



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENVIRONMENTAL SCIENCES

DEPARTMENT OF ENVIRONMENTAL SCIENCE

**BACHELOR OF SCIENCE HONOURS DEGREE IN ENVIRONMENTAL SCIENCE AND
HEALTH**

WASTE WATER MANAGMENT

ESH 4121

Final Examination Paper

December 2024

This examination paper consists of 3 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: None

Examiner's Name: Dr T Kativhu

INSTRUCTIONS

1. Answer any **FOUR** questions
2. Each question carries 25 marks

MARK ALLOCATION

QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
5.	25
6.	25
TOTAL	100

Question 1

- a. Describe the different types of heterotrophic and autotrophic bacteria used in treating wastewater. (15 marks)
- b. Give reasons why Dissolved Oxygen (DO) and Biological Oxygen Demand (BOD) are important parameters in waste water treatment. (10 marks)

Question 2

Compare and contrast the treatment mechanisms in constructed wetlands and Biological Nutrient Removal (BNR) systems.

Question 3

Give a detailed account of the treatment processes at a plant that uses biological filters.

Question 4

- a. Define the following terms in relation to wastewater treatment
 - i. Return activated Sludge (2 marks)
 - ii. Waste activated sludge (2 marks)
 - iii. Sludge age (2 marks)
- b. Given the following characteristics of a community:

<i>Number of residential units</i>	2 500
<i>Water consumption</i>	200l/c/d
<i>Return flow</i>	75%
<i>Industrial effluent</i>	2 000m ³ /d
<i>Residential BOD load</i>	70g/c/d
<i>BOD concentration for industrial effluent</i>	2 000mg/l

Assuming a return factor of 0.80 and an average of 7 people per unit, calculate;

- i) Domestic dry weather flow (3 marks)
- ii) Total dry weather flow (3 marks)
- iii) Average domestic BOD load (3 marks)
- iv) Industrial BOD load (3 marks)
- v) Total BOD load (3 marks)
- vi) Average BOD concentration (4 marks)

Question 5

- a) An activated sludge treatment plant has an average flow of $12\,000\text{m}^3/\text{day}$. The primary clarifier at the plant has a total surface area of 30m^2 and a weir with a length of 20m. Calculate:
- i) Overflow rate (2 marks)
 - ii) Detention time (2 marks)
 - iii) Effluent weir loading rate (2 marks)
- b) Differentiate Carbonaceous oxygen demand from Nitrogenous oxygen demand. (6 marks)
- c) With reference to the oxygen sag curve, explain how effluent from a wastewater treatment plant affect oxygen levels in a river.

Question 6

- a. Critique the possible uses of reclaimed municipal wastewater. (15 marks)
- b. Give an account of the barriers to waste water reuse in Zimbabwe. (10 marks)