(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY 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: TUESDAY 26TH APRIL 2022 TIME: 8.00 – 10.00 AM

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) With reference to wastewater treatment, define the following terms;
   i. Influent
   ii. Sewerage works
   iii. Effluent
   (3 Mark)

b) Explain how temperature and wastewater flow characteristics affect dissolved oxygen in wastewater (2 marks)

c) Differentiate the following wastewater collection systems
   i. Sanitary sewer system
   ii. Storm sewer system
   iii. Combined sewer system
   (3 marks)

d) In the design of a sewer conveyance system, differentiate between infiltration and inflow (2 marks)

e) Give and explain 4 factors to be considered in locating a wastewater treatment plant (4 Marks)

f) Outline the importance of the following processes in sludge treatment
   i. Sludge thickening
   ii. Sludge digestion
   iii. Sludge drying
   (3 Marks)

g) A fast growing transit trading center of 2,000 persons is considered for a water supply and wastewater treatment system. The following data on the trading center is available;
   - Population for the Base Year 2019 – 2,000 persons
   - Population growth rate (r)– 2.8%
   - Population growth for the town is geometric

Considering a design horizon of 20 years, determine the following

   a) The ultimate(2042) wastewater generation for the trading center
   b) Design a sewer pipe in reinforced concrete to carry the ultimate design flow for the Trading Centre. (10 marks)

Question TWO (15 marks)

a) Explain the following criteria as used in the design of wastewater collection systems;
   - Location,
   - Changes in pipe size,
   - Flow velocities
   (3 marks)

b) Give 3 consideration for use of a separate sewer collection system (3 marks)

c) Explain how the following may influence the selection of a sewerage system
   - Physical characteristics of wastewater
   - Wastewater treatment standards
   - Sludge disposal regulation
   (3 marks)

d) Determine the velocity of 0.0086 m^3 /s flow in a 250 mm diameter sewer at a slope of 0.0040 m/m. The pipe is new HDPE Pipe. Use the attached chart adapted from Camp 1946 - Hydraulic Properties of Circular Sewers (7 Marks)

Question THREE (15 marks)

a) Explain How the following factors affect self-purification of streams after discharge of sewage
- Sunlight
- Dilution
- Temperature
- Rate of oxidation
- Current

(5 marks)

b) A wastewater influent of 500l/sec with a BOD of 60mg/l, DO= 2.5mg/l and temperature 250C enters a river where the flow is 30m3/sec and BOD=3mg/l, DO=8.5mg/l and tempertature 160C.The de-oxyganation constant of the wste is 0.1 per day at 200C. The velocity of the river downstream is 0.15m/s amd the depth of flow is 1.5m

Determine the following after mixing of the wastewater and river water:

i. Combined discharge (1 marks)
ii. BOD (3 marks)
iii. DO (3 marks)
iv. Tempertaure (3 mark)
v. Critical Oxygen Demand (3 mark)

Question FOUR (15 marks)

a) Give 4 conditions that may require the use of a sewer pumping station (4 marks)
b) The design of force mains is fundamentally based on velocity, give the reason. What are the minimum and desirable velocities in a force main (3 marks)
c) Give 4 factors considered when designing a wet well (4 marks)
d) A pumping station is to be designed for a flow rate of 80 litres/minute. The pumping cycle time is estimated as 5 minutes. Determine the active volume of the wet well for the pumping station in litres. (4 marks)

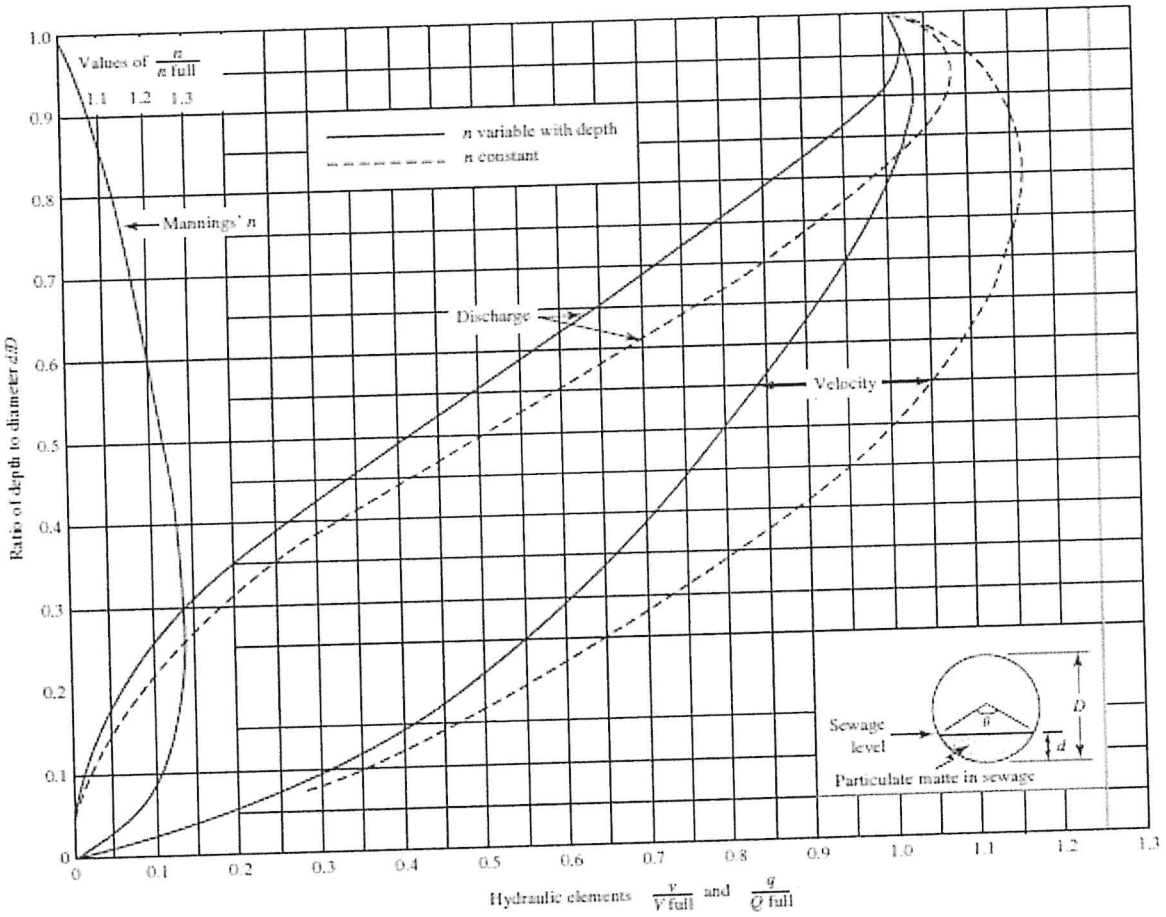
Question FIVE (15 marks)

a) Describe the following process in a municipal wastewater treatment system

i. Screening (1 marks)
ii. Flow metering and sampling (1 marks)
iii. Disinfection (1 marks)
iv. Disposal (1 marks)

b) Design a primary settling tank for a wastewater treatment plant of a town with a per capita sewage production of approximately 100 litres/day. Assume 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

Pipe material	Condition		
	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.