



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

WASTEWATER ENGINEERING

TCW 3104

Special Examination Paper

NOVEMBER 2016

This examination paper consists of 3 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: NONE

Examiner's Name: Eng. A Chinyama

INSTRUCTIONS

1. Answer any Four (4) questions
2. Each question carries 25 marks
3. Use of calculators is permissible

MARK ALLOCATION

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

QUESTION 1

- a. Describe how you would estimate the dry weather flow generated by a community?
(5marks)
- b. Define the term “population equivalence” and explain how it is applied in estimating wastewater flow. (5 marks)
- 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.
(15 marks)

QUESTION 2

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

- i. Aeration period
- ii. Organic loading rate
- iii. Food to microorganism ratio
- iv. Sludge age (25 marks)

QUESTION 3

- a. Define “on site sanitation” and describe the different types and their suitability
(10 marks)
- b. With the aid of a neat sketch, describe the operation of a trickling filter (10 marks)
- c. Discuss the differences between attached growth treatment and suspended growth treatment. (5 marks)

QUESTION 4

- a. Describe ‘nutrients’ in relation to water quality and pollution. How do they affect water bodies and what conditions increase these effects? (10 marks)
- b. Suggest measures that can be put in place to control the effects of nutrients in surface water bodies. (10 marks)
- c. Briefly describe the microbiological processes that reduce the levels of nutrients in wastewater during treatment. (5 marks)

QUESTION 5

- b. From first principles derive the Phelps' equation. (5 marks)
- c. A BOD test is run using 100ml of treated wastewater mixed with 200ml pure water. The initial dissolved oxygen of the mix is 9.0mg/l. After 5 days the dissolved oxygen is 4.0mg/l:
 - i. Estimate the 5 day BOD of the wastewater
 - ii. Estimate the ultimate BOD

Assume $K = 0.23 \text{ day}^{-1}$ (5 marks)

- d. Outline briefly the BOD and the COD tests and highlight the major differences between the two tests. (15 marks)