NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

WATER QUALITY & TREATMENT

TCW 5101

Main Examination Paper

December 2015

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**
TOTAL	**100**

QUESTION 1

a. Describe two main methods used in setting standards for water quality, state their advantages and disadvantages. (10 marks)

b. Describe the formulation of any water quality model you know and highlight its application in water pollution control. (15 marks)

QUESTION 2

Raw water from a surface reservoir was found to be very turbid and it was recommended to use 50mg/l of alum for coagulation.

a. With use of chemical equations describe the process of coagulation. (5 marks)

b. How much alkalinity is consumed? (7 Marks)

c. What changes take place in the ionic composition of the water? (5 marks)

d. What would be the concentration of aluminum hydroxide produced? (8 Marks)

QUESTION 3

a. Discuss the factors that must be considered in the selection of water treatment processes. (5 marks)
b. Describe the treatment processes for water sourced from an unprotected hand dug well, clearly explaining the parameters being dealt with at every stage. (20 marks)

QUESTION 4

a. Describe the following water treatment processes and state the water quality parameters that are being dealt with in the processes:

i. Pre settlement
ii. Addition of activated carbon
iii. Pre chlorination
iv. Aeration
v. Chlorination (10 marks)

b. Design a set of three sedimentation tanks to treat a maximum flow of $0.5m^3/s$, assuming a settling velocity of 0.45mm/s, a retention period of 2 hours and a length: width ratio of 4:1. (15 marks)

QUESTION 5

a. Slow and rapid sand filters are commonly used in water treatment. Describe these two filtration techniques and explain where they would most suitable to use. (10 marks)

b. Design a set of rapid sand filter units to treat 23 Gl/day at a rate of 5m/h if the overflow rate is not to exceed 8m/h with one filter being backwashed. Sketch the designed units. (15 marks)

QUESTION 6

a. Many bottlers of water use ultra violet disinfection to disinfect the water. What are the advantages and disadvantages of this method? Describe two (2) other methods that can be used to disinfect the water and the advantages and disadvantages of each method. (10 marks)

b. The following data was obtained in a chlorination experiment. Plot the data and determine the breakpoint dosage. What dosage is required to provide a free residual of 1.5 mg/l? (15marks)

Dosage (mg/l)	1.00	2.00	3.00	4.00	5.00	6.00	7.00
Residual (mg/l)	0.8	1.55	1.95	1.25	0.5	0.85	1.95