



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR**

FIFTH YEAR FIRST SEMESTER EXAMINATIONS

**FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL
ENGINEERING**

COURSE CODE: CSE 531

**COURSE TITLE: SEWAGE AND WASTEWATER
TREATMENT**

DATE: THURSDAY 23RD JANUARY 2020 TIME: 12.00 – 2.00 PM

INSTRUCTIONS:

1. This paper consists of **FIVE** questions.
2. Answer question **ONE** and any other **THREE** questions
3. All symbols have their usual meaning unless otherwise stated
4. Time allowed is **TWO (2)** hours

MMUST observes **ZERO** tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

Question ONE {Compulsory (25 MARKS)}

- a) Explain the following terms
- i. Sewerage
 - ii. Sewage
 - iii. Dry weather flow (3 marks)
- b) With a sketch, explain the variation of waste water flow versus water supply (4 marks)
- c) List FOUR means/methods of ensuring there is proper ventilation in a sewer line (2 marks)
- d) Explain the factors that determine the rate of re-oxygenation of a river (4 marks)
- e) Explain FOUR problems that may arise when using *trickle filters* in waste water treatment (4 marks)
- f) A town discharges $100 \text{ m}^3/\text{sec}$ of sewage into a stream having a rate of flow of $1200 \text{ m}^3/\text{sec}$ during lean days, at a 5 day BOD of sewage 250 mg/l . The ultimate BOD (L_0) is 120% of BOD mixture. Find time the critical DO deficit (DO_c) occurs, distance it occurs downstream and its magnitude. (8 marks)
- Take:
- Cross sectional area of river as 2400 m^2
 - De-oxygenation co-efficient as 1.0
 - Co- efficient of self-purification as 3.5
 - Saturation DO of the river as 9.2 mg/l
 - DO of sewage and 5-day BOD of the river as zero respectively

Question TWO (15 marks)

- a) Differentiate between *conservancy system* and *water carriage system* as used in sewage domestic waste water disposal (2 marks)
- b) List the factors that affects the quantity storm water flow (4 marks)
- c) What necessitates/need for sewage pumping (5 marks)
- d) Find the minimum velocity and gradient required to transport coarse sand through a sewer of 40 cm diameter with sand particles of 1.0 mm diameter and specific gravity 2.65. The friction factor for the sewer material may be assumed 0.03, roughness coefficient of 0.012 and k of 0.04 (4 marks)

Question THREE (15 marks)

- a) List THREE advantages and THREE disadvantages of a *separate system* of waste water disposal (3 marks)
- b) Explain FOUR factors that are considered in determining the design period of a sewerage system (3 marks)
- c) For a standard rate trickling filter without re-circulation, determine:
- i. The efficiency (1 marks)
 - ii. The volume (3 marks)
 - iii. The diameter (1 mark)
 - iv. Rate of surface loading (2 mark)
 - v. Rate of organic loading (2 mark)

The following data is given

- Quantity of settled sewage as 8 million litres/day
- BOD of sewage as 225 mg/l
- Final BOD required as 30 mg/l
- Depth of filter as 3m

Question FOUR (15 marks)

- List THREE advantages and THREE disadvantages of a *combined system* of waste water disposal (3 marks)
- Explain SIX essential requirements of a good sewer (6 marks)
- Design a circular stoneware sewer with Manning's n value of 0.012, running half full to serve a town with the following data: Estimated population is 100,000, rate of water supply is 135 LPCD, average sewage discharge is 85% of water supply, peak flow factor of 2 and the slope of sewer is 1:300. What is the velocity of sewage flow? (6 marks)

Question FIVE (15 marks)

- Explain the factors that affect the quantity of sewage flow (4 marks)
- Figure 5(b) shows the shape of a sewer line. List TWO advantages and TWO disadvantages of such a sewer shape (2 marks)

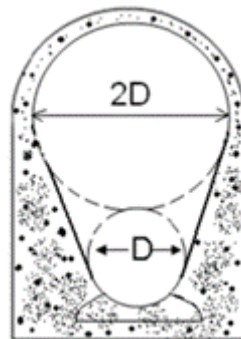


Figure 5(b)

- Calculate the quantity of sewage for combined system for a town, given the following data: Area of the town is 600 hectares, time of concentration is 30 minutes, population density is 300 persons/hectare, rate of water supply is 135 LPCD, peak factor is 2 and the surface classification is given below. Assume 80% of the water supplied reaches the sewer. (6 marks)

Type of surface	% Area	Runoff coefficient
Roofs	40	0.95
Paved surfaces	20	0.80
Non paved surfaces	40	0.25