INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR
M.E. (Civil) 2nd Semester Examination, May, 2014
ENVIRONMENTAL ENGINEERING HYDRAULIC DESIGN (CE 1021)

Full Marks : 70 . Time : 3 Hours

PART – 1

Answer any 3 (Three) questions.

1. How the design of a water supply system is influenced by the fluctuation in water demand? Estimate the average & maximum daily demand and the average & maximum hourly demand of a town sheltering a population of 75000.
   What do you understand by 'hydraulics' of the water supply pipe? Define the term 'Nomogram' and mention its utility for designing a water supply pipe.
   (3+4+3+4=14)

2. How can you determine the friction factor (f) in Darcy-Weisbach's formula?
   Design a water supply pipe to carry a discharge of 30 LPM under a pressure 140 kPa at the consumer point, which is 1200 m away from the inlet. The pumping head may be considered as 22 m. [C= 100].
   Write the scope of 'Modified Hazen-William's formula' in hydraulic design of a water supply pipe. Briefly highlight on the 'cost-effective design' of the pipelines as per CPHEEO manual.
   (4+4+3+3=14)

3. How can water be supplied to a city with varying demand by means of a pump system and an elevated reservoir? Draw the H.G.L. under various operating conditions and write the relevant energy equations. What is the 'Load centre'?
   Estimate the maximum amount of water flow that can be obtained from a 'Pumping with gravity' system' of a city with following inputs.
   (i) R.L. of the Pump Head = 50 m (from datum)
   (ii) R.L. of the city = 5 m (from datum)
   (iii) R.L. of the Reservoir Head = 35 m (from datum)
   (iv) Length and Diameter of the pipeline between the pump and the city = 600 m and 300 mm.
   (v) Length and Diameter of the pipeline between the city and the reservoir = 750 m and 250 mm.
   (vi) 'f' vale of the pipeline between the pump and the city = 0.05
   (vii) 'f' vale of the pipeline between the city and the reservoir = 0.04
   (viii) Desired water supply pressure at the city point = 140 kPa
   (3+4+2+5=14)

4. Write the general hydrological equilibrium relationship in case of groundwater. What are the assumptions of 'equilibrium analysis,' for estimating the well discharge? How would you determine the 'well discharge' under unsteady flow condition?
   Derive an expression for estimating the discharge from an unconfined aquifer. The depth of water table inside the well before and after pumping is H m and h m respectively. The 'radius of influence' and the 'diameter' of the well are R and d respectively. Consider steady state equilibrium of groundwater flow and the co-efficient of permeability as k.
   (2+3+4+5=14)

P.T.O.

PART – 2

Answer any 2 (Two) questions.

5. What do you understand by 'per capita sewage flow' from a town? Briefly highlight on different methods of estimating 'Groundwater infiltration'. Write the steps involved in determining the intensity of rainfall (i) for a specific return period.
Calculate the quantity of 'dry weather flow' and 'combined flow' from a city having population 125000. The area coverage of the city is 17 km^2. The optimum intensity of rainfall for a return period of 20 years is estimated as 35 mm/hr. The weighted average imperviousness for the city is already estimated as 0.72. The proposed combined sewer would be laid below the G.W.T.

(2+3+3+6=14)

6. How can you estimate the 'self-cleansing velocity' in a gravity sewer? Briefly highlight on the 'Hazen-William's method' for calculating velocity of sewage flow. What are the criteria for designing a sewer?
A circular sewer of diameter 300 mm is laid at a slope of 1 in 1250. The sewage is flowing under 70% filled condition. The Manning's co-efficient for the sewer is 0.011. Estimate the velocity and the flow of sewage in that sewer. Assume any other data, if necessary.

(3+2+3+6=14)

7. Write the general principle of hydraulic network analysis. State the utility of such analysis in designing a water distribution system. Briefly highlight on the "Balancing head" approach of network analysis proposed in Hardy-Cross .method.
A square water supply grid ABCD is equally divided into two parts with a pipe (EF II AB) of length 1000 m and diameter 300 mm. The length of all the outer pipes in ABCD is 1000 m, whereas diameter of AB, BC, CD and DC are 350 mm, 250 mm. 300 mm and 350 mm respectively. It is estimated that a 5 m^3/min of water flows into the Node A and a 2.5 m^3/min of water each flows out from Node F and Node C. Determine the actual discharge of water in all the pipe segments of the above network. The 'C' value of all the pipes can be taken as 100.

(2+3+3+6=14)