

The Assam Royal Global University, Guwahati

Royal School of Engineering & Technology

B.Tech (Civil Engineering), 6th Semester

Semester End Examination, July 2022

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

- a. The alum, when added as coagulant in water
 - i. Does not require alkalinity in water for flocculation
 - ii. Does not affect pH value of water
 - iii. Increases pH value of water
 - iv. Decreases pH value of water
- b. What are the assumptions of Stokes law?
- c. Match List I with List II:

List I (Terms/Description)	List II (Treatment operation/process)
A. Sludge volume index	1. Settling in primary sedimentation tank
B. Thickening of sludge	2. Settling in secondary Sedimentation tank
C. Scum Removal	3. Filtration in trickling filter
D. Recycling effluent	4. Activated sludge process

- d. The chlorine demand of a water sample was found to be 0.2 mg/l. Determine the amount of bleaching powder containing 30% available chlorine to be added to treat one liter of such a water sample.
- e. What is Break point chlorination?
- f. The alkalinity and the hardness of a water sample are 250 mg/L and 350 mg/L as CaCO₃, respectively. How much carbonate hardness and non-carbonate hardness will present in the water.
- g. Two sample of water A & B have pH value of 3.2 and 5.7. How many times more acidic sample A is then sample B.
- h. What is adsorption?

Section – B

2. Attempt any two of the following: 6 x 2

- a. Consider a primary sedimentation tank (PST) in a water treatment plant with surface Overflow Rate (SOR) of 40 m³/m²/d. Find the diameter in μm of the spherical particle which will have 90 percent theoretical removal efficiency in this tank. Assume that

settling velocity of the particles in water is described by Stokes's Law. Given Density of water = 1000 kg/m^3 ; Density of particle = 2650 kg/m^3 ; $g = 9.81 \text{ m/s}^2$; Kinematic viscosity of water (ν) = $1.10 \times 10^{-6} \text{ m}^2/\text{s}$.

- b. 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.
- c. What are the limitations of Aeration? Explain.

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

7 x 2

- a. A city has a population of 100,000 with an average rate of demand of 160 liters per day. Find the area of rapid sand filter.
- b. Write short notes:
 - i. Pressure filter
 - ii. Double filtration
- c. Describe with the help of sketches, a slow sand filter. Explain its working.

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

7 x 2

- a. An experiment shows that a concentration of 0.1 g/m^3 of free available chlorine yield a 99% kill of bacteria in 8 minutes. What contact time is required to achieve a 99.9% kill at a free available chlorine concentration of 0.05 g/m^3 ? Assume that Chick's Law and Watson's Law hold with $n=1$.
- b. Write short notes on various forms of chlorine?
- c. If 0.6 mg/l of total chlorine is required for satisfactory disinfection of water at $\text{pH} = 7.0$, what dosage will be necessary at $\text{pH} = 9.0$. If it is given that initially, 12 min contact time is required at $\text{pH} = 7.0$, find contact time at $\text{pH} = 9.0$ if $n = 1.5$ in the equation $C^n t = k$. Take $K_1 = 2.7 \times 10^{-8} \text{ mol/lit}$.

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

7 x 2

- a. 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?
- b. A raw water sample contains the following impurities:
 $\text{CaCO}_3 = 200 \text{ ppm}$, $\text{MgCl}_2 = 150 \text{ ppm}$, $\text{Mg}(\text{HCO}_3)_2 = 120 \text{ ppm}$, $\text{MgSO}_4 = 100 \text{ ppm}$,
 $\text{CaSO}_4 = 100 \text{ ppm}$, $\text{NaCl} = 25 \text{ ppm}$, $\text{Fe}_2\text{O}_3 = 40 \text{ ppm}$, $\text{SiO}_2 = 30 \text{ ppm}$.
Compute the annual requirement of slaked lime and soda, for treating 80000 litres of water daily. The purity of slaked lime is 85% and that of soda is 90%
- c. What are the advantages and disadvantages of Lime soda process?