ME (C.E.) 2nd SEMESTER FINAL EXAMINATION, 2012-13
Environmental Engineering Hydraulic Designs (CE 1021)

Time Allowed: 3 hrs. **Full Marks: 70**

Assume reasonable data if necessary.
Answers should be brief and to the point.
*Answer **FIVE (5)** questions.*

1) a) How will you estimate the quantity of water required by a town while arranging a water supply scheme for the same?
b) Discuss about various factors which directly affect the per capita water demand of a town?
c) The populations of a town as per the Census records are given below for the years 1941 to 2011. Assuming that the scheme of water supply will commence to function from 2016, it is required to estimate the population 30 years and also the intermediate population 15 years after 2016. Use geometric progression method for population forecasting. If average daily demand is 135 lpcd, find average daily draft, maximum daily draft, maximum hourly draft of the maximum day and fire flow according to Kuichling's formula after 30 years of commencement of the scheme.

Year	1941	1951	1961	1971	1981	1991	2001	2011
Population	41,300	45,200	59,800	74,100	97,600	1,22,700	155,000	185500

5+3+6=**14**

2) a) State the various methods of water distribution system. State the different layout of distribution system and mention their merits and demerits.
b) Show the various pattern of sewage collection system of a city. Which factors mainly govern the various collection patterns?
c) Compare between 'separate' and 'combine' system of sewerage.
d) What are the differences between drains and sewers? Show the various sections of drains and sewers.

4+3+3+4=**14**

3) a) Define the following terms with sketches (if required)
(i) Specific yield; (ii) Piezometric surface; (iii) Perched aquifer; (iv) Storage coefficient; (v) Coefficient of transmissibility.
b) Derive the expression of discharge for a fully penetrated well in a confined aquifer assuming radial steady flow.
c) A 30 cm diameter well penetrates 25 m below the static water table. After 24 hours of pumping at a rate of 5400 liter/minute, the water level in a test well at 90 m is lowered by 0.53 m and in a well 30 m away the drawdown is 1.11 m. What is the transmissibility of the aquifer? Also determine the drawdown in the main well.

5+4+5=**14**

4) a) Define the terms with suitable examples.
(i) Aquifer, (ii) Aquitard, (iii) Aquiclude and (iv) Aquifuse
b) Give an equation defining Darcy's law. What is its limitation?
c) What is infiltration gallery? Derive an expression for discharge through an infiltration gallery mentioning the assumptions.
d) Design an infiltration gallery, given the following:
Population = 75000 — Per capita water supply = 135 liters/day
Length of test gallery constructed = 6 m — Static water depth = 5 m
Pumping rate = 600 lpm — Drawdown corresponding to 600 lpm = 1.5 m
It is desired to maintain a depth of atleast 1 m above the sole of the aquifer. Draw a typical cross section of the gallery indicating different layers.

3+3+4+4=**14**

5) a) Write the Hazen-Williams formula in connection with the pipe flow. State its limitations and also write the modified Hazen Williams formula.
b) Comment on the values of friction factor in case of pipe flow.

c) A pipe network consists of the following pipes.

Pipe	Length (m)	Diameter (mm)	Friction factor
AB	400	300	0.014
BC	600	300	0.010
AD	500	400	0.012
DC	500	250	0.011

Inflow at A is 1.0 cum/s, while outflows at B, C and D are 0.3, 0.5 and 0.2 cum/s respectively. Find the flow in each pipe using Hardy Cross method.

4+3+7= **14**

6) a) Derive the expression for different hydraulic elements of a circular sewer when running partially full.
b) Why sewers are designed for maximum and minimum flow?
c) A town has a population of 200000 persons with a per capita water supply of 135 liters/day. Design a sewer running 0.7 times full at maximum discharge. Take a constant value of N = 0.013 at all depths of flow. The sewer is to be laid at a slope of 1 in 500. Take a peak factor of 3. Assume 85% of water supplied will be wastewater. (Refer Fig. 6.c).

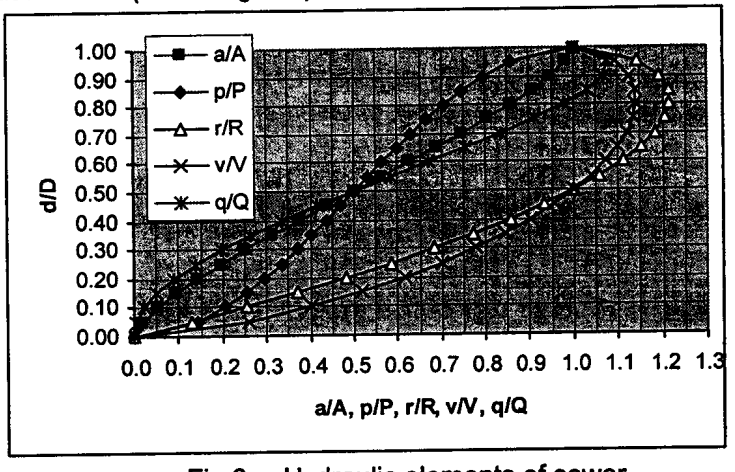
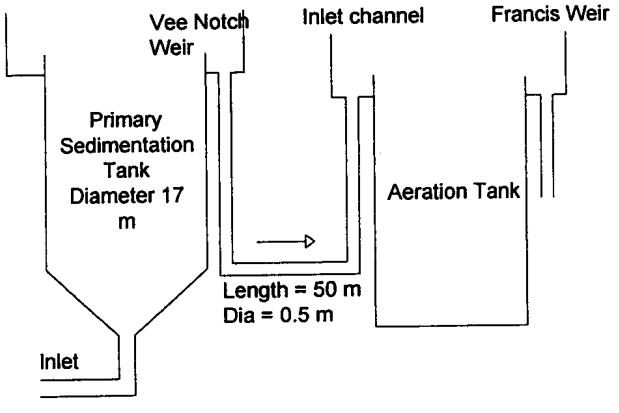


Fig 6.c: Hydraulic elements of sewer

6+3+5= **14**

7) Prepare a hydraulic profile for peak flow conditions and set the control elevation for the portion of the treatment plant shown below.



Flow Rates:
Average flow = 10000 m^3/d Peak flow = 20000 m^3/d
Primary sedimentation tank:
Weir spacing = 0.3 m Weir type = 90° Vee notch
Weir depth = 0.1 m Returned sludge = 0.15Q
Aeration tank:
Length of influent and effluent weir = 16 m
Inlet and effluent weir type = straight sharp crested (Francis weir)
Returned sludge = 0.25Q
Head loss computations:
Head loss coefficients for
Pipe entrance = 0.5
Pipe bends = 0.4
Pipe exit = 1.0
Darcy-Weisbach friction factor = 0.020
Head loss across the aeration tank = 0.03 m
In setting weir elevations assume free fall of 0.01 m between weirs crest and water surface in the downstream channel.
Water surface elevation in aeration tank effluent channel = 100.0 m

14

8) Write short notes on the following:
a) Estimation of sewage quantity
b) Equivalent pipe method

7+7= **14**
