



# UNIVERSITY OF RUHUNA

## FACULTY OF FISHERIES AND MARINE SCIENCES & TECHNOLOGY

Academic Year 2022/2023

Bachelor of Science Honours in Fisheries and Marine Sciences Degree

Bachelor of Science Honours in Marine and Freshwater Sciences Degree

Level III, Semester II Examinations – October /November-2024

LIM 3213: Principles and Applications of Hydrology-Theory

Time: 02 hours

Answer only four (4) questions

1. Using the Budyko Curve, answer the following questions:
  - a. Describe the principles of the Budyko Curve and discuss its significance in understanding water balance within ecosystems. (10 marks)
  - b. In a research study, it was found that a forest ecosystem had an annual precipitation (P) of 1000 mm and actual annual evapotranspiration (AET) of 700 Based on the Budyko Curve, calculate the potential evapotranspiration (PET) for this ecosystem. Provide a detailed explanation of your calculations and the reasoning behind each step. (15 marks)
2. You are given the ordinates of a 3-hour unit hydrograph. A storm produces rainfall over three successive 3-hour intervals with the following magnitudes: 3 cm, 6 cm, and 4 cm.
  - a. Assuming a loss rate of 0.3 cm/h and a base flow of 30 m<sup>3</sup>/s, calculate the resulting flow hydrograph. (15 marks)
  - b. Show all steps in your calculations. (10 marks)

| Time (hr.) | Unit Hydrograph (m3/sec) |
|------------|--------------------------|
| 0          | 0.00                     |
| 3          | 12.82                    |
| 6          | 38.45                    |
| 9          | 62.80                    |
| 12         | 71.77                    |
| 15         | 64.08                    |

|    |       |
|----|-------|
| 18 | 51.26 |
| 21 | 38.45 |
| 24 | 20.50 |
| 27 | 10.25 |
| 30 | 0.00  |

3. Hydrological models are widely used in water resource analysis. Answer the following questions based on modeling.

- Discuss the categorization of hydrological models built on spatial variation of parameters and simulation structure. (08 marks)
- Students who are enrolled in the Principles and Applications of Hydrology module are assigned to investigate the flow dynamics of the Nilwala River by routing the flow through a specific section of the river. An inflow hydrograph developed for a cross-section at an upstream location is shown in the below Table:

| Time (hours) | Inflow (m <sup>3</sup> /s) |
|--------------|----------------------------|
| 0            | 8                          |
| 6            | 18                         |
| 12           | 40                         |
| 18           | 50                         |
| 24           | 45                         |
| 30           | 42                         |
| 36           | 32                         |
| 42           | 25                         |
| 48           | 15                         |

The Muskingum method uses the following equation to determine outflow  $Q_2$ . The text size in equations use to explain  $c_1$ ,  $c_2$  and  $c_3$  are too small and they should have appeared as in the main equation).

$$Q_2 = C_1 I_2 + C_2 I_1 + C_3 Q_1,$$

$$\text{where } C_1 = \frac{\Delta t - 2Kx}{2K(1-x) + \Delta t}, C_2 = \frac{\Delta t + 2Kx}{2K(1-x) + \Delta t}, C_3 = \frac{2K(1-x) - \Delta t}{2K(1-x) + \Delta t}$$

- i. Calculate the values of  $C_1$ ,  $C_2$ , and  $C_3$  for the specified location assuming  $K=5$  hours,  $x=0.15$ , and an initial condition where outflow equals inflow.

(07 marks)

- ii. Determine the outflow hydrograph using the Muskingum method.

(10 marks)

4. Write short notes on the following topics related to hydrology, explaining relevant key concepts clearly:

- a. The water cycle and its main components, precipitation, evaporation, and infiltration.

(10 marks)

- b. The interactions between surface water and groundwater, and their significance in hydrology.

(10 marks)

- c. The importance of hydrology in water resource management and planning.

(5 marks)

5. Answer all the sections on precipitation

- a. Briefly describe the various types of precipitation and the meteorological principles applied to explain the mechanisms of them.

(08 marks)

- b. Describe condensation and coalescence relevant to the cloud formation process

(08 marks)

- c. How do humidity, atmospheric pressure and temperature affect the type and quantity of precipitation?

(09 marks)

6. Write short notes on the following key principles of water resources management.

- a. Sustainable usage of water

(08 marks)

- b. Water conservation techniques

(08 marks)

- c. Integrated watershed management

(09 marks)

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