

**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 2014**

**HYDRAULIC DESIGN I -TCW3203**

**Instructions:**

Answer **ANY FOUR** questions

Total marks: 100

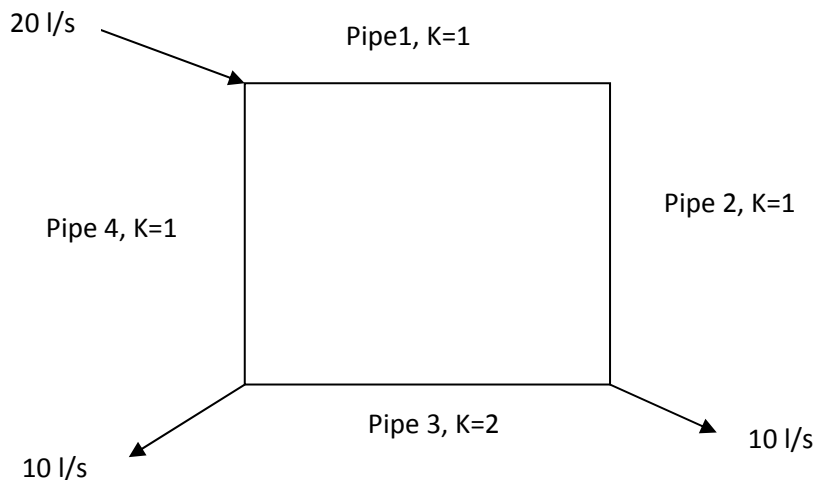
All questions carry equal marks

Time: 3 hours

---

**QUESTION 1**

- a. Briefly describe the following hydraulic structures, highlighting their application in hydraulic engineering and give an example for each:
- i. Energy dissipating structures
  - ii. Flow measuring structures
  - iii. Intake structures
  - iv. Conveyance structures
  - v. Energy conversion structures
- (10 marks)
- b. Using the Hardy Cross method and for three adjustments analyse the following network. Assume  $n = 1.84$ ,  $h_f = KQ^n$
- (15 marks)



**[25 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  $k=0.15\text{mm}$ . The sewers are to be designed for a return period of 1 in 10 years and it can be assumed that rainfall intensity is given by  $i = [360T^{0.3}/(t_c+30)] \text{ mm/h}$ , 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 ( $\text{km}^2$ )		Comments
			Pervious	impervious	
1.0	41	1 in 250	0.002	0.002	Main sewer
1.1	39	1 in 400	0.004	0.001	Main sewer
2.0	35	1 in 160	0.001	0.001	Branch
2.1	40	1 in 160	0.001	0.002	Branch

[25 marks]

### **QUESTION 3**

- Discuss and compare the design parameters for wastewater drainage systems and stormwater drainage systems. (10 marks)
- When a sewer pipe is flowing full the discharge is  $63\text{m}^3/\text{min}$  and the velocity is  $1.57\text{m/s}$ . If the depth of flow is  $275\text{mm}$  at a discharge of  $8.5\text{m}^3/\text{min}$ :
  - Determine the diameter of the pipe. (8 marks)
  - Determine the velocity of flow. (7marks)

[25 marks]

### **QUESTION 4**

- 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)
- Describe with aid of neat sketches, the procedures followed in laying and testing the water supply mains. (10 marks)
- Explain the importance of providing for fire demand in a water supply system. How would you provide for that fire demand? (5marks)

[25 marks]

### **QUESTION 5**

For a community with the following average monthly water consumption values, determine the storage required for a constant demand of  $60\text{m}^3/\text{sec}$ .

Month	Days in Month	Discharge ( $\text{m}^3/\text{sec}$ )	Month	Days in Month	Discharge ( $\text{m}^3/\text{sec}$ )
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 6**

Murambinda Growth point is planning a housing development.

