NATIONAL EXAMINATION, MAY 2019

16-CIV-B5-Water Supply 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 briefly describe the significance of the following in water/wastewater treatment or analysis.

i. Population equivalent **(5 marks)**
ii. Indicator organisms **(5 marks)**
iii. Harmon peaking factor **(5 marks)**
iv. Disinfection by-products **(5 marks)**
v. Coagulation and flocculation **(5 marks)**

Q2 (25 marks)

a. With the help of the chemical equation involved, explain how the water pH influences the disinfection efficiency **(12 marks)**
b. For a town of population 5,000, calculate the average and peak wastewater flow assuming an average daily water demand of 450 L per capita per day. Make suitable assumptions where required **(13 marks)**

Q3 (25 marks)

a. List the key requirements of an adequate water distribution system. Discuss the advantages and disadvantages of grid iron and dead end system. **(10 marks)**
b. A city has a wastewater treatment plant (WWTP) with a rated capacity of 12,000 m^3/d and needs to expand it to 15,000 m^3/d. The treated effluent from WWTP is discharged to a river. The current effluent discharge limits for $cBOD_5$ and total phosphorus (TP) are 10 mg/L and 0.5 mg/L respectively. As a requirement of the WWTP expansion, the effluent loadings of TP and $cBOD_5$ are not to exceed the loading limits for the current capacity. Also, an additional loading limit of 60 kg/d of total ammonia (TAN) is to be included. Determine the new effluent limits for $cBOD_5$, TP and TAN for higher capacity and comment on the impact of revised limits on the aeration requirements. **(15 marks)**

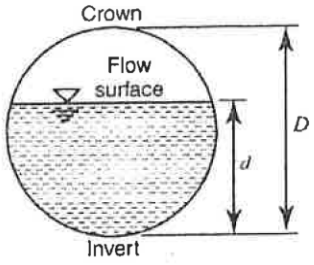
Q4 (25 marks)

a. Identify and explain briefly four key phenomenon by which particles get removed in filtration of water **(10 marks)**
b. Define and differentiate between free residual and combined residual chlorine **(8 marks)**
c. Describe the process of break-point chlorination **(7 marks)**

Q5 (25 marks)

The invert elevation of a 300-mm sewer drops by 1.0 m over a 200 m distance. Determine the discharge and flow velocity in the sewer when flowing 30% full. Assume n = 0.013. Refer the pipe flow curves provided on the next page. **(25 marks)**

Partial Flow in Pipes



Nomenclature:
d = partial depth
D = full depth or pipe diameter
q = partial discharge
Q = full-flow discharge
v = velocity, partially full
V = velocity, full