

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION

ENVIRONMENTAL ENGINEERING

PTE2259

Second Semester Examination Paper

May 2019

This examination paper consists of 3 pages

Time allowed: 3 hours

Total Marks: 100

Special requirements: none

Examiner's Name: Mrs F. Makwiranzou

INSTRUCTIONS

- 1) The paper consists of 3 printed pages with 5 questions.
- 2) Each question carries 25 marks.
- 3) Answer any **4(four)** questions
- 4) Answer a new question on a fresh page.

MARK ALLOCATION

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

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QUESTION 1

- a) Define water pollution [2]
- b) List any **five** wastewater characteristics. [5]
- c) With the aid of a clearly labelled diagram describe the process of eutrophication. [8]
- d) List and describe fully the causes of water pollution. In your answer include ground water pollution and surface water pollution. [10]

QUESTION 2

- a) Briefly discuss **five** objectives of wastewater treatment.[10]
- b) Compute the DWF and the average BOD concentration given the following design data

No. of residential units	7550	
Water Consumption	350l/ca.day	
Industrial effluent	3000m ³ /day	
BOD load	60g/ca.day	
BOD for industrial effluent	2500mg/l	[15]

QUESTION 3

- a) Describe the biochemical processes that take place in nutrient removal in a treatment plant. [5]
- b) Draw a flow diagram indicating all stages and processes involved in wastewater treatment from preliminary to tertiary treatment. [10]
- c) Explain the objectives of preliminary treatment and describe the processes used to achieve these objectives. [10]

QUESTION 4

- a) From first principles derive the Phelps equation. [5]
- b) Differentiate between biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). [10]
- c) Given the following parameters:

$$BOD_u = 50\text{mg/l}$$

$$\Theta = 1.05$$

$$K_{20} = 0.23\text{d}^{-1}$$

Temperature = 35°C

Calculate BOD_5 for the wastewater [10]

QUESTION 5

- a) Explain the common procedure used for the determination of the BOD for a given wastewater sample. [10]

- b) A BOD test is run using 100ml of treated wastewater mixed with 200ml of pure water. The initial DO of the mix is 9.0mg/l. After a long period of time, the DO is 2.0mg/l and it no longer seems to be dropping.
 - i. What is the 5 day BOD of the wastewater? [5]
 - ii. Estimate the ultimate BOD, neglecting the effects of nitrification. [5]
 - iii. What would be the remaining BOD after 5 days? [5]