(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2023/2024 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 WASTE WATER TREATMENT

DATE: ~~7TH~~ 5 **DECEMBER 2023** **TIME: 8 A.M – 10 A.M**

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

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

Question ONE {COMPULSORY (25 marks)}

a) In wastewater treatment, differentiate sewage from sewerage works (4 Marks)

b) Explain the overall objective of wastewater treatment (4 Marks)

c) Give three negative effects of untreated wastewater discharged into a receiving stream (3 marks)

d) Differentiate the action of aerobic and anaerobic bacteria in a wastewater treatment process (2 marks)

e) Explain the importance of testing a sewer line and give two methods commonly used to test sewers (3 Marks)

f) Give four favorable conditions for development of a separate sewer system (4 marks)

g) Design a sewer for a maximum discharge of $1.5m^3/s$ running half full. Consider Manning's Coefficient n = 0.012, and gradient of sewer S = 0.0001. (5 Marks)

Question TWO (15 marks)

a) Explain why design of sewer pumping main is fundamentally based on flow velocities (4 marks)

b) Outline three conditions that favor the development of a combined sewer system for a town. *(3 marks)*

h) Due to terrain and to manage sewer pumping costs, it has been decided that a sewer treatment plant be developed for Suneka in the peri-urban of Kisii town. The following data is available for the urban center;

- Population for the Base Year 2019 – 10,000 persons
- Population growth rate (r)– 2.3%
- Population growth for the town is geometric

Estimate the current wastewater generation for the urban center to inform design for the sewer system and treatment plant. (8 marks)

Question THREE (15 marks)

a) Explain the overall objective of wastewater treatment process (2 marks)

b) Explain two reasons why provision of freeboard is necessary in the design of sewer pipes (4 marks)

c) Give 4 reasons that may necessitate the use a sewer pumping station (4 Marks)

d) Treated wastewater is being discharged into a receiving stream at 500l/sec with a BOD of 80mg/l, DO= 2.5mg/l and temperature 20^0C. At the point of discharge, the receiving stream is flowing at $40m^3$/sec with a BOD=3mg/l, DO=7.5mg/l and temperature 15^0C.The de-oxygenation constant of the waste is 0.1 per day at 20^0C. The velocity of the river downstream is 0.15m/s and the depth of flow is 1.5m

Determine the following after mixing of the wastewater and river water: Combined Discharge,Biochemical Oxygen Demand, Dissolved Oxygen,Temperature and Critical Oxygen (5 marks)

Question FOUR (15 marks)

a) Classify with examples, the main contaminants found in wastewater (6 marks)

b) Explain why screening and pre-aeration is important in a wastewater treatment process (2 marks)

c) Design a grit chamber for a conventional water treatment system to remove substances with the following parameters;

Diameter 0.2mm, specific gravity 2.65, settling velocity range from 0.018m/s, Flow-through velocity 0.3m/s. Assume a wastewater flow of 10,000m3/d with a rectangular section of 1.5m depth. (7 marks)

Question FIVE (15 marks)

a) Explain two factors that are likely to affect the rate of reaction in an oxidation pond (4 Marks)

b) Wastewater sludge treatment process includes sludge thickening, digestion and condition. Expalin the aim of each of the processes (3 marks)

c) Outline two functions of a manhole in a sewer conveyance system (2 marks)

d) Determine the dimensions of an oxidation pond to treat $8000m^3$/day of sewage received from a suburb of a city, located in an area of hot climate, the BOD of sewage being 350 mg/l. Assume BOD loading of 300m3/Ha/Day for hot climate, detention time of 14 days for winter and 7 days for summer. (6 marks)