



UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA
SECOND SEMESTER EXAMINATIONS, MAY 2018

COURSE NO: ENVIRONMENTAL MODELLING

COURSE NAME: ES 378

CLASS: ES 3

TIME: 3 HOURS

Name: _____ Index Number: _____

Attempt all questions in both sections

SECTION A [10 MARKS]

1. Give three (3) reasons why water quality parameters are often monitored [1.5 Marks]
2. List four Biological Water-Quality Parameters [1 marks]
3. List four Physical Water-Quality Parameters [1 marks]
4. List four Chemical Water-Quality Parameters [1 marks]
5. State two differences between Water Quality Standards and Water Quality Requirement [2 marks]
6. State three (3) possible effects of a low amount of dissolved oxygen in surface water? [1.5 marks]
7. Define biochemical oxygen demand (BOD) and outline the steps used in the standard 5-day BOD test [2 marks]

SECTION B (50 MARKS)

1. Tables 1 and 2 contain the standard and measured values of Huni River quality parameters as well as the arithmetic Water Quality Index (WQI) Rating. Using the data in Tables 1 and 2 and equations provided below
 - i. Calculate the proportionality constant

- ii. Calculate the unit weight of each parameter
- iii. Estimate the water quality index of the river
- iv. Determine the suitability of the water for domestic usage

$$q_n = 100 [(V_n - V_{io}) / (S_n - V_{io})] \quad \text{Eq. 1}$$

$$WQI = [(\sum q_n W_n) / (\sum W_n)] \quad \text{Eq. 2}$$

$$W_n = k / S_n \quad \text{Eq. 3}$$

where

q_n = Quality rating for the n^{th} water quality parameter

V_n = Estimated value of the n^{th} parameter at a given sampling station.

S_n = Standard permissible value of the n^{th} parameter

V_{io} = Ideal value of n^{th} parameter in pure water. [i.e., 0 for all other parameters except the pH and Dissolved oxygen (7.0 and 14.6 mg/l respectively)].

W_n = Unit weight for the n^{th} parameters

k = constant of proportionality

Table:1 Physicochemical parameters, Drinking Water standards and unit weights.

No.	Parameters	Observed values	Standard values
1.	pH	6.2	6.5-8.5
2.	Electrical Conductivity	401	300
3.	Total Dissolved Solids	490	500
4.	Total Alkalinity	78	120
5.	Total hardness	175	300
6.	Total suspended solids	412	500
7.	Calcium	75	75
8.	Magnesium	36	250
9.	Chlorides	178	250
10.	Nitrate	52	45
11.	Sulphate	151	150
12.	Dissolved oxygen	3	5.00
13.	Biological oxygen demand	33	5.00

Table: 2 Water Quality Rating as per Weight Arithmetic Water Quality Index Method

WQI Value	Rating of Water Quality	Grading
0-25	Excellent water quality	A
26-50	Good water quality	B
51-75	Poor water quality	C
76-100	Very Poor water quality	D
Above 100	Unsuitable for drinking purpose	E

2. An analysis for BOD₅ is to be run on a sample of wastewater. The BOD is expected to range from 50 to 350, and the dilutions are prepared accordingly. In each case, a standard 300-mL BOD bottle is used. The data are recorded below

Bottle No.	Wastewater (mL)	DO _i	DO ₅
1	20	8.9	1.5
2	10	9.1	2.5
3	5	9.2	5.8
4	2	9.2	7.5

- i. Determine the BOD₅ of the wastewater
 - ii. If you know that the oxygen utilization rate is 0.21 per day at 20 °C, what will be the BOD₃ if the test is run at 30 °C
3. An effluent with calcium concentration of 120 mg/l enters a river at a flow rate of 20 m³/s. The resultant flow rate and calcium concentration of the river after dilution were 15 m³/s and 58 mg/l, respectively. Determine the concentration of calcium present in the river prior to the dilution assuming a complete mixing occurred.
4. Discuss how the following activities were carried out during the field work
- i. Outline the steps involved in selecting a site for water quality monitoring within the community

- ii. Outline the steps to follow in order to help the team to determine the velocity of the river
- iii. Briefly discuss how the cross sectional area of the river will be determined
- iv. Briefly discuss the discharge rate or load will be determined

Dr Ishmael Quicoe