



MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FOURTH YEAR SECOND SEMESTER EXAMINATION

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 407: HYDROLOGY II

DATE:

TIME:

INSTRUCTIONS

This paper contains five questions; question is compulsory and attempt any other two (2).

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Define the term 'Hydrograph'. (2 marks)
- Draw a single-peaked hydrograph and indicate its various components.(4 marks)
 - State the significance of the inflection point on the recession side of the hydrograph. (2 marks)
- b) Describe with the help of a neat sketch THREE methods of separation of base flow from the hydrograph of runoff (i.e., stream flow hydrograph) indicating the situations under which each one is most preferable. (10 marks)
- c) Highlight the THREE basic propositions of the unit hydrograph theory. (3 marks)
- d) Data shown in Table Q1(d) shows the ordinates of the hydrograph of flow from a catchment area of 760 km² due to a 6-hour rainfall. Derive the ordinates for 6-hour unit hydrograph for the basin and state its peak. (9 marks)

Table Q1(d): Hydrograph ordinates due to a 6-hour rainfall.

<i>Date</i>	<i>Time from beginning of rainfall (hr)</i>	<i>Discharge (cumec)</i>	<i>Remarks</i>
1-3-1980	6	40	
	12	64	
	18	215	
2-3-1980	0	360	
	6	405 ←	Peak
	12	350	
3-3-1980	18	270	
	0	205	
	6	145	
4-3-1980	12	100	
	18	70	
	0	50	
	6	42	

QUESTION TWO (20 MARKS)

- a) Explain ‘synthetic unit hydrograph’. (3 marks)
- b) Distinguish between:
- i. Stream flow and Overland flow. (2 marks)
 - ii. Lag time and recession time. (2 marks)
 - iii. Annual series and partial duration series. (2 marks)
- c) A drainage has an area of 1650 km². Construct a 6-hour unit hydrograph, the data is given as follows:

Length of the longest water course = 80 km

Length along the main watercourse from the gauging station to a point opposite the centroid of the basin = 48 km.

From another catchment, which is meteorologically and hydrologically homogeneous, the constants obtained: $C_t = 1.2$, $C_p = 5$ (11 marks)

QUESTION THREE (20 MARKS)

- a) Highlight FOUR factors that influence the selection of a site for a stream gauging station. (4 marks)

- b) Explain how the stage-discharge-rating curve for a stream-gauging is prepared. Sketch a typical rating curve. (7 marks)
- c) With help of a typical sketch explain the flow-rating curve (4 marks)
- d) Velocities in Table Q3 (d) were recorded in a stream using current meter.

Table Q3(d): Velocities of a stream.

Depth above bed (m)	0	1	2	3	4
Velocity (m/s)	0	0.5	0.7	0.8	0.8

Calculate the discharge per unit width of stream near the point of measurement. Depth of flow at the point was 4 m.

QUESTION FOUR (20 MARKS)

- a) Define ‘flood routing’. Highlight assumptions made in routing a flood in a reservoir (5 marks)
- b) Distinguish between ‘stream flow routing’ and ‘reservoir flood routing’. (4 marks)
- c) The inflow hydrograph readings for a stream reach are given in Table Q4(c) for which the Muskingum coefficients of $K = 30$ hr and $x = 0.2$ apply. Route the flood through the reach and determine the reduction in peak and the time of peak outflow. Outflow at the beginning of the flood may be taken as the same as inflow. (11 marks)

Table Q4(c): Inflow hydrograph readings

Time (hr)	Inflow (cumec)	Time (hr)	Inflow (cumec)
0	15	132	32
12	16	144	28
24	31	156	24
36	96	168	22
48	121	180	20
60	102	192	19
72	85	204	18
84	70	216	17
96	57	228	16
108	47	240	15
120	39		

QUESTION FOUR (20 MARKS)

- a) Describe the phrase Flow Duration Curve and give it implication in hydrology (4 marks)
- b) For probability analysis to provide reliable answers, it must start with a data series that is relevant, adequate, and accurate. Discuss this assertion. (6 marks)
- c) The mean annual flood of a river is $600\text{m}^3/\text{s}$ and the standard deviation of the annual flood time series is $150\text{m}^3/\text{s}$. what is the probability of a flood of magnitude $1000\text{m}^3/\text{s}$ occurring in the river within the next five years? Use Gumbel's method and assume large sample.

(10 marks)