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The Assam Royal Global University, Guwahati

Royal School of Engineering & Technology

B.Tech. Civil Engineering 6th Semester

Semester End Examination, June 2023

Course Title: Physico-chemical Processes for Water & Wastewater Treatment

(Elective III)

Course Code : CEE022D605

Time: 3 Hours

Maximum Marks: 70

Note: Attempt all questions as per instructions given.

The figures in the right-hand margin indicate marks.

Section – A

1. Attempt all questions. (Maximum word limit 50) 2 x 8
- If tomato juice is Having a pH of 4.1, what will be the hydrogen ion concentration in mol/L?
 - What is Unit process?
 - What is flocculation process?
 - Illustrate filter crack developed in rapid sand filter.
 - How would you identify the use of various type of filter?
 - How would you describe the uses of chlorine as disinfectant for swimming pool?
 - A given sludge with 98% moisture is x times more bulky than with 95% moisture. Determine the value of x .
 - The alkalinity and the hardness of a water sample are 250 mg/L and 350 mg/L as CaCO_3 , respectively. How much carbonate hardness and non-carbonate hardness will present in the water?

Section – B

2. Attempt any two of the following: 6x 2
- At a water treatment plant, 12 million liters of water is treated daily, using alum dosage of 16 mg per liters. Find i) total quantity of alum used daily, ii) amount of carbon dioxide released.
 - In a continuous flow type sedimentation tank having 3.5 m deep and 65 m long and velocity of flow is 1.22 cm/sec. The specific gravity of solid is 2.65 and kinematic viscosity is $1.22 \times 10^{-5} \text{ cm}^2/\text{sec}$. Calculate the diameter of the solid particles that can be removed with 100% efficiency.
 - A plain sedimentation tank with a length of 20 m, width of 10 m, and a depth of 3 m is used in a water treatment plant to treat 4 million litres of water per day (4 MLD). The average temperature of water is 20°C. The dynamic viscosity of water is $1.002 \times 10^{-3} \text{ N-s/m}^2$ at 20°C. Density of water is 998.2 kg/m^3 . Average specific gravity of particles is 2.65. Considering the mention values, Calculate
 - The surface overflow rate in the sedimentation tank?
 - The minimum diameter of the particle which can be removed with 100% efficiency in the above sedimentation tank?

3. Attempt any two of the following: 7 x 2
- A flat bottom trough is to receive the wash water from a section of the filter which is 2 m wide and 3 m long. The wash water rate is 700 litres per min. per sq. m. If the water

is to have a depth of 25 cm at the upper end of the trough, what should be the dimensions of the trough. Also design the dimension if the wash water trough is to be V-shaped

b. Find the loss of head for the sharp filter sand shown in table below, for a bed of depth 65 cm, and operated at a rate of 0.45 cm/sec. Take $e = 0.44$, $\phi_s = 0.8$ and kinematic viscosity = 0.80×10^{-2} cm²/sec.

Mean Dia of particles (cm $\times 10^2$)	3.5	4.5	5.5	6.5	7.5	8.9	11.8
Wt fraction of particles (%)	4	9	20	24	20	14	9

c. Describe with the help of sketches, a Rapid sand filter. Explain its working.

4. Attempt **any two** of the following:

7 x 2

- Chlorine is used as the disinfectant in a municipal water treatment plant. It achieves 50 percent of disinfection efficiency measured in terms of killing the indicator microorganisms (E-Coli) in 3 minutes. Determine the minimum time required to achieve 99.99 percent disinfection efficiency.
- If 0.6 mg/ liters of total chlorine is required for satisfactory disinfection of water at pH = 7.0, what dosage will be necessary at pH = 9.0. If it is given that initially, 12 min contact time is required at pH = 7.0, find contact time at pH = 9.0 if $n = 1.5$ in the equation $C^n t = k$. Take $K_i = 2.7 \times 10^{-8}$ mol/ lit.
- Explain various forms of chlorine that are used in IOCL refinery guwahati

5. Attempt **any one** of the following:

14 x 1

- A sample of raw water contains, 200 mg/l alkalinity, 50mg/l hardness as CaCl_2 and 75 mg/ l hardness as MgSO_4 . Compute the quantities of lime and soda required to treat 1 million liters of water. If slaked lime of 85% purity is available in place of pure lime, what will be the required quantity of slaked lime? What way would you design for the treatment of Royal Global University drinking water, if the water source is Brahmaputra River.
- Design a parabolic section of a grit channel for the following data:
 - Maximum flow: 60,000 m³/day
 - Minimum flow: 14000 m³/day
 - Average flow: 37000 m³/day
 - Horizontal velocity: 0.25 m/sec