Motilal Nehru National Institute of Technology Allahabad

Odd Semester 2015-16

B.Tech V Sem (Civil Engineering)

Environmental Engineering-I (CE 1505)

End Semester Examination

3 Hrs

MM: 60

OTE: Q1 is compulsory. Attempt any four from Q2-Q6.
Attempt all questions in given sequence to avoid negative marking
Assume suitable data, if necessary

Q1 a.

1. Mention the interval at which the following are provided along the pipeline:
   i). Manhole ii). Sluice valve → Gate Valve.
2. Provide the following information:
   i). Depth of water seal in traps ii). Size of residential ferrule bore
3. Calculate the carbonate and non-carbonate hardness, if the total hardness and alkalinity of water sample are 300 mg/L and 100 mg/L as $CaCO_3$ respectively.
4. A standard multiple-tube fermentation test was conducted on a water sample. The results of the analysis are given below:

Sample size (mL)	No. of positive results out of 5 tubes	No. of negative results out of 5 tubes
10	5	0
1.0	5	0
0.1	3	2
0.01	1	4

MPN index for combination of positive results is as follows:

Combination of positive	MPN index per 100 mL
5-5-1	350
5-5-3	920
5-3-1	110

[1×4=4]

b.

1. Enumerate the disadvantages of employing-
   (i) Steel pipes in conveyance and distribution of water
   (ii) Steel, concrete and AC pipes as sewers
2. Calculate the alkalinity of a water sample at pH 7 containing 122 mg/L of bicarbonates.
3. Two sewers with dia. 300 mm and 600 mm run half-full. Find the ratio of their velocities if the slope of both pipes is same.
4. A stratum of clean sand gravel 5 m deep has a coefficient of permeability as 1×10^{-3} m/s and supplied with water from a ditch that penetrates to the bottom of the stratum. If the water surface of the infiltration gallery lies 1 m above the sole and its distance to the ditch is 12 m, calculate flow per metre of gallery.

[2×4=8]

Q2 a. What is the purpose of providing the following?
(i) Surge arrester (ii) Butterfly valve (iii) Scour valve (iv) Check valve [4]

b. A tannery with a wastewater flow of 0.011 m^3/s and a BOD_5 of 590 mg/L discharges into a river which has 10-year, 7-day low flow of 1.7 m^3/s. Upstream of the tannery, the BOD_5 of the river is 0.6 mg/L. The BOD rate constants k are 0.115 d^{-1} for the tannery and 3.7 d^{-1} for the river. The temperature of both the river and tannery wastewater is 20°C. Calculate the initial ultimate BOD after mixing. [4]

c. Determine the lime and soda dose to soften water to a final hardness of 70 mg/L as $CaCO_3$. The ion concentrations (mg/L as $CaCO_3$) are reported as follows:
$Ca^{2+} = 220$, $Mg^{2+} = 75$, $HCO_3^- = 265$, $CO_2 = 17$ [4]

Q3 a). Differentiate between the following on the basis of function/utility:
(i) Clean-out and Lamphole (ii) Manhole and Drop manhole. Draw neat sketches to explain. [4]
b). What are the usual approaches adopted for "setting out" of sewer lines? Why is "timbering of trench" needed? [4]
c). For a small town having a projected population of 30,000 residing over an area of 20 hectares, find the design discharge for a combined sewer for the following data:
i). Rate of water supply = 150 Lpcd
ii). Runoff coefficient = 0.4
iii). Time of concentration = 30 minutes

Assume coefficients a = 40 and b = 20 in the expression for rainfall intensity $R = \frac{25.4\,a}{t+b}$ mm/h, where t is duration in minutes. Assume 75% water supply to reach sewer as wastewater. [4]

Q4 a). Outline the steps undertaken in the testing of water supply pipeline and sewers. [4]
b). Explain with neat sketch various types of storm regulators provided in combined sewerage. [4]
c). Identify if the maximum water hammer pressure will be generated in a pipe of 2 m diameter with an initial velocity of 2.5 m/s and length of 9 km. the downstream valve at pipe end is closed in 4 seconds. The bulk modulus of water is 2.2×10^6 kPa and mass density is 995 kg/m^3. Estimate the water hammer pressure and critical time of closure, neglecting elasticity of pipe material. [4]

Q5 a). What is the need for ventilation in sewers? Explain the function of an anti-siphonage pipe with the help of neat sketch. [4]
b). Explain the difference in behavior of unconfined and confined aquifers during pumping and its influence on the assumptions made in deriving the Thiem's formula for well yield in case of both aquifers. [4]
c). A 50 cm diameter sewer is required to flow at half-depth on a grade ensuring a degree of self-cleaning equivalent to that obtained at full depth at a velocity of 0.9 m/s. Find the required grade, velocity and discharge at full and half depths. Assume uniform N=0.015 at all depths. [4]

Q6 a). Enumerate the various appurtenances provided in the water supply mains bringing water from a source to the city, distribution system as well as in the service connection from water mains. [4]
b). Design a raw water intake and screening facility for a city with average daily demand of 64,000 m^3/d. The minimum and maximum reservoir elevation is 65 m (MSL) and 85 m (MSL) respectively, and the normal water level is 80 m (MSL). The bottom elevation of the intake is 55 m (MSL). The velocity through the course and fine screen should not exceed 8 cm/s and 0.2 m/s. Make any other suitable assumption and provide diagram with necessary details. [8]
