



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 310: PUBLIC HEALTH ENGINEERING II

DATE:

TIME:

INSTRUCTIONS

- This paper comprises of FIVE questions. Answer **THREE** questions
- Question one is **compulsory** and carry 30 marks
- Answer any other **TWO** questions
- Reasonable assumptions should be made where necessary

QUESTION ONE (COMPULSO (30MKS))

- a) Natural and anthropological processes often result in wastewater generation. Briefly describe the common sources of wastewater. (8 marks)
- b) Discuss the main objectives of wastewater treatment. (8 marks)
- c) Why is wastewater flow characterization important to the overall wastewater treatment scheme? (4 marks)
- d) Estimate the wastewater generation from the water demand for a city of 200,000 people. Assume the annual average consumption rate is 171 litres per capita per day and use the flow ratios given in Table 1 for estimating the following flow rates in million litres per day (MLD):

- i) Average daily demand and hence average wastewater generated.
- ii) Peak daily demand and hence peak daily wastewater generated.
- iii) Peak hourly demand and hence peak hourly wastewater generated. (10 marks)

Table 1: Flow Ratios with respect to Average Daily Demand.

Flow ratio	Range	Average
Peak daily demand : average daily demand	1.5:1 to 3.5:1	2.0:1
Peak hourly demand : average daily demand	2:1 to 7.0:1	4.5:1
Minimum hourly demand : average daily demand	0.25: to 0.5:1	NA

QUESTION TWO (20 MARKS)

- a) Discuss in your own words what is meant by an indicator organism. Which group of organisms are used as indicator organisms and why? List three groups of pathogenic organisms that may be found in water and wastewater. (5 marks)
- b) State and discuss five methods of collection and conveyance of wastewater. (10 marks)
- c) Estimate the size of a septic tank for a picnic park which hosts 500 residents on average daily. Assume that the anticipated flow is 150L/day per capita and HRT of 24hrs (5 marks)

QUESTION THREE (20 MARKS)

- a) Calculate the five -day and seven-day BOD for a sample of treated wastewater assuming a BOD rate constant, $k=0.10\text{days}^{-1}$ and an ultimate BOD of 350mg/L. Finally calculate the percent of ultimate BOD exerted at 5 days and 7 days respectively (10 marks)
- b) The following data (table 2) were determined in the laboratory by incubation at 20°C. determine the BOD reaction rate constant, k , and the ultimate BOD, BOD_u . (10 marks)

Table 2: Analytical BOD data

Time (days)	0	1	2	3	4	5	6	7
BOD (mg/L)	0	72	120	155	182	202	220	237

QUESTION FOUR (20 MARKS)

A feasibility study has shown the suitability of a sanitary gravity sewer for a community. Design a sanitary gravity sewer of concrete ($n=0.013$), square in shape flowing half full and which must carry sewage at a uniform rate of flow of 2000 L/s. The choice of your design velocity should ensure that there is no deposition and sewer corrosion is minimal. Allow a 10% freeboard. What will be the required channel bottom slope for this sewer?

QUESTION FIVE (20 MARKS)

- a) Discuss the factors that necessitate the construction of household and small-scale wastewater treatment systems. Give five examples of these systems. (10 marks)
- b) With the aid of a diagram describe the treatment process in septic tanks. What are some of the operation procedures that must be observed? (10 marks)