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B.Sc. Engg. (CEE)/ 4th Semester — 20 February, 2023 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Mid Semester Examination — **Summer Semester: 2021-2022**
Course No.: CEE 4431 — **Full Marks: 75**
Course Title: WATER SUPPLY ENGINEERING — **Time: 1.5 hours (2:00 -3:30 PM)**

There are **03 (Three) Questions**. **Answer ALL the Questions**. The related CO-PO and the marks for each questions are also shown. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning.

1(a) Prepare a list for investigation of a surface water source for water supply in a city with respect to quality and quantity. What are the criteria of a safe water? — CO1, PO1: **(06)**

What are the differences between primary and secondary standards? — CO1, PO1: **(06)**
A drinking has the following characteristics:
Turbidity of water = 15 NTU, Fluoride = 2.5 mg/L, Fe = 1.5 mg/L, As = 40 µg/L, Nitrate = 20 mg/L and *E.coli* = 10 No. /100 mL.
List the health problems (short and long term) may arise from the drinking of this water.

(b) There are several methods for the projection of future population in an urban area. Which methods are suitable for population projection in Gazipur City Corporation area? What are the data required for the methods? — CO1, PO1: **(05)**

(c) The population data of an urban area is given below: — CO1, PO1: **(08)**

Year	1960	1970	1980	1990	2000	2010
Population (Thousand)	40	46	56	65	78	90

If the per capita water consumption in 450 lpcd, estimate the design capacity of the water treatment plant and the distribution network for water supply in the area for 2040. Use Least Square Parabolic method for population estimation. What will be the volume of water required for firefighting in 2040?

(d) A water treatment plant is proposed to treat 20,000 m^3/day of water. A Jar test was conducted with alum and it was found that the optimum alum dosage obtained when 50 mL alum solution containing 1.0 gm/L is added into 2.0 L of water. Calculate the amount of alum required (kg) in a month to run the plant. Also calculate the alkalinity that will be consumed at this alum dosage. — CO1, PO1: **(05)**

2(a) A settling column analysis is run with type-I suspension. The settling column is 2.0 m depth and the initial concentration of the well-mixed suspension is 600 mg/L. Results of the analysis is given below. — CO2, PO2: **(08)**

Time (min)	0	58	77	91	114	154	250
Conc. remaining (mg/L)	600	560	415	325	215	130	52

Determine the theoretical removal efficiency of a settling basin with a surface area of 500 m^2 and an inflow of 14,500 m^3/day.

(b) (i) What is the effect of surface overflow rate (SOR) on the performance of plain sedimentation process? CO2, PO2 **(06)**

(ii) Aeration of groundwater prior to chemical softening can save a significant amount of chemical required for softening-explain how?

(iii) Suppose that the depth of a sedimentation tank is reduced by 50%. Assume discrete particle settling, what is the effect on particle removal efficiency if the flow rate is unchanged? Explain your answer.

(iv) Chemical coagulation in water treatment plants are normally accomplished by the addition of trivalent metallic salts. Explain why?

(c) A water has the following ionic constituents in mequiv/L: CO2, PO2: **(08)**

$Ca^{+2} = 4.7$ $HCO_3^- = 2.5$

$Mg_{+2} = 1.0$ $SO_4^{-2} = 2.9$

$Na^+ = 2.2$ $Cl^- = 2.5$

$CO_2 = 0.6$

(i) Calculate the chemical requirements required to remove as much as Ca as possible and to re-stabilize the water (Mg hardness removal is not required)

(ii) Calculate the daily quantity of lime and soda ash to treat 25,000 m^3/day of this water and also the amount of sludge produced per day.

(d) The influent particles settling characteristics of a rectangular horizontal flow sedimentation basin is given below: CO2, PO2: **(08)**

Ave. settling velocity, m/h	Number of particles in suspension, No./mL
0.2	511
0.6	657
1.0	876
1.4	1168
1.8	1460
2.2	1314

Calculate the counts of the particles at the outlet zone and the overall particle removal efficiency in this settling basin, if flow rate is 19,000 m^3/day and the length and width of the basin are 72 m and 12 m, respectively.

3(a) For a mechanically tapered coagulation-flocculating process, rapid mixing chamber and 03 flocculating tanks are required to be constructed in series. The designed velocity gradient in the rapid mixing chamber is 700 sec^{-1} and that for the first, second and third Flocculating tanks are $80s^{-1}$, $50s^{-1}$ and $20s^{-1}$, respectively. The flow rate for each tank is 2 million liters per day and the water temperature is 20^OC ($\mu = 1.005x10^{-3}$ kg/m-sec and density of water = 998.23 kg/m^3). Retention time for rapid mixing tank is 2 minutes and that for flocculating chamber is 30 minutes. CO3, PO3: **(07)**

Design the rapid mixing and flocculation tanks to treat the water.

(b) Design a sedimentation basin to treat water of 18,900 m^3/day for an overflow rate of 30 m/d, detention time of 4.0 hrs and 250 m^3/m.day weir loading rate. Use a rectangular basin with length to width ratio of 4 to 1. CO3, PO3: **(04)**

(c) Determine the appropriate number of circular sedimentation basins and the dimensions to treat 75,000 m^3/day at an overflow rate of 0.8 m/hr. CO3, PO3: **(04)**