissolved oxygen (D.O) through an aeration tank subjected to bubble aeration.	5
c)	With the help of a suitable example show that more numbers of fall will more efficient than a single cascade. Deduce the necessary equation.	
Q3 a)	What is an 'ideal settling tank'? State its assumptions. Compute the terminal settling velocity of a spherical particle with diameter 0.4 mm and specific gravity 2.6 settling through water at 22 ^{o}C temperatures. Give kinetic viscosity of water = 0.962 centistoke	7

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Full Marks ~~30~~/100

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No. of Questions	Part II (Marks:60)	Marks
	Solve the above problem upto 3rd trial	4
b)	Calculate the size of particle of specific gravity 2.65, which would be 100 % removed in a continous flow sedimentation tank of 3.5 m depth and of 65 m length. The flow velocity is observed as 1.22 cm/sec. Assume $\upsilon = 0.01$ cm^2/sec at 25 ^oC	
c)	Ferrous sulphate ($FeSO_4$, 7 H_2O) is to be used for coagulation in a water treatment plant for a flowrate of 10,000 m^3/day The flowrate has a natural alkalinity of 16 mg/L as $CaCO_3$. The dose is 30 mg/L. How much quantity of CaO shall be required daily for coagulation?	4
Q4.		
a)	Deduce the expression for ratio of flocculation kinetics for 'orthokinetic' and perikinetic flocculation?	
	Explain briefly the importance of velocity gradient (G) in mixing unit in chemical sedimentation unit.	8
	Deduce an expression of determining 'G' using a volume element of water	
b)	Following information is available for designing of mixing and flocculation unit of clariflocculator. Flow rate = 5MLD Rapid mixing time = 60sec Viscosity of water = 1.08×10^{-3} N-sec/m^2 The depth of rapid mixing unit = 3.2 m The depth of flocculation basin = 3.8 m Flocculation time = 15 min Determine 1) the power input in the above two units in KW 2) dimension of mixing and flocculation unit Assume G for flash mixing unit - 700 sec^{-1} G for flocculation unit- 35 sec^{-1} Deduce the necessary expression for solving the problem.	7