NATIONAL EXAMINATION, May 2015

98-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 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)

Explain the impact of the following characteristics of wastewater on the receiving water bodies:

i. BOD **(5 marks)**
ii. Phosphorus **(5 marks)**
iii. Total ammonia, free ammonia and nitrates **(5 marks)**
iv. Pathogens, residual chlorine and sodium bisulfite **(5 marks)**
v. High temperature **(5 marks)**

Q2 (25 marks)

a. Define and differentiate between BOD_5, $cBOD_5$ and ultimate BOD **(10 marks)**
b. Explain the significance of fluorides, nitrates, sulfates and hardness as water quality parameters **(15 marks)**

Q3 (25 marks)

a. Explain the process of coagulation-flocculation with specific reference to charge neutralization, ionic layer compression and sweep coagulation. **(15 marks)**
b. Define taste and odour (T&O) in water supplies. Name typical sources of T&O in water supplies and briefly explain the principle of at least two T&O removal processes used in water treatment. **(10 marks)**

Q4 (25 marks)

Explain the following in water treatment:

a. Shmutzdecke, filter headloss, and filter backwash in rapid sand filtration. **(9 marks)**
b. Relationship between surface overflow rate and settling efficiency in primary sedimentation tanks. **(8 marks)**
c. Permanent hardness and its principle of removal in ion exchange process. **(8 marks)**

Q5 (25 marks)

With the help of a neat diagram, explain the working principles and operation of a trickling filter in wastewater treatment, with special reference to biofilm formation and sloughing, aeration of biomass, effluent recirculation and nuisance organisms.