

The National University of Lesotho

BSc. Examination

PG 3412: Hydrometeorological Instrumentation and Observation

January 2024

Duration: 3 hours

Marks: 100

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**Instructions:**

- Answer **Question 1** and **any three**.
  - Where applicable illustrate your answer with diagrams.
  - Show all calculations.
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Question 1

- a. Define the following terms (14)
- Effective porosity
  - Zero-flux plane
  - Potential Evapotranspiration
  - Random error
  - Temperature inversion in the atmosphere
  - Wind error
  - Wetting error
- b. List 5 processes that are part of the hydrological cycle and for three processes of your choice, give the units and instruments that are used to measure them (11)
- (25)

Question 2

- a. List two categories of rain-gauges, give an example of a rain gauge falling in each category and give three differences between the two categories (13)
- b. As an expert in hydrometeorology, you know that in order to calibrate a tipping bucket rain gauge, you need to pass a known volume of water through it. You have 310ml of water that you are going to use. The cylindrical opening of the rain gauge is  $420\text{cm}^2$ . Each bucket of a rain gauge has a capacity of 0.2mm. How many times should the bucket tip over if the gauge is working properly? (12)
- (25)

Question 3

- a. Draw a fully labelled diagram of a maximum-minimum thermometer (10)
  - b. Explain how a maximum -minimum thermometer operates. (15)
- (25)**

Question 4

- a. What is a measurement drift and under what conditions does it occur? (4)
  - b. With the help of a labelled diagram of a tipping bucket rain gauge, explain how a tipping bucket rain-gauge operates and how you can use it to determine the total amount of rainfall per day (13)
  - c. Give two examples of the possible sources of systematic and two of random errors that can occur when measuring rainfall using a tipping bucket rain gauge. (8)
- (25)**

Question 5

You want to measure the discharge of a 10m wide river using a float method.

- a. List the equipment that you would need? (8)
  - b. Give a step by step procedure that you would follow to be as accurate as possible (17)
- (25)**

Question 6

- a. A standard 20cm diameter cylindrical rain gauge is designed such that the angle between the vertical side wall and sloping funnel wall is  $125^\circ$ . What must be the minimum height of the side wall to avoid splashing error? (15)
  - b. With the help of a graph, explain how a layer of oil is used as an evaporative suppressant in a standard rain gauge. The graph should illustrate the impact of the oil suppressant (10)
- (25)**