



**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

**MAIN CAMPUS**

**UNIVERSITY MAIN EXAMINATIONS  
2023/2024 ACADEMIC YEAR**

**FIRST YEAR FIRST SEMESTER EXAMINATIONS**

**FOR THE DEGREE  
OF  
MASTERS OF SCIENCE IN WATER RESOURCES  
ENGINEERING**

**COURSE CODE: CWE 853**

**COURSE TITLE: APPLIED ENGINEERING HYDROLOGY**

**DATE: 20<sup>TH</sup> DECEMBER 2023**

**TIME: 3 HOURS**

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**INSTRUCTIONS:**

1. This paper contains **FOUR** questions
2. Answer **ALL THE FOUR QUESTIONS**
3. Marks for each question are indicated in the parenthesis
4. Examination duration is **3 Hour**

MMUST observes **ZERO** tolerance to examination cheating

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

**QUESTION ONE (25 Marks)**

- (a) Briefly discuss the Convolution method for channel routing. [5 Marks]
- (b) Distinguish between hydraulic routing and hydrological routing [5 marks]
- (c) Perform a channel routing using classical Muskingum method having the following stream characteristics: Weighting factor  $x=0.2$ , Storage time constant  $K= 1.5$ hrs, Time travel interval  $\Delta t= 1$ hr. Assume the initial outflow is  $78\text{m}^3/\text{s}$ . [15 Marks]

Time (h)	1	2	3	4	5	6	7	8	9	10	11	12
Inflow( $\text{m}^3/\text{s}$ )	50	105	180	270	315	350	310	190	150	135	100	75

**QUESTION TWO (25 Marks)**

- (a) Distinguish between Stationary time series of second order and Stochastic time series [5marks]
- (b) A sample time series of mean flows for six consecutive years in a river in  $\text{m}^3/\text{s}$  is given as follows: 59, 80, 67, 87, 93, 100  
Estimate the first three sample autocorrelation coefficient [10 marks]
- (c) A first order autoregressive model is given by:  $x_i - 7.5 = 0.6(x_{i-1} - 7.5) + a_i$   
Where  $a_i$  is normally distributed white noise having zero mean and variance  $\sigma_a^2 = 16$ .  
Given a starting value  $X_1=60$ , generate the next four values,  $X_2, X_3, X_4$  and  $X_5$  assuming the following random  $N(0,1)$  values: 0.576, -0.634, 0.085, 1.135, -0.075, 0.197, [10Marks]

**QUESTION THREE (25 Marks)**

- (a) Define Unit Hydrograph and state its implication [5 Marks]
- (b) Given below is the discharge from a rainfall of magnitude 2.2cm, 2.5 and 2.4 cm occurring in three consecutive 3-hrs duration in a catchment of area  $35.6\text{Km}^2$ .  
i. Derive the 3-h Unit Hydrograph [10 Marks]  
ii. Derive the ordinates of a 9-h unit hydrograph for the same catchment [10 Marks]

Time(hrs)	0	3	6	9	12	15	18	21	24	27	30	33	36
Total Discharge ( $\text{m}^3/\text{s}$ )	6	10	18	26	35	46	58	50	47	40	30	20	10

**QUESTION FOUR (25 Marks)**

The annual maximum discharges of River X in Kenya for the year 2000 – 2015 are as follows in  $\text{m}^3/\text{sec}$ . 44.8, 51.4, 48.6, 54.8, 49.7, 53.7, 49.6, 54.9, 39.9, 55.6, 48.9, 60.1, 44.9, 61.8, 47.9. Assuming that these data constitute a random sample from a population of Q values which have the EVI distribution, estimate  $Q_T$  values for the return period 70 years.

- (i) Use the Moment methods to estimate the parameters [13 Marks]  
(ii) Use Probability weighting moment's method to estimate the parameters [12 Marks]