



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING AND TECHNOLOGY

Department of BUILDING & Civil engineering

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECV 4323 : PUBLIC HEALTH ENGINEERING II

END OF SEMESTER EXAMINATION

SERIES: APRIL 2025

TIME: 2 HOURS

PAPER 1

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **five** questions.

Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

QUESTION ONE (COMPULSORY) 30 Marks

- a) Discuss the importance of wastewater management. **(4 Marks)**
- b) Explain the differences between combined and separate sewerage systems. **(4 Marks)**
- c) Discuss why studying the characteristics of wastewater is important. **(4 Marks)**
- d) Discuss the significance Biochemical Oxygen Demand (BOD) in wastewater management. **(4 Marks)**
- e) Explain why microbiology is important in wastewater treatment. **(4 Marks)**
- f) Assuming the rate of de-oxygenation (oxygen uptake) is directly proportional to the amount of organic matter remaining in the wastewater, show that:

$$\text{BOD exerted,} = L_0(1 - e^{-k't})$$

Where:

L_0 = Initial ultimate BOD in mg/l

L_t = BOD remaining at any time, t

K' = de-oxygenation constant in d^{-1}

t = time in days

(5 Marks)

- g) The BOD of sewage incubated for three days at 30°C has been found to be 210 mg/l. what is the 5-day BOD at 20°C? Assume the reaction rate constant, $K = 0.1 \text{ d}^{-1}$ at 20°C. **(5 Marks)**

ANSWER ANY TWO QUESTIONS FROM THIS SECTION

QUESTION TWO (20 Marks)

- a. Discuss the various growth phases of bacterial growth. **(4 Marks)**
- b. Describe briefly the following terms as applied in biological wastewater treatment:
 - i. Aerobes
 - ii. anaerobes
 - iii. facultative bacteria**(6 Marks)**
- c. Discuss the factors which affect the environment of microorganisms for effective biological wastewater treatment. **(4 Marks)**
- d. Explain why bacteriological examination is of great importance in the water treatment plant compared to at the wastewater treatment plant. **(3 Marks)**
- e. There are a number of ways of classifying microorganisms responsible for wastewater treatment. State the classifications of microorganisms based on their survival temperature range. **(3 Marks)**

QUESTION THREE (20 Marks)

- a. Describe the function of the skimming tank in wastewater treatment. **(2 Marks)**
- b. Explain the process of primary and secondary treatment of wastewater. **(4 Marks)**
- c. Describe with a neat sketch of various units of a typical activated sludge process for wastewater treatment. **(6 Marks)**
- d. A medium sized town in Kenya has an ultimate projected population of 160,000. The expected average wastewater flow per capita is 150 l/h/d. Design a sedimentation tank for wastewater treatment for the town. The recommended depth is 3 metres. Assume a detention time of 3 hours and a design flow of 120% of the average flow. Give a sketch of the tank. **(8 Marks)**

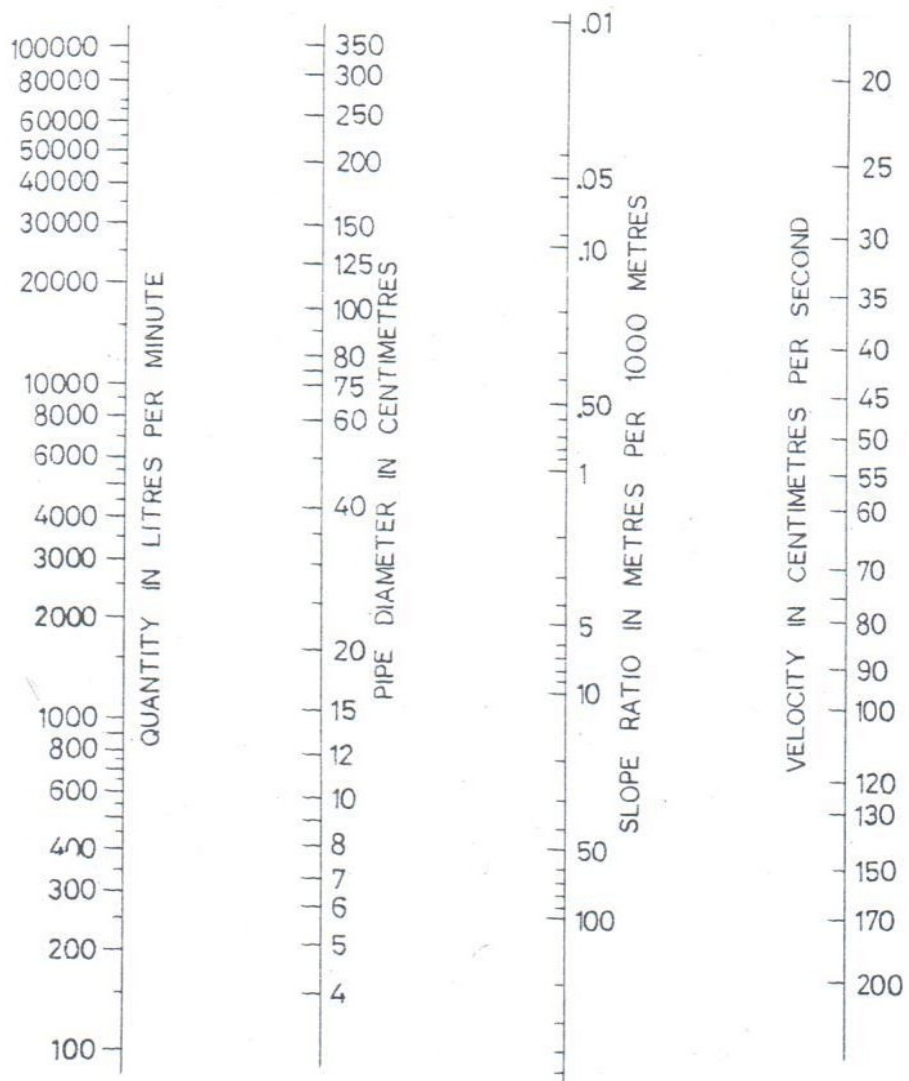
QUESTION FOUR (20 Marks)

