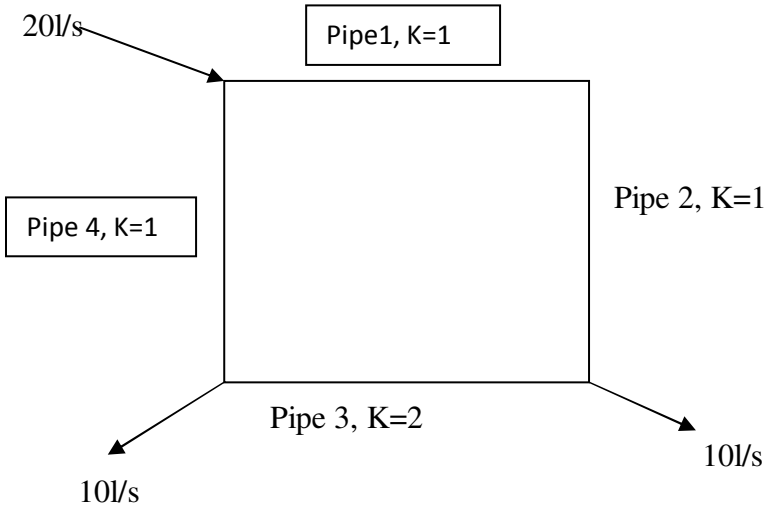
NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONS) DEGREE
DEPARTMENT OF CIVIL AND WATER ENGINEERING
PART III SECOND SEMESTER EXAMINATIONS- MAY 2011

HYDRAULIC DESIGN I -TCW3203

Instructions:
Answer ANY FOUR questions Total marks: 100
All questions carry equal marks Time: 3 hours

QUESTION 1

a. Using the Hardy Cross method and for three adjustments analyse the following network. Assume n= 1.84, $h_f=KQ^n$ **(10 marks)**



b. What factors influence the siting of intake structures? With the aid of neat sketches describe the types of intake structures and the protection measures required for these structures. **(10 marks)**

c. Outline the merits and demerits of the various water distribution system layouts. **(5 marks)**

QUESTION 2

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 10 years and it can be assumed that rainfall intensity is given by $i = [360T^{0.3}/(t_c+30)]$ *mm/h*, where t_c= time of concentration, T = return period in years. Assume C= 0.3 for pervious areas and C= 0.9 for impervious areas; time of entry as 7 min, t_f = L/60V

Sewer Ref No.	Length (m)	Gradient	Catchment area (km^2) Pervious	Catchment area (km^2) impervious	Comments
1.0	41	1 in 250	0.002	0.002	Main sewer
1.1	39	1 in400	0.004	0.001	Main sewer
2.0	35	1 in 160	0.001	0.001	Branch
2.1	40	1 in160	0.001	0.002	Branch

(25 marks)

QUESTION 3

Given the following average discharge values into a community in a year, determine the storage required for a constant demand of $60m^3$/sec.

Month	Days in Month	Discharge (m^3/sec)	Month	Days in Month	Discharge (m^3/sec)
January	31	90	July	31	15
February	28	100	August	31	20
March	31	80	September	30	30
April	30	60	October	31	80
May	31	40	November	30	120
June	30	15	December	31	140

(25 marks)

QUESTION 4

a. Describe the factors that influence water demand. **(5 marks)**

b. Discuss the importance of population forecast in the design of public water supply systems and describe the different methods employed for this purpose.
(10 marks)

c. Cowdary Park's population growth rate has been observed to be geometric. Given the following population data, calculate the population of the town in the year 2012 ,2022 and 2032

YEAR	1972	1982	1992	2002
POPULATION 000s	40	70	105	150

(10 marks)

QUESTION 5

a. Describe the main system components in a sewer system. **(5 marks)**

b. In urban drainage system, the most common types of sewerage systems are the separate and combined system. Describe each system highlighting the advantages and disadvantages of each system. **(15 marks)**

c. Discuss the factors to be considered in designing an urban sewer and storm water drainage system. **(5 marks)**

