



**UNIVERSITY OF SWAZILAND
MAIN EXAMINATION PAPER**

**PROGRAMME: BSC IN AGRICULTURAL AND BIOSYSTEMS
ENGINEERING YEAR 2**

COURSE CODE: ABE 201

TITLE OF PAPER: AGRO CLIMATOLOGY

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO
OTHER QUESTIONS**

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GRANTED BY THE CHIEF INVIGILATOR**

QUESTION 1

- a) Draw a clearly labelled diagram, showing the way of water in the atmosphere onto and into the ground and back (i.e. the hydrological cycle). **[10 marks]**
- b) Explain in detail how a rainfall type of precipitation is formed. **[10 marks]**
- c) Using the formulae as given in appendix 1, copy and fill in table 1 below. Using the results, explain the relationship between rainfall observed and the effective portion (%).

Monthly dependable and effective rainfall

Month	Observed (mm)	Effective (mm)	Dependable Effective (mm)	% effective
Jan	149.4			
Feb	126.1			
Mar	88.6			
Apr	51.1			
May	24.1			
Jun	12.4			
Jul	9.8			
Aug	14.4			
Sep	32.8			
Oct	70			
Nov	91.1			
Dec	123.8			
TOTALS				

[10 marks]

Clearly discuss why it is makes more scientific sense to use **dependable** and **effective** rainfall rather than observed rainfall in deciding whether a crop can be grown in a particular area.

[10 marks]

QUESTION 2

Climate variability and climate change take place because of internal changes within the climate system or in the interaction of its components, or because of changes in external forcing either by natural factors or anthropogenic activities. Explain how the following are probable causes of both climate variability and change.

- Sunspot cycle
- El Nino/Southern Oscillation
- Land surface changes
- Greenhouse gases

[30 marks]**QUESTION 3**

The correct use of well-functioning instruments is important in collecting climate data. Thus any user of an instrument should understand how the instrument operates and most importantly how to read the instrument correctly. Therefore:

- i) Explain how a Campbell-Stokes sunshine recorder works, stating its advantages and disadvantages. **[10 marks]**
- ii) Discuss the proper installation of a rain gauge, and give the possible sources of error when using this instrument. **[10 marks]**
- iii) Explain how a Stevenson screen looks like, and the rationale of having some instruments housed in it. **[10 marks]**

QUESTION 4

- a) The roots of a well watered crop completely covering the ground can take up to 50 – 80 tons of water per hectare per day, depending on the weather conditions. Scientists have all along been confused as to why plants are so 'wasteful' of water.

Explain why each of the functions listed below, and even collectively do not justify such an amount of water being required by the plants. You can add value to your answer by giving estimates of water needed for each process.

- Photosynthesis
- Transport of nutrients from roots to leaves
- Cooling of plant

If the three do not justify such a large use, then why do plants need so much water?

[15 marks]

- b) With the aid of a diagram, discuss the **three** stages of evaporation from a soil surface from the moment just after irrigation or a rainfall event up to when most of the water has been removed from the soil.

[15 marks]

APPENDIX 1

a) USDA Soil Conservation Service Method to determine effective rainfall.

$$P_{\text{eff}} = P (125 - 0.2P)/125 \quad \text{for } P < 250\text{mm/month}$$

$$P_{\text{eff}} = 125 + 0.1P \quad \text{for } P > 250\text{mm/month}$$

b) FAO developed a relationship to estimate dependable effective rainfall from monthly mean rainfall;

$$P_{de} = 0.6 P - 10 \quad \text{for } P < 70\text{mm}$$

$$P_{de} = 0.8 P - 24 \quad \text{for } P > 70\text{mm}$$