NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL AND WATER ENGINEERING

WASTEWATER ENGINEERING

ECW/TCW3104

Supplementary Examination Paper

August 2024

This examination question paper consists of 5 pages.

Time Allowed:	**3 Hours**
Total Marks:	**100**
Examiner's Name:	**Felix. M Mudhindi**

INSTRUCTIONS

1. Answer all questions in Section A and any other 2 from Section B.

2. Use of calculators is permissible.

ADDITIONAL INFORMATION

None

MARK ALLOCATION

QUESTION	MARKS
SECTION A	
1.	20
2.	20
3.	20
SECTION B	
4.	20
5.	20
6.	20
TOTAL POSSIBLE MARKS	100

SECTION A: ANSWER ALL QUESTIONS

QUESTION 1

(a) Define "on site sanitation technology" and describe the any three (3) different types and their suitability. (10)

(b) A mining residential compound depend on treated piped water from a nearby river. The total number of households is twenty (20). The groundwater level in the area is very low. Assuming an average temperature of 22 oC throughout the year and an average of six (6) people per household.

     i.   Suggest an onsite sanitation technology for the community, giving a reason for your answer. (2)

    ii.   Design the onsite sanitation technology proposed for the community (8)

QUESTION 2

(a) Determine the ultimate BOD of a sewage sample obtained from the inlet of one of the sewage works in a remote area in Mabale . The prevailing temperature is 28 oC . The decay coefficient at this temperature is 0.13 per day. The six-day BOD is estimated at 240 mg/L at the same temperature. You are given that nitrogen of the raw sewage is 28 mg/L while phosphorous is 4 mg/L. (3)

(b)In certain cases the BOD may be near zero and high values of COD recorded in municipal wastewater, what could be the reason(s) for this? (2)

(c) In a B0D determination 10milli-litres of wastewater is mixed with 290 milli-litres of diluting water containing 9.15 mg/L of dissolved oxygen. After 5day incubation at 20 Oc,

the dissolved oxygen content of the mixture is 1.42mg/L. Calculate the BOD of wastewater stating your assumptions clearly (3)

(d) A sewage treatment plant of daily discharge 18000 m3. Find the quantity and sizes of standard rate and high rate trickling filters if: Raw sewage BOD5 =250 mg/l, Effluent BOD5 = 40 mg/l and The BOD5 removal efficiency of primary sedimentation= 30% (12)

QUESTION 3

(a) Discuss the differences between attached growth treatment and suspended growth treatment. (4)

(b) Determine the size of anaerobic ponds for Zimbabwean conditions. Take the influent BOD and the inflow to be 430 mg/l and 40 600 m3 /day respectively. (8)

(c) The wastewater discharged from a dairy plant is 3000 m3/day with a BOD concentration of 1300 mg/l. Calculate the total daily BOD and the equivalent population of the daily wastewater flow assuming a daily BOD contribution of 80 g/person (8)

SECTION B: ANSWER ANY TWO (2) QUESTIONS

QUESTION 4

(a) Estimate the screen requirement for a plant treating a peak flow of 60million liters per day of sewage   (10)

(b) Design a waste stabilization pond to treat 10,000 m3/day of a wastewater which has a BOD of 150 mg/L and 1×10^8 FC per 100 mL. The effluent should contain no more than 5000 FC per 100 mL and 20 mg/L BOD. The design temperature is 28oC   (10)

QUESTION 5

(a) With the aid of diagrams describe the following methods as used in wastewater treatment

i.   Ultrafiltration

ii.   Nano- Filtration

iii.   Reverse osmosis

iv.   Ozonation

v.   Microfiltration   (20)

QUESTION 6

(a) With the aid of d neatly labeled flow diagram derive expressions used in determining the following design parameters for an activated sludge unit

    i.   Aeration period   (2)

    ii.   Organic loading rate   (2)

    iii.   Food to microorganism ratio   (3)

    iv.   Sludge age   (3)

(b) Describe 'nutrients' in relation to water quality and pollution. How do they affect water bodies and what conditions increase these effects? (6)

(c) Suggest measures that can be put in place to control the effects of nutrients in surface water bodies. (4)