NATIONAL EXAMINATION, MAY 2019

18-ENV-A4-Water and Wastewater Engineering

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. 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)

Define and explain the following terms in water and wastewater engineering

  a. Carbonaceous BOD_5 **(5 marks)**
  b. Nitrification in wastewater treatment **(5 marks)**
  c. Types of alkalinity in water or wastewater **(5 marks)**
  d. Sloughing of biomass in trickling filter **(5 marks)**
  e. Turbidity in water **(5 marks)**

Q2 (25 marks)

  a. 20 mL of a water sample required 3 mL of 0.02N H_2SO4 to reach the end point with phenolphthalein as indicator (pH 8.3) , and 5 mL of 0.02N H_2SO4 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 of ozonation for disinfection of water. Give two advantages and two disadvantages of ozonation over chlorination for disinfection **(10 marks)**

Q3 (25 marks)

A conventional activated sludge based wastewater treatment plant (WWTP) has an average flow of 16,000 m^3/d. There are two (2) circular secondary clarifiers in the WWTP which operate at a surface overflow rate of 16 m^3/m^2-d at average flow.

  a. Determine the diameter of each secondary clarifier **(8 marks)**
  b. If the aeration tank in the WWTP is operated at an MLSS of 3,000 mg/L, and return activated sludge flow is 10,000 m^3/d, determine the solids loading rate on the secondary clarifiers at average flow. **(7 marks)**
  c. With aeration tank volume of 4,000 m^3; waste sludge rate of 150 m^3/d at waste sludge MLSS of 8,000 mg/L, calculate the SRT of the system **(10 marks)**

Q4 (25 marks)

Define and differentiate between

  a. Chlorination and Dechlorination of wastewater **(6 marks)**
  b. Facultative and aerated lagoons **(6 marks)**
  c. COD and BOD_5 **(7 marks)**
  d. Coagulation and Flocculation **(6 marks)**

Q5 (25 marks)

  a. 5 ml of a raw sewage sample diluted to 300 mL in a BOD bottle had an initial DO of 8.0 mg/L. After 3 days of incubation at 20°C, the DO in the sample was measured at 5.0 mg/L. Assuming 5% of the oxygen demand over this 4-day period being contributed by the seed in the sample, determine the standard BOD_5 and ultimate BOD of the sample. **(15 marks)**
  b. Outline and briefly describe the 4 key steps of the digestion mechanism in anaerobic sludge digesters **(10 marks)**.