

**NATIONAL EXAMINATION, MAY 2013**

**98-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. An approved 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 briefly describe the significance of the following parameters of water or wastewater characteristics.

- i. Turbidity in water (5 marks)
- ii. pH and Alkalinity in water (5 marks)
- iii. Taste and odour in water (5 marks)
- iv. Biochemical oxygen demand in wastewater (5 marks)
- v. Total Kjeldahl Nitrogen in wastewater (5 marks)

**Q2 (25 marks)**

- a. Define and differentiate between discrete and flocculent settling. List the factors that affect the discrete particle settling and briefly explain the effect of each on discrete settling (10 marks)
- b. Explain the mechanisms of charge neutralization, ionic layer compression, and sweep coagulation in the treatment process of coagulation-flocculation (15 marks)

**Q3 (25 marks)**

A city wastewater treatment plant (WWTP) treats  $10,000 \text{ m}^3/\text{d}$  of wastewater and discharges the treated effluent to a river which has a flow of  $5.79 \text{ m}^3/\text{s}$ . The current effluent discharge limit for total phosphorus (TP) from the WWTP is  $1.0 \text{ mg TP/L}$ . A water quality study of the river has indicated that the background concentration of TP in the river upstream of the WWTP discharge is  $0.01 \text{ mg/L}$  and that the river can assimilate TP concentration of up to  $0.02 \text{ mg/L}$ , beyond which TP will have a deteriorating impact on the water quality and aquatic life of the river. Comment on the current effluent TP limit based on this finding and determine if this finding should cause any change in the current effluent TP limit and by how much (25 marks)

**Q4 (25 marks)**

A primary clarifier in a wastewater treatment plant has a hydraulic retention time (HRT) of 2.0 h and a side water depth of 3.0 m. The plant has an average flow of  $15,000 \text{ m}^3/\text{d}$ .

- a. Determine the volume and surface overflow rate (SOR) of the clarifier (10 marks)
- b. Constructing an additional identical primary clarifier or doubling the height of the existing clarifier both result in doubling the overall primary clarification volume. Which of these two options would you recommend for improving the overall settling efficiency of primary treatment? Explain the reasoning behind your choice with reference to the HRT and SOR. (15 marks)

**Q5 (25 marks)**

With the help of a process schematic, describe the principal and working of a trickling filter. Also list the common issues associated with the operation of a trickling filter. (25 marks)