



# TECHNICAL UNIVERSITY OF MOMBASA

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FACULTY OF ENGINEERING AND TECHNOLOGY  
DEPARTMENT OF BUILDING & CIVIL ENGINEERING

**UNIVERSITY EXAMINATION FOR:**  
**BACHELOR OF SCIENCE IN CIVIL ENGINEERING**

**ECE 2313A : PUBLIC HEALTH ENGINEERING II**

**END OF SEMESTER EXAMINATION**

**SERIES: DECEMBER 2016**

**TIME: 2 HOURS**

**DATE: 15 Dec 2016**

**Instructions to Candidates**

You should have the following for this examination

*-Answer Booklet, examination pass and student ID*

*-Drawing instruments.*

This paper consists of five questions.

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

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



## **QUESTION 1**

- a) Define the following terms as used in wastewater engineering:
- i. Combined sewerage system
  - ii. Separate sewerage system
  - iii. Partially combined system.

**(6 Marks)**

- b) Discuss the merits and demerits of combined and separate sewerage systems. **(8 Marks)**
- c) Determination of sewage is very important in planning a sewerage system. Groundwater infiltration into sewers is one of the factors which affect the quantity of sewage. List four factors which influence the amount of groundwater infiltration into sewers. **(4 Marks)**
- d) State the factors that affect the quantity of storm water flow in. The formula derived from these factors is called rational formula. State the formula. **(5 Marks)**
- e) A residential estate in a town in Kenya constitutes a drainage zone in the town it has a total area of 20 hectares with 30 houses per hectare. The average area of the roof is 80m<sup>2</sup> per house with a runoff coefficient of 0.8. The roads occupy 20% of the total area and they are tarmacked with a runoff coefficient of 0.6. The remaining area is open space whose runoff coefficient is 0.2. The rainfall intensity measured in the estate is 5cm/hour. What will be the storm water discharge from the area? **(5 Marks)**
- If a partially combined system is proposed for the estate and that only runoff from the roofs will be allowed into the sewerage system, calculate the storm water flow contribution to the sewer design flow. **(2 Marks)**

## **QUESTION 2**

- a) State the significance of studying the characteristics of sewage in wastewater management. Name four chemical characteristics of sewage. **(6 Marks)**
- b) Explain the difference between Biodegradable and non-biodegradable matter. **(4 Marks)**
- c) In wastewater treatment, Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are very important parameters. Discuss the differences between BOD and COD. **(4 Marks)**
- d) The BOD of a sample of wastewater incubated at 20<sup>0</sup>C for five days was found to be 300mg/l. Calculate the following:
- i. Ultimate BOD
  - ii. 6-day BOD
  - iii. 9-day BOD

**(6 Marks)**

## **QUESTION 3**

- a) Describe using a neat sketch the treatment units of a typical activated sludge process as a method of wastewater treatment. **(6 Marks)**



- b) Outline the steps necessary in the activated sludge wastewater treatment process. **(6 Marks)**
- c) A town with a population of 60,000 people has no functional sewerage system currently. The management is proposing to have a sewerage system which will incorporate the activated sludge process in the treatment of sewage. The Dry Weather Flow (DWF) is 135 litres per head per day. Design an aeration tank for activated sludge process for the town. Assume aeration period of eight hours and recirculation flow of 30%. **(8 Marks)**

#### **QUESTION 4**

- a) Define the following microbiology terms as they are applied to wastewater management:
- i. Microorganisms
  - ii. Bacterial growth curve
  - iii. Aerobic organisms
  - iv. Anaerobic organisms
- (4 Marks)**
- b) Explain the functions of the following units in a wastewater treatment plant:
- i. Skimming tank
  - ii. Sedimentation tank
  - iii. Filters
- (6 Marks)**
- c) Consider town, A, situated along a river and discharges its sewage into the river downstream of the water supply intake so that the raw water source for the town is not polluted. The dissolved oxygen (DO) is maximum at the point of discharge. Clearly describe the river self-purification process from the time the sewage is discharged into it to the time it would have fully recovered from the effects of the sewage. Use sketches and chemical equations where necessary to illustrate your answer. **(6 Marks)**
- d) Show the end products of aerobic and anaerobic reactions as it relates to wastewater treatment. Use appropriate chemical reactions as may be necessary to illustrate your answer. **(4 Marks)**

#### **QUESTION 5**

- a) In the design of sewers why is it important to have a minimum and maximum limit of velocity in sewers? **(4 Marks)**
- b) Sewers are laid in a slope. List and explain the factors on which the gradient of sewers depends on. **(6 Marks)**
- c) Describe the procedure for the design of wastewater collection and conveyance system. **(5 Marks)**



- d) Calculate the velocity of flow in a circular sewer of diameter 30cm laid in a slope of 1 in 600 while flowing full. The sewer is made of cast iron with a Manning's coefficient of roughness,  $n = 0.012$ . Also determine the flow,  $Q$  in the sewer. **(5 Marks)**

