UNIVERSITY OF ESWATINI

RE-SIT EXAMINATION PAPER

PROGRAMME: BSC AGRICULTURAL AND BIOSYSTEMS ENGINEERING (ABE)

COURSE CODE: ABE401

TITLE OF PAPER: RURAL WATER SUPPLY AND HYDROLOGY

TIME ALLOWED: TWO (2) HOURS

INSTRUCTIONS: ANSWER THECOMPULSARY QUESTION ONE AND ANY TWO OTHER QUESTIONS.

DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

## SECTION I: COMPULSARY

### QUESTION 1

An earth dam is to be constructed to provide storage of at least **115, 000 m³** of irrigation water. The catchment from which the water will be obtained has a total size of **144 ha** of sandy clay soil. The catchment is **800 m** wide, and has a maximum length of **1800** m with a slope of 10 m fall over the full length. The area receives an average rainfall of **800 mm/year**. The rainfall intensity for the catchment area is **100 mm/h** with a runoff coefficient (C) of **0.36**.

**A)** **i.** Determine if the catchment is capable of providing enough water for the required storage of **115, 000 m³** (**Table 1**). **(10 marks)**

**ii.** Calculate the design peak runoff to accommodate the 100 mm/h storm.

**(10 marks)**

$$Q = \frac{CiA}{360} \quad \textbf{(1)}$$

**B)** **i.** Name three (3) types of earth dams. **(6 marks)**

**ii.** Briefly discuss the role of water storage in agricultural production.

**(14 marks)**

**[40 marks]**

Table 1. Runoff from catchment areas

| Average rainfall, R (mm) | Total annual evaporation (mm) | Reliability (yrs out of 10) | Runoff as a % of average rainfall, Y | | | |
|---|---|---|---|---|---|---|
| | | | Shallow sand or loam soils (%) | Sandy clays (%) | Elastic clays | Clay pans, inelastic clays or shales (%) |
| > 1100 | - | 8 | 10 – 15 | 0 – 15 | 15 – 20 | 15 - 25 |
| | - | 9 | 6.5 – 10 | 6.5 – 10 | 10 – 13 | 10 – 16.5 |
| | - | 8 | 10 – 12.5 | 10 – 15 | 12.5 – 20 | 15 - 20 |
| | - | 9 | 6.5 – 8 | 6.5 – 10 | 8 – 13 | 10 - 13 |
| 901- 1100 | - | 8 | 10-12.5 | 10 – 15 | 12.5 – 20 | 15 – 20 |
| | - | 9 | 6.5 – 8 | 6.5 – 10 | 8 – 13 | 10 - 13 |
| 501 – 900 | < 1300 | 8 | 7.5 -10 | 7.5 – 15 | 7.5 – 15 | 10 - 15 |
| | | 9 | 5 – 6.5 | 5 – 10 | 5 – 10 | 6.5 - 10 |
| | 1300-1800 | 8 | 5-7.5 | 5-12.5 | 5-10 | 10-15 |
| | | 9 | 3-5 | 3-8 | 3-6.5 | 6.5-10 |
| 401-500 | 1300-1800 | 8 | 2.5-5 | 5-10 | 2.5-5 | 7.5-12.5 |
| | | 9 | 1.5-3 | 3-6.5 | 1.5-3 | 5-8 |
| 250-400 | < 1800 | 8 | 0-2.5 | 0-5 | 0-2.5 | 2.5-7.5 |
| | | 9 | 0-1.5 | 0-3 | 0-1.5 | 1.5-5 |
| | ≥ 1800 | 8 | 0 | 0-2.5 | 0 | 2.5-5 |
| | | 9 | 0 | 0-1.5 | 0 | 1.5-3 |

**Source**: Nelson (1985)

## SECTION II: ANSWER ANY TWO QUESTIONS

### QUESTION 2

A) Discuss briefly the **data** that you would require to determine the water demand requirements for a small rural community. **(15 marks)**

B) A small rural community of **15, 000** people in the Highveld of Swaziland had water requirements of **40 l/h/d** with a peak day factor (PDF) of **1.3**. Calculate the design capacity for this community in **$m^3$/day and $m^3$/ h**. **(10 marks)**

C) What material would you recommend for the construction of the water storage tank for the community water supply and why? **(5 marks)**

**[30 marks]**

### QUESTION 3

A) i. Most **NGO** erected boreholes are reported to be failing in some rural areas in **Eswatini**. Briefly discuss how these boreholes fail. **(10 marks)**

ii. Discuss briefly any two **contingency** water sources that you could recommend for domestic use. **(5 marks)**

B) Discuss the following components of rural water supply:

i. Surface water. **(5 marks)**

ii. Rainwater harvesting. **(5 marks)**

iii. Rooftop rainwater harvesting. **(5 marks)**

**[30 marks]**

### QUESTION 4

A) i. State the **"continuity principle"** in hydraulics and explain briefly its relevance in rural water supplies. **(10 marks)**

ii. Water flows from a tank into a **pipe** at a rate of **1.0 l/s**. Calculate the velocity of entrance into the pipe if the internal diameter of the inlet is **45 mm**. **(5marks)**

B) Describe with the aid of a diagram the three categories of small community water distribution. **(15 marks)**

**[30 marks]**