



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FIFTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 511: PUBLIC HEALTH ENGINEERING IV

DATE: 23/10/2020

TIME: 2.00-4.00 PM

INSTRUCTIONS

- (i) QUESTION ONE IS COMPULSORY**
- (ii) ATTEMPT ANY OTHER TWO QUESTIONS**
- (iii) REASONABLE ASSUMPTIONS SHOULD BE MADE WHERE NECESSARY**

QUESTION ONE (30 MARKS)

A rising main is to convey an average flow of $833.3 \text{ m}^3/\text{h}$ and a maximum of $937.5 \text{ m}^3/\text{h}$ against a static lift of 0.055 km through $1.6 \times 10^4 \text{ m}$ of main. Using annual costs, compare the cost of using 0.5 m , 0.6 m and 0.7 m diameter pipes given the following information:

Costs are: pipeline Ksh 35 per mm diameter per m laid in rural conditions; pumps Ksh 3000 per kW installed with 50% standby required; power Ksh 4.5 pence/kWh. Capital repayment charges assumed 12%, and friction coefficient of the pipeline $k = 0.6 \text{ mm}$ and water viscosity at 15°C in the Colebrook-White formula.

QUESTION TWO (20 MARKS)

- a) Discuss 3 common methods used at the feasibility study stage in cost comparison of capital projects whose implementation is to be phased (10 marks)
- b) Describe the principles followed in the design of a gravity main for water supply. List the key elements of the main (10 marks)

QUESTION THREE (20 MARKS)

Figure question 3 below shows a supply scheme in which existing sources (1), (2) and (3) feed water into the principal network shown. A new source (4) is proposed to bring, say, another 80 ml/day into the urban area via pipeline AB. Possible areas of substantial growth of demand are labelled D1, D2, ..., D5. Discuss the most practicable and efficient way of laying the new pipeline to serve the anticipated increase in demand. Clearly state your assumptions

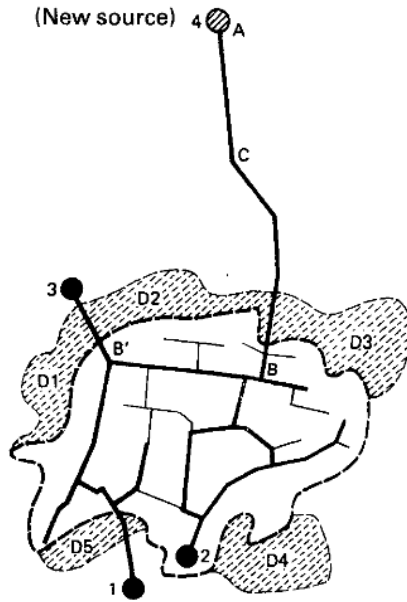


Fig. Question 3

QUESTION FOUR (20 MARKS)

A spun precast concrete pipe is required to carry a storm wastewater discharge of $0.95\text{m}^3/\text{s}$ when laid at a gradient of 1 in 430. Determine its size. Relevant chart is provided

$k = 0.6\text{mm}$

QUESTION FIVE (20 MARKS)

- The pipelines of a distribution system can be divided into three functional categories. State these categories and discuss their design requirement with the respect to the consumption demand they are to convey (10 marks)
- Service levels are the standards of supply which a water undertaking affords its customers. In Kenya the service targets are set by the Water services regulatory authority (WASREB). In connection with this, discuss the three principal levels of service which relate to the performance of distribution systems (10 marks)
- Discuss the principles and guidelines followed when undertaking pipeline planning in distribution system establishment (10 marks)