(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY SEPCIAL/SUPPLEMENTARY EXAMINATIONS 2021/2022 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:3RD OCTOBER 2022 **DURATION: 3- 5 P.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) Define wastewater discharge and give three negative effects into a receiving water body

(4 Marks)

b) Characterize treated and untreated wastewater in terms of pH and color (4 marks)

c) In designing a sewer system for a town, under what circumstance would a combined system be preferred over a separate system (3 marks)

d) Wastewater sources and chemical characteristics are key in determining the type of wastewater treatment system, explain. (4 marks)

e) Give two reasons why flow velocities of wastewater is an important criterion in design of sewer pipes (2 Marks)

f) Sotik Town in Bomet County lacks a water borne sewerage system. The area has a water supply scheme which has been earmarked by the government for expansion to improve access to water for the residents in line with the provisions of the Kenyan Constitution 2010. There's therefore an urgent need to design a waterborne sewerage system for the town. The following data on the trading center is available;

- Population for the Base Year 2019 – Urban = 10,400 and Rural = 96,000
- Areas
- Medium Variant Growth Rates
- Growth Rate for Urban Areas
  - ✓ 3.00 % per annum from year 2015 to year 2020
  - ✓ 2.50 % per annum from year 2020 up to year 2030
- Population growth for the town is geometric

Considering a design horizon of 20 years, determine the ultimate (2042) wastewater generation for the urban center (8 marks)

Question TWO (15 marks)

a) Characterize typical contaminants found in untreated wastewater giving at least one example for each class. (4 marks)

b) Polyvinyl Chloride (PVC) pipes are widely used in the construction of sewer lines. Give two reasons for the preference and one limitation (3 marks)

c) Describe how sunlight and stream current contributes to self-purification of water bodies receiving wastewater (4 marks)

d) The active volume of a pumping station is 100 litres and the design flow rate is 80 litres/minute. Estimate the pumping cycle time. (4 marks)

Question THREE (15 marks)

a) Differentiate the action of aerobic and anaerobic bacteria and how favourable conditions are created in wastewater treatment   (4 marks)

b) Explain how topography and environmental considerations may influence the location of a wastewater treatment plant   (4 marks)

c) Sewage from a town is discharged into a river having a discharge of 200 l/sec. If the quantity of sewage is 6 million litres/day and the BOD of sewage and river are 260 mg/l and 6 mg/l respectively, determine the BOD of the diluted water. If it is required to reduce the BOD of the diluted water to 20 mg/l, what should be the discharge in the river?   (4 marks)

d) Give three applications of manholes in sewer conveyance   (3 marks)

Question FOUR (15 marks)

a) Explain the following pre-design activities in sewer line design
   i.   Preliminary investigations
   ii. Surveying and Mapping   (4 marks)

b) With the aid of a sketch, explain the use of drop manholes in sewer line design(2 marks)

c) In the design of pumping stations, how is siltation minimized and what remedial action can be put in place in case siltation is likely to occur   (2 marks)

d) Determine the velocity of 0.0090 m3 /s flow in a 300 mm diameter sewer at a slope of 0.0035 m/m. The pipe is new PVC Pipe. Use the attached chart adapted from Camp 1946 - Hydraulic Properties of Circular Sewers (7 Marks)

Question FIVE (15 marks)

a) Sewer pumping stations are considered confined spaces by Occupational Safety and Health Administration (OSHA). Give three safety precautions while working in a sewer pumping station   (3 marks)

b) Describe pre-aeration in as applied in convetional waswater treatment system and give its importnace

                                    (2 marks)

c) Mbita Town at the shores of Lake Victoria has a wastewater generation capacity of 50litres/day per person. The current population of the town ids approximately 10,000. Design a primary settling tank for a wastewater treatment plant of a town assuming a detention time of 2 hours and tank depth of 3 metres.   (10 marks)

