



MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV: 302: HYDROLOGY 1

DATE:

TIME:

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) 30 MARKS

- Discuss the importance of studying hydrology in civil engineering. (4 marks)
- Discuss various reasons or circumstances why one can have missing precipitation data in a weather station (3 marks)
- Discuss the factors that affect the rate of run-off on a watershed. (5 marks)
- With the aid of a well labeled diagram, define and discuss the various processes of a hydrological cycle (8 marks)
- Explain the conditions and mechanics of rainfall formation. (6 marks)
- With illustrations, explain the formation of orographic precipitation. (4 marks)

QUESTION TWO (20 MARKS)

- Discuss the effects of the global climate change on hydrological cycle. (6 marks)
- Rainfall depth in a certain watershed is monitored through six well distributed rain gauges whose gauged data are given below. Calculate the Thiessen mean value of the rainfall. (4 marks)

Rain Gauge Number	A	B	C	D	E
Rainfall Depth (cm)	10.5	11.56	9.57	10.50	11.63

Area of Thiessen Polygon (km ²)	15.0	23.5	35.9	8.5	12.35
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- c) Outline the factors that you would consider in selecting a site for a stream gauging station. (4 marks)
- d) For a watershed of varying land use systems, soils and topography, determine the following
- (i) The weighted runoff coefficient, (2 marks)
 - (ii) Time of concentration (TOC) (2 marks)
 - (iii) Peak runoff rate. (2 marks)

The requisite details are outlined as under:

- Length of longest water course =1500m
- Average longitudinal slope of water course=2.5%.
- Length of overland flow=125m
- Slope of overland flow path =0.02.
- Rainfall depth =5.0cm
- Take Manning's roughness coefficient as 0.15

Land use/topography	Agricultural lands/ topography is flat/ soil sandy	Grassland/ rolling topography/ soil is sandy	Residential lands/ topography is flat/ soil is tight clay or hard soil.
Area (ha)	250	175	25
Runoff coefficient	0.30	0.16	0.40

QUESTION THREE (20 MARKS)

- a) What is the difference between aquiclude, aquifuge and aquitard.? (3 marks)
- b) With an aid of a well labelled diagram, discuss three types of aquifers (5 marks)
- c) With an aid if a well labelled diagram, show the different parts of a non-recording Symons rain gauge and explain how it works. (4 marks)
- d) The following are the rain gauge observations during a storm. Construct:
- (i) mass curve of precipitation (4 marks)
 - (ii) hyetograph. (4 marks)

Time elapsed (min)	5	10	15	20	25	30	35	40	45	50
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Accumulated Rainfall (cm)	0.1	0.2	0.8	1.5	1.8	2.0	2.5	2.7	2.9	3.1
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QUESTION FOUR (20 MARKS)

- a) Write a hydrologic budget equation and discuss its components (3 marks)
- b) Discuss the factors that affect evapotranspiration. (3 marks)
- c) Discuss the four main components of a watershed. (4 marks)
- d) Outline the factors that affect infiltration rates in a catchment. (4 marks)
- e) A certain hydrological basin has the following characteristics, an area of 26560km², perimeter 965km and a longitudinal length of 230 km. Determine:
 - i. form factor of the basin. (1 mark)
 - ii. compactness coefficient. (2 marks)
 - iii. elongation ratio. (1 mark)
 - iv. circularity ratio. (2 marks)

QUESTION FIVE (20 MARKS)

- a) The management of Machakos University has given you a task to install five rain-gauges at different locations within the university. Explain the various conditions that you would consider in selecting a suitable position for installation. (6 marks)
- b) After the installation, it was observed that one of the rain gauge (C) didn't function properly for a part of a month during which a storm occurred. However, the total and the normal annual precipitation for the other gauges were recorded and tabulated as shown in the table below. Find out the missing storm precipitation data of station (C). (4 marks)

Rain gauge	A	B	C	D	E
Total precipitation (mm)	28	45	?	56	38
Annual precipitation (mm)	395	430	367	495	462

- c) Problems associated with groundwater over exploitation (4 marks)
- d) The rainfall intensity vs time data derived from the mass curve of a specific rainfall event is given as under. Determine the depth of rainfall of the rain event. (6 marks)

<i>Rainfall time (hour)</i>	<i>0-1.5</i>	<i>1.5-3.0</i>	<i>3.0-4.5</i>	<i>4.5-6.0</i>	<i>6.0-7.5</i>	<i>7.5-9.0</i>
<i>Rainfall intensity (cm/h)</i>	<i>3.50</i>	<i>5.25</i>	<i>6.00</i>	<i>5.00</i>	<i>6.25</i>	<i>3.50</i>