- a. Describe the details of a typical trickling filter unit in wastewater treatment. **(5 Marks)**

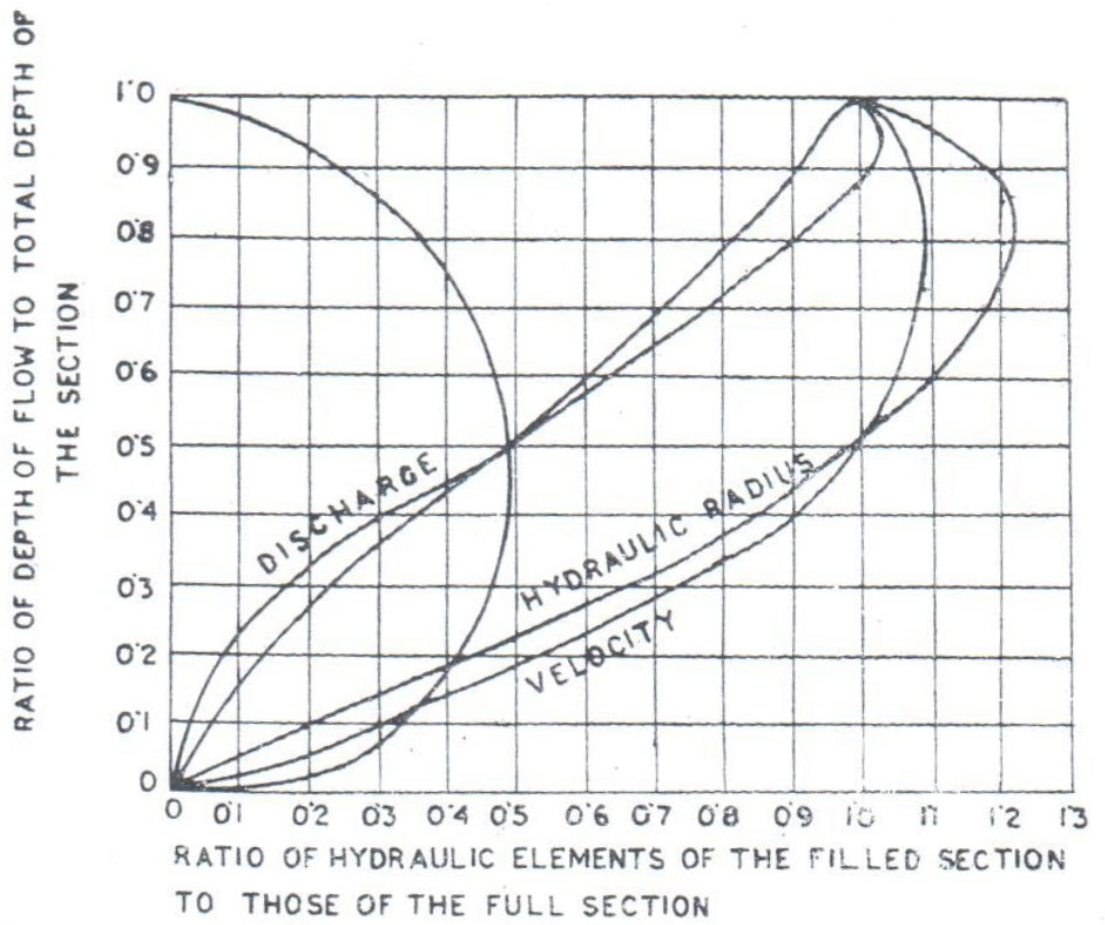
- b. Explain explicitly the biological processes that take place in a trickling filter that effect the wastewater treatment. **(5 Marks)**
- c. Design trickling filters for a town with a population of 50,000 people with a dry weather flow (DWF) of 120 l/h/d. Use volumetric loading of 400l/m³ of filter media.
- d. When using trickling filters for wastewater treatment it is sometimes important to recirculate effluent from the process to mix it with the influent sewage. What is the purpose of effluent re-circulation? **(4 Marks)**

QUESTION FIVE (20 Marks)

- a. Explain the use of nomograms and partial flow diagrams in the design of sewers. **(6 Marks)**
- b. Determine the velocity, v and rate of flow, Q , in a circular sewer of diameter 180cm laid in a slope of 1 in 750 while flowing full. The sewer is made of cast iron with a Manning's coefficient of roughness, $n = 0.012$. **(6 Marks)**
- c. Determine the discharge in a 48 cm circular sewer with a Manning's coefficient of roughness, $n = 0.013$, slope, $i = 0.005$ and depth of flow equal to 12 cm. Use both the nomogram based on Manning's formula for circular sewers ($n = 0.013$) and partial flow diagram provided. **(8 Marks)**



Nomogram based on Manning's formula for circular pipes (for $n=0.013$) running full



Partial flow diagram