After Camp 1946
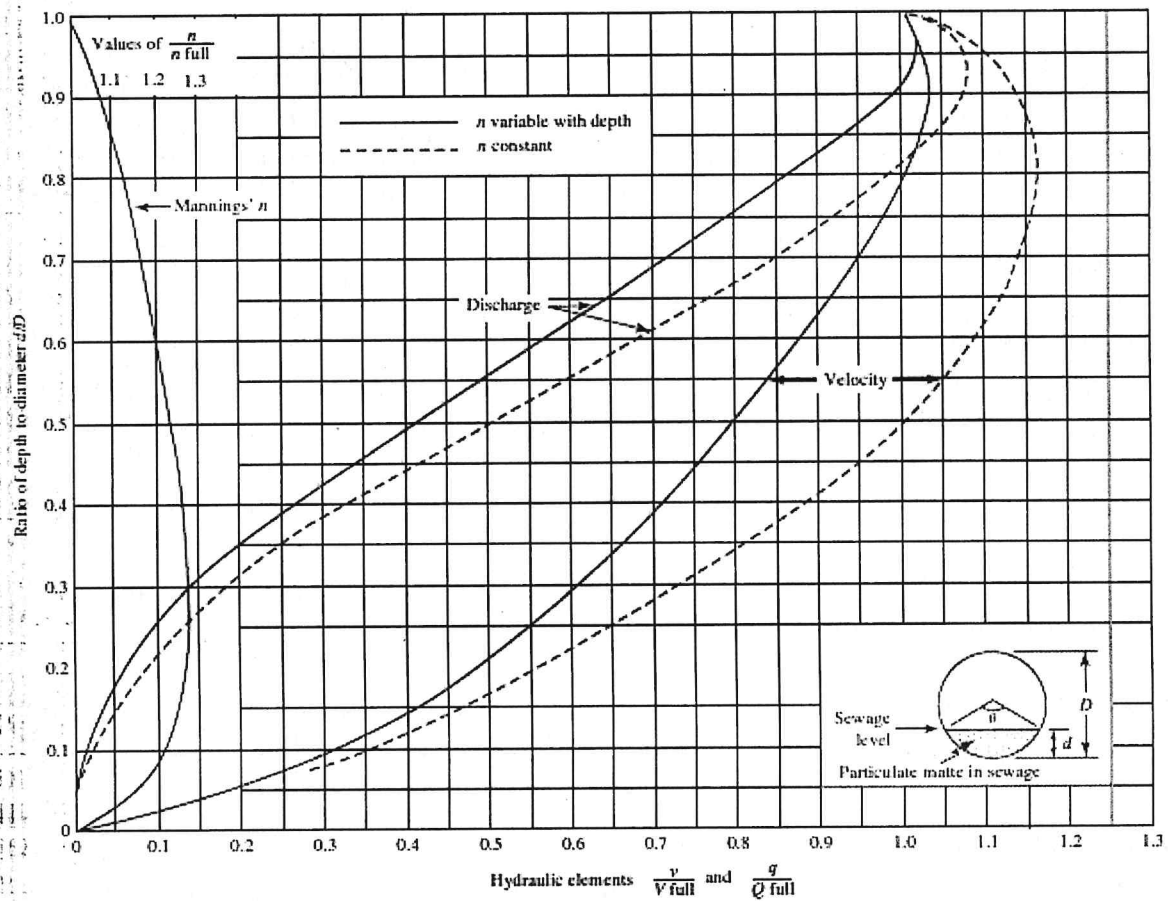
Typical values of *n* that are used with the Manning equation

	Condition		
Pipe material	Good	Fair	Deteriorated
DIP (lined)	0.011	0.013[a]	0.015
HDPE	0.010[a]	0.011	0.013
PVC	0.010[a]	0.011	0.013
RCP	0.013	0.015[a]	0.018
VCP	0.013[a]	0.015[a]	0.017

[a]Values commonly used in design.