QUESTION 6

Two similar pumps were installed at a pumping station of which one had been used mainly as standby. Using the pump characteristics equation: $H\ (m) = a_1Q^2+a_2Q+a_3$; Pump efficiency $\eta\ (\%) = a_4Q^2+a_5Q+a_6$; and pipe system characteristics equation: $H = H_s+KQ^2$, where H_s = static pressure head = 30m, $a_1 = -1.0833 \times 10^{-2}$, $a_2 = 0.6633$, $a_3 = 50$, $a_4 = -7.78 \times 10^{-3}$, $a_5 = 0.93$, $a_6 = 45$, $K = 6$.

i. Determine the operating head, flow and efficiency of the single pump. **(10 marks)**

If due to increased demand on the water distribution system, it is planned to put both pumps into operation, investigate the relative benefits of arranging the two pumps in series or in parallel to provide the increased flow. Justify your choice of arrangement. **(15 marks)**

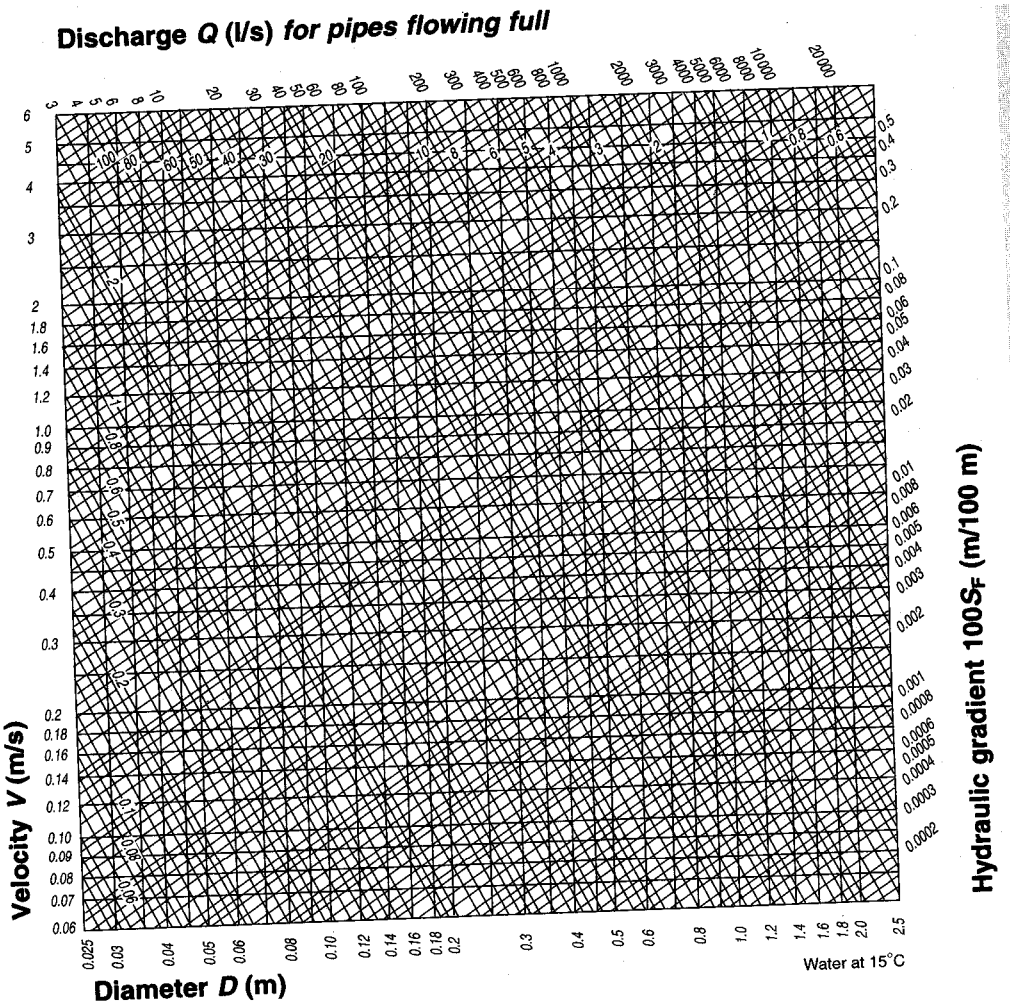


Figure 6.15 Hydraulics Research chart for $k = 0.15$ mm [*courtesy HR, Wallingford*]