- Describe how you would estimate the water demand for the area, stating what factors you would consider. (10 marks)
- With the aid of a neat sketch show how water distribution, wastewater and stormwater drainage systems will be provided to the development. State any assumptions made clearly. (15 marks)

[25 marks]

### **Useful Formulae**

$$V = kCR^{0.63}S^{0.54} \quad k = 0.85 \quad h_f = f \cdot LV^2 / 2gD$$

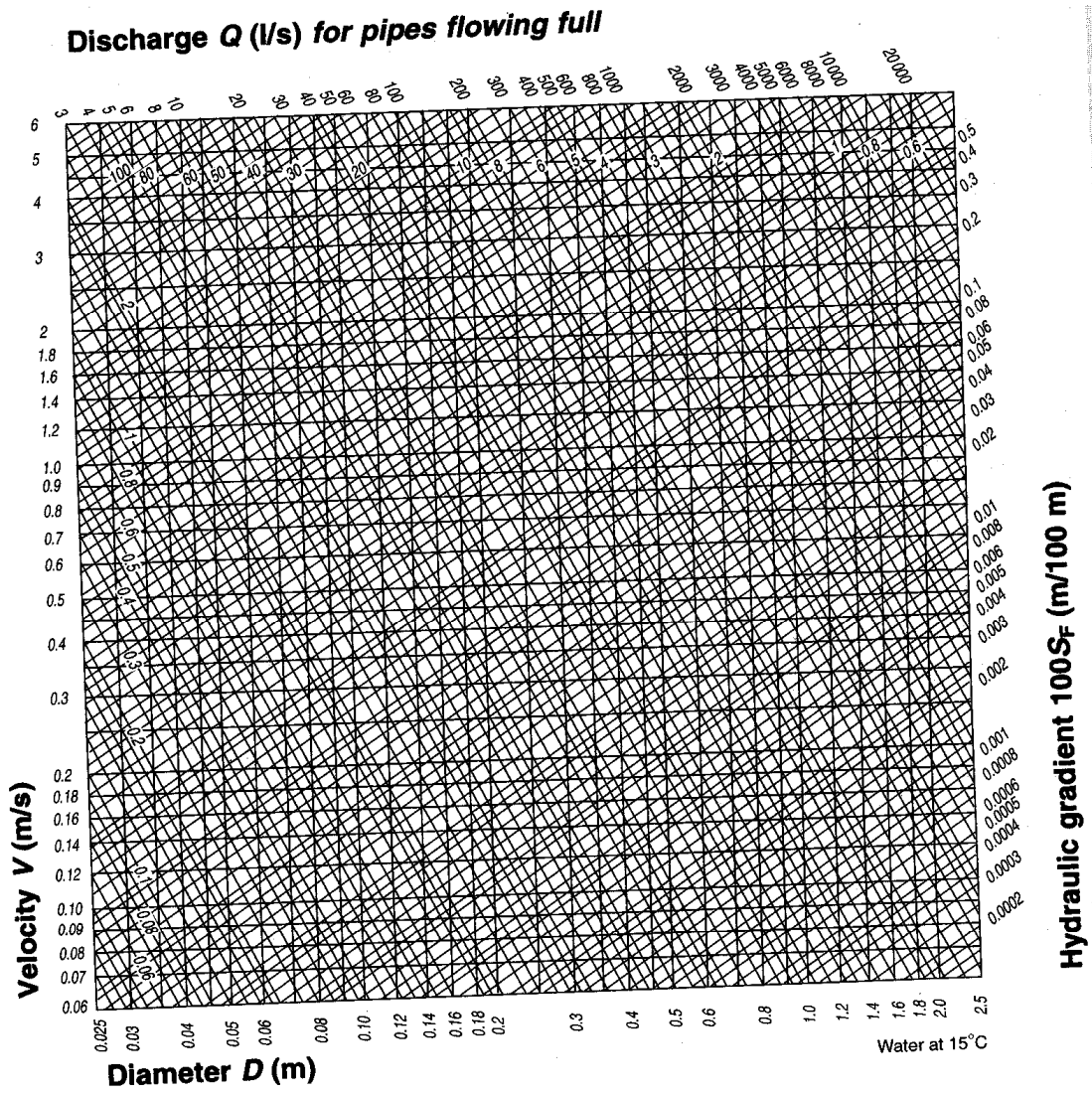


Figure 6.15 Hydraulics Research chart for  $k = 0.15$  mm [courtesy HR, Wallingford]

