NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

HYDRAULIC DESIGN 1

TCW 3203

Main Examination Paper

MAY 2015

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: NONE

Examiner's Name: Eng. A Chinyama

INSTRUCTIONS

1. Answer any Four (4) questions
2. Each question carries 25 marks
3. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
5.	25
6.	25
TOTAL	100

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QUESTION 1

    a. If a pump has a performance curve described by the relation $h_p = 12 - 0.1Q^2$, determine:

        i. The performance curve for a system having three pumps in series   (5marks)

        ii. The performance curve for a system having three pumps in parallel (5marks)

    b. Given the following population figures, estimate the population if the design life of your water supply scheme is to end in the year 2020 using:

        i. Graphical extension   (8marks)

        ii. Arithmetic growth projection   (7marks)

Year	Population
1920	125 000
1930	150 000
1940	150 000
1950	185 000
1960	185 000
1970	210 000
1980	280 000
1990	320 000

[25 Marks]

QUESTION 2

    a. A service reservoir is to be designed for a water supply system serving 250 000 people with an average demand of 600 l/cap/d and a fire requirement of 37 000 l/min for 9 hours. Estimate the required volume of storage.   (15 marks)

    b. Describe any five categories of hydraulic structures giving an example for each. (10 marks)

[25 marks]

QUESTION 3

a. Calculate the depth of flow and velocity of a circular concrete sewer of diameter 1500mm with a flow of 4m^3/s. Assume a Manning n of 0.015 and a slope of 1%. (15 marks)

b. Discuss the different pipe materials which can be used for sanitary sewers, highlighting the conditions under which they would work best.   (10 marks)
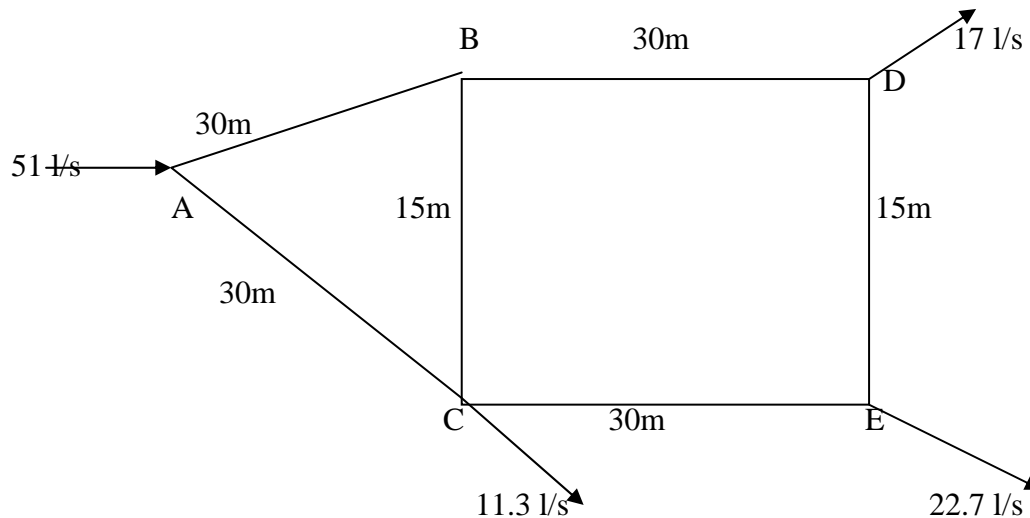
[25 marks]

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QUESTION 4

Find the discharge (Q in m^3/s) in each pipe of the welded steel pipe network shown in **Fig Q4** below. All pipes are 100mm in diameter. The pressure head at A is 15m. Determine the pressure at the different nodes. Assume the equivalent resistance, K, for the pipe is given by:

$$K=10.7L/(C^{1.85}d^{4.87}) \qquad \text{(from Hazen- Williams)}$$

Where: L= length of pipe (m); d= diameter of pipe (m); C=120.

Fig Q4

[25 marks]

QUESTION 5

You have just been appointed the Rural District Engineer for Runde Rural District council and your first assignment is to provide water and sanitation services to a small town developing in the district. Write a report stating the specific services required by the different users in the town and what infrastructure should be in place to provide those services. Also state the design considerations in setting up this infrastructure.

[25 marks]

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QUESTION 6

A new 1.2 ha residential area is to be drained by a storm sewer that connects to the municipal drainage system. Given that C=0.4, Manning n=0.20, average overland flow length =70m and average slope =0.7%,

    a. Determine the peak run off flow to be handled by the storm sewer, take

'$i=315.5 /(t^{0.81}+6.19)$ and $t_c=[6.99(nL)^{0.6}]/[58^{0.4}S_o^{0.3}]$.   (15 marks)

    b. Discuss the separate and combined systems for municipal drainage, in what situations would each be most suitable?   (10 marks)

[25 marks]

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