NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONS) DEGREE
DEPARTMENT OF CIVIL AND WATER ENGINEERING
PART III SECOND SEMESTER EXAMINATIONS- JUNE 2010

HYDRAULIC DESIGN I -TCW3203

Instructions:
Answer ALL
Total marks: 100
Time: 3 hours

QUESTION 1

a. Discuss the factors to be considered in selecting a location for an intake structure. (5marks)

b. Mushayavanhu village had a population of 10000 in 1978 and 15000 in 1988. A water supply scheme with design life of 20years was constructed in 1988. This scheme consisted of a clear water reservoir located at elevation 1200m connected by 80km PVC gravity main to a distribution reservoir in the village at an elevation of 1000m. If the per capita consumption rate is 38l/day estimate the diameter of the gravity main to ensure adequate transmission capacity up to the end of the design life. (20 marks)

QUESTION 2

a. Discuss the factors to be considered when designing a water distribution system. (5marks)

b. Briefly describe the Hardy-Cross Method. (5marks)

c. A rectangular loop ABCD is described by the following data:

Pipe	AB	BC	CD	DA
Length (m)	3.0	1.5	3.0	1.5
Diameter (mm)	450	350	400	550

The inflow at node D is 360l/s and the rest of the nodes have got outflows.

i. Using Hazen- Williams formula, $Q=0.278C_HD^{2.63}S_f^{0.54}$ Where $C_{H=}120$ for all pipes, determine the discharges in the loop.

ii. If the total energy at node A was given as 68.42m, and that node B is 5m above node A, What would be the pressure head at B.? (15 marks)

QUESTION 3

a. Describe the functions of storage structures in a water supply scheme. (5 marks)

b. The water supply for a city is pumped from a deep well to a distribution reservoir with both pump and reservoir designed to operate at a uniform pumping rate for 24 hours. The hourly demand for maximum day is as shown in the table below:

Hour	1	2	3	4	5	6	7	8	9	10	11	12
Demand M^3	273	206	256	237	257	312	438	627	817	875	820	773
Hour	13	14	15	16	17	18	19	20	21	22	23	24
Demand M^3	759	764	729	671	670	657	612	525	423	365	328	309

Due to power shortage the pumping station will only receive power between 1900hrs and 0700hrs. Estimate the percentage increase in pumping rate and volume of storage reservoir to ensure continued supply of water to the city. (25 marks)

QUESTION 4

Using the rational method and the information given below, design a storm water drainage system for a community. The pipes are concrete with roughness k=0.15mm. The sewers are to be designed for a return period of 1in 5 years and it can be assumed that rainfall intensity is given by $i=650/(t+8)mm/h$. Assume time of entry as 5 min, $t_f = L/60V$ and C=0.98.

Sewer Ref No.	Length (m)	Gradient	Catchment area (km^2)	Comments
1.0	41	1 in 250	0.004	Main sewer
1.1	39	1 in400	0.005	Main sewer
2.0	35	1 in 160	0.002	Branch
2.1	40	1 in160	0.003	Branch

(25 marks)

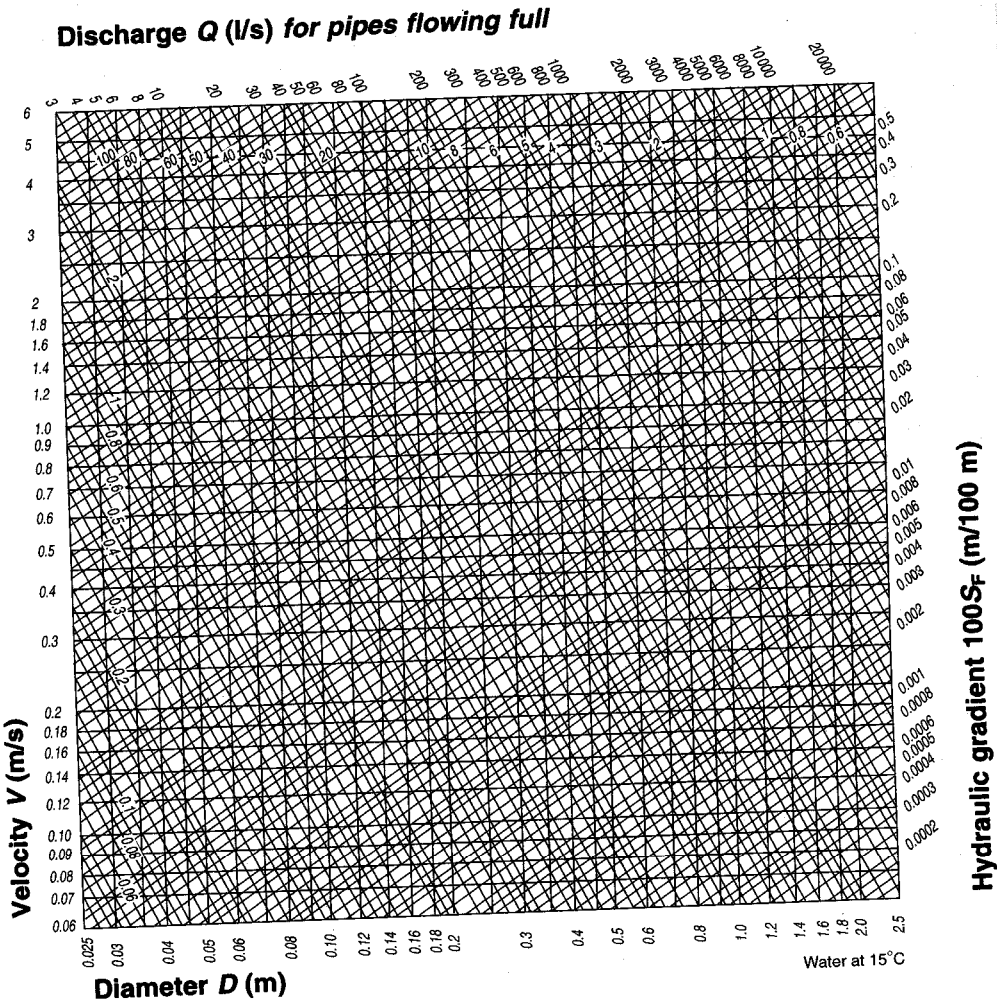

Figure 6.15 Hydraulics Research chart for k = 0.15 mm [*courtesy HR, Wallingford*]

Useful Formulae

$V=kCR^{0.63}S^{0.54}$ k=0.85

$h_f=f.LV^2/2gD$