



## TECHNICAL UNIVERSITY OF MOMBASA

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SCHOOL OF ENGINEERING AND TECHNOLOGY  
Department of BUILDING & Civil engineering  
**UNIVERSITY EXAMINATION FOR**  
BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING  
**TCV 4327 : PUBLIC HEALTH ENGINEERING II**

SPECIAL/SUPPLEMENTARY EXAMINATION  
**SERIES: NOVEMBER 2024**  
**TIME: 2 HOURS**

### **PAPER 2**

#### **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 any **THREE** questions.

**Do not write on the question paper.**

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#### **QUESTION ONE (20 Marks)**

- Define the terms “wastewater engineering”. (4 Marks)
- Explain the role of algae in sewage treatment in waste stabilization ponds. (4 Marks)
- Explain the difference between Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). (4 Marks)
- Differentiate between biodegradable and non-biodegradable organic matter. (4 Marks)
- In a BOD determination test, 40 ml of wastewater was mixed with 960 ml of diluting water. The mixture was found to contain 6.4 mg/l of dissolved oxygen before incubation. After a 5-day incubation at 200C, the dissolved oxygen content in the mixture was found to be 2.8 mg/l. Calculate the BOD of wastewater. Assume that the initial dissolved oxygen in the wastewater was zero. (4 Marks)

#### **QUESTION TWO (20 Marks)**

- Explain the meaning of runoff coefficient. **(4 Marks)**
- Discuss the factors, which influence the runoff coefficient. **(5 Marks)**
- Explain how to calculate the storm water flow from a catchment area. **(5 Marks)**

- d. A 30 hectare (ha) drainage area in Kenya experiences rain in five months a year. It has an average of 20 houses/ha. The average area of roofs is 100 m<sup>2</sup> per a house with a runoff coefficient of 0.9. The roads occupy 20% of the total area. The roads are tarmacked with an average runoff coefficient of 0.7. The remaining area is open space with a runoff coefficient of 0.10. The rain falls only four months in a year in this area. If the rainfall intensity of the area is 4.5 cm/h, calculate the stormwater discharge from this area. **(6 Marks)**

**QUESTION THREE (20 Marks)**

- a. Explain the importance of wastewater treatment before discharging it into the environment. **(4 Marks)**
- b. Discuss the main considerations in the selection of a suitable method of wastewater treatment. **(4 Marks)**
- c. Describe what will happen when wastewater with high BOD is discharged to a natural water body. Use sketches if necessary to support your answer. **(4 Marks)**
- d. Discuss the design criteria of a trickling filter for a wastewater treatment plant. **(4 Marks)**
- e. Design trickling filters for a town with a population of 150,000 people. The dry weather flow (DWF) is 120 l/h/d. Assume a volumetric loading of 900 litres per m<sup>3</sup> of filter media. **(4 Marks)**

**QUESTION FOUR (20 Marks)**

- a. What are waste stabilization ponds? **(3 Marks)**
- b. Discuss why waste stabilization ponds are recommended for warm climates compared to cold climates. **(3 Marks)**
- c. The recommended depth for facultative ponds is 1.0m to 1.5m. Explain why very shallow and deep depths are not recommended. **(4 Marks)**
- d. Discuss the major challenges of using waste stabilization ponds as a method of wastewater treatment. **(4 Marks)**
- e. In a high density housing scheme, the design population is projected to be 36,000 people with a water consumption rate of 150l/h/d. The sewage generation is estimated to be 80% of water consumption. The temperatures experienced in the area do not go below 20°C. The waste stabilization ponds (WSPs) system that has been designed, for this scheme consists of anaerobic pond with retention time of 5 days, a facultative pond with retention time of 5 days and two maturation ponds each with a retention period of 7 days. All the ponds are in series. Check if the effluent from this system meet the bacteriological quality standard to be discharged to the environment. Assume an

influent coliform count of  $5 \times 10^7$  per 100ml of sewage and first order rate constant for fecal coliform die-off,  $K_2 = 2.0$ . **(6 Marks)**