(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

FIFTH YEAR SEMESTER ONE

FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: CSE 551

COURSE TITLE: WATER RESOURCES ENGINEERING

DATE: MONDAY 25th APRIL 2022 **TIME: 8.00 – 10.00 AM**

INSTRUCTIONS:

1. This paper contains FOUR questions
2. Answer question ONE (compulsory) and any other TWO question
3. Marks for each question are indicated in the parenthesis.
4. Some useful equations are provided
5. Examination duration is **2 Hour**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION 1 (30 Marks)

(a) Discuss the relevance of Engineering economics in Water Resources Engineering[5 Marks]

(b) A stream receives untreated wastewater from sources located at site 1 and 2. Site 2 is downstream site1. The water quality indicator (DO-dissolve Oxygen), q_i mg/l at site 2 and site 3 is below the desired WHO standards. Site 3 is downstream site 2. Assuming that for each unit of waste removed (not discharged into the stream) at site 1, the quality index of at site2 improves by 0.020mg/l, and that that at site 3 improves by 0.015mg/l. For each unit of waste removed at site2, the quality index at site 3 improves by 0.023mg/l. The existing water quality at site 2 and 3 are 4 and 2.5 respectively, and the desired water quality at site 2 and 3 are 8 and 5 respectively. The waste input at site1 is 180units/day and that at site 2 is 100 units/day. The constraints for removable fractions on both sides are 30%on lower-limit and 90% on upper-limit, and the total cost is 2.7. Determine the level of wastewater treatment (waste removal) at site1 and 2 required to achieve desired concentrations at site 2 and 3 at minimum cost [25 marks]

Hint: The objective is to determine removable fractions x_1 and x_2 for site 1 and 2 respectively that minimizes total cost i.e. optimization. Make reasonable assumptions where necessary.

QUESTION 2 (20 Marks)

(a) Differentiate between the following

(i) Potential Water supply and Net Water supply [4 Marks]

(ii) Controlled and uncontrolled Spillway [4 marks]

(b) Explain the components of Urban Drainage systems [4marks]

(c) Design the most economical open trapezoidal channel to drain off water in an urban area. The following are given: Discharge, $Q=20m^3/s$, Manning's coefficient =0.017, Bottom slope $S_f=0.012$, and Side Slope of 1:0.577 [8 Marks]

QUESTION 3 (20 Marks)

(a) With examples differentiate between the following indicating where they are used

(i) Weir and a Barrage [4 Marks]

(ii) Gravity dam and earthen dam [4 Marks]

(b) Water is to be diverted from a river of discharge $6.2m^3/s$ for irrigation during dry spell using a broad crested weir with an upstream square corner and spanning the full width of a the river of 7.0m. The proposed crest length is 1.3m and the crest elevation is 1.8m above the bed.

Assuming an initial Cd=0.525, calculate the water surface elevation up-stream of the weir if a total flow of $3.2m^3/s$ of water is supposed to be diverted for irrigation using a broad crested Weir. [12 Marks]

QUESTION 4 (20 Marks)

(a) Discuss the following as used in drought studies [8 Marks]

i. Hazard
ii. Risk
iii. Vulnerability
iv. Acceptable Risk

(b) In an endeavor to minimize drought impacts through mitigation and risk management, briefly highlight some of the mitigation tools that can be deployed [12 Marks]

Some Useful Formula:

$C_d = 0.028\left(\frac{H_1}{B_W}\right) + 0.521$ for broad crested weir, and $C_d = 0.120\left(\frac{H_1}{B_W}\right) + 0.492$ for narrow-crested weir

For laminar flow, $Q = \frac{AR^{2/3}S_f^{1/2}}{\eta}\ m^3/s$