NATIONAL EXAMINATION, DECEMBER 2018

16-CIV-B5-Water Supply and Wastewater Treatment

3 hours duration

Notes:

1. Question 1 is compulsory, attempt any three questions from the remaining four questions.
2. If doubts exist as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
3. This is a closed book exam. However, one aid sheet is allowed written on both sides.
4. Only an approved Casio or Sharp calculator is permitted.
5. Marks of all questions are indicated at the end of each question.
6. Clarity and organization of answers are important.

Q1 (25 marks)

Describe and explain the significance of the following in water and wastewater characteristics:

    i.   Sulfates and Nitrates in water **(5 marks)**

    ii.   Total ammonia nitrogen and free ammonia in wastewater **(5 marks)**

    iii.   Alkalinity in wastewater **(5 marks)**

    iv.   Chemical oxygen demand in wastewater **(5 marks)**

    v.   Iron and Manganese in water **(5 marks)**

Q2 (25 marks)

a. 20 mL of a water sample required 6 mL of 0.02N H_2SO_4 to reach the end-point with phenolphthalein as indicator (pH 8.3) , and 8 mL of 0.02N H_2SO_4 to reach the end-point with Bromocresol Green (pH 4.5). Name the type of alkalinity indicated by each of these end points and determine the value of each alkalinity. Also, what other type of alkalinity value can you calculate from these two observations, and what is its value? **(15 marks)**

b. Explain the principal and working of disinfection of water by UV radiation. State its key advantages and disadvantages over chlorination. **(10 marks)**

Q3 (25 marks)

c. Define and explain the significance of solids retention time and solids loading rate in the secondary treatment system of activated sludge process. **(15 marks)**

d. As a consulting engineer you are asked to select the preferred sludge digestion process for an extended aeration wastewater treatment plant. Which digestion process out of aerobic and anaerobic would you prefer if the plant is operating at an SRT of 30 days? List the factors considered for your evaluation and the reasons for your choice. **(10 marks)**

Q4 (25 marks)

Describe the following in water treatment:

a. "Schmutzdecke or dirty skin" and backwash in rapid sand filters. **(8 marks)**

b. Design and operating principle of coagulation-flocculation-settling systems in water treatment. **(9 marks)**

c. Mechanisms of contaminant removal in the filtration process. **(8 marks)**

Q5 (25 marks)

a. With the help of a sketch, explain the working principle and operation of a facultative lagoon. **(10 marks)**

b. Determine the SRT of an activated sludge system with average raw sewage flow of 10000 m^3/d, aeration tank volume of 2,500 m^3, MLSS concentration of 3,000 mg/L, waste sludge production of 300 m^3/d, and the return activated sludge solids concentration of 8,000 mg/L. Also calculate the surface area of the secondary clarifier so that the surface over flow rate does not exceed 40 m^3/m^2-d under peak flow condition. Make suitable assumptions. **(15 marks)**