



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

FIFTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 511: PUBLIC HEALTH ENGINEERING IV

DATE:

TIME:

INSTRUCTIONS

- This paper comprises of *FIVE* questions. Answer **THREE** questions
- Question one is **compulsory** and carry 30 marks
- Answer any other **TWO** questions
- Reasonable assumptions should be made where applicable

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) 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. (15 marks)
- b) Calculate the flow to be conveyed by each category of pipeline identified in (i) above after estimating the water demand for a city of 200,000 people. Assume the average consumption rate is 171 litres per capita per day and use the flow ratios given in Table 1 for estimating the flow in each category of pipeline. (15 marks)

Table 1: Flow Ratios with respect to Average Daily Demand

<i>Flow ratio</i>	<i>Range</i>	<i>Average</i>
Peak daily demand : average daily demand	1.5:1 to 3.5:1	2.0:1
Peak hourly demand : average daily demand	2:1 to 7.0:1	4.5:1
Minimum hourly demand : average daily demand	0.25: to 0.5:1	NA

QUESTION TWO (20 MARKS)

- a) Project implementation is carried out after a series of stages in the planning phase. One of the key stages is feasibility study. The most feasible option or options are carried forward to preliminary design and ultimately detailed design. A number of methods are used at the feasibility study stage in cost comparison of capital projects whose implementation is to be phased. Consider 3 of these methods and give a comparative analysis. (10 marks)
- b) Gravity mains remain to be the most economical way of conveying water, often in bulk and as such certain key principles are followed in their design. By way of a discussion show why these principles are normally followed. Your discussion should be guided by the key elements or components of a gravity main and the principle or principles guiding the design of each element. (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.

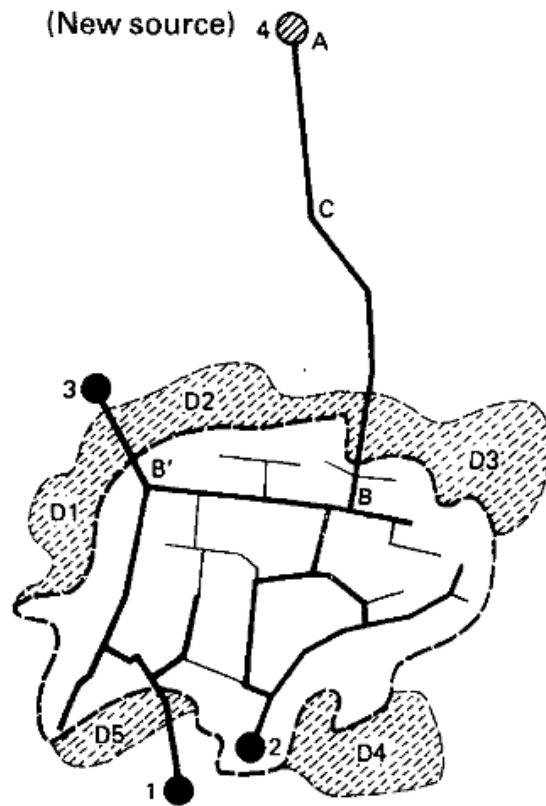


Fig. Question 3

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 0.002325. Determine its size. Relevant chart is provided.

$$k = 6 \times 10^{-4} \text{m}$$

QUESTION FIVE (20 MARKS)

- Constructed wetlands can be used for wastewater treatment. Define a constructed wetland. (3 marks)
- Give the categories of wetlands with respect to the state of wetland plants (macrophytes) used and/or grown. (4 marks)
- With respect to flow of wastewater, discuss the types of constructed wetlands available (4 marks)
- What are the limitations of submerged vegetation in the performance of constructed wetlands for wastewater treatment. (3 marks)
- By use of a sketch, describe the components of a constructed wetland with horizontal sub-surface flow. (6 marks)