



**UNIVERSITY OF SWAZILAND
MAIN EXAMINATION PAPER**

PROGRAMME: BSC IN AGRICULTURAL & BIOSYSTEMS
ENGINEERING

COURSE CODE: ABE 201

TITLE OF PAPER: AGROCLIMATOLOGY

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO
OTHER QUESTIONS.

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

SECTION A. COMPULSORY QUESTION**Question One**

- a. Using the processes listed below, explain how radiation from the sun interacts with the atmosphere and earth's surface;
- | | | |
|------|----------------------------|----|
| i. | Reflection from clouds | /5 |
| ii. | Diffuse scattering | /5 |
| iii. | Radiation on earth surface | /5 |
| iv. | Net radiation | /5 |

[20 marks]

- b. The earth has a mechanism of distributing its energy resulting in the tropics not being as hot or the Polar Regions not being as cold as they would be had there been no such distribution. Discuss four factors by responsible for energy distribution.

[20 marks]**SECTION B. ANSWER ANY TWO QUESTIONS****Question Two**

- a. Briefly explain the effects of the following environmental factors in evapotranspiration:
- | | | |
|---|--|----|
| - | Carbon dioxide concentration inside leaves | /5 |
| - | Air humidity | /5 |
| - | Vapour pressure | /5 |
| - | Heat energy | /5 |

[20 marks]

- b. Explain how a Campbell-Stokes sunshine recorder works, stating its advantages and disadvantages.

[10 marks]

Question Three

- a. Discuss the possible benefits of climate change on crop production due to:
- Increased mean temperatures
 - Carbon dioxide fertilisation
- [10 marks]
- b. Mitigation and adaptation are two main action plans in climate change. Explain how these differ from each other, and give at least two examples for each
- [10 marks]
- c. A plant in summer is exposed to temperatures of 27°C and acquires the same temperature. Assuming that the plant behaves like a black body and using Wien's Law of radiation ($\lambda_{\text{max}} = 2897/T$), calculate the wavelength at which maximum radiation will be emitted from the plant. /5
- d. Using the electromagnetic spectrum of Figure 1, explain why the plant is not visible at night despite its emitted radiation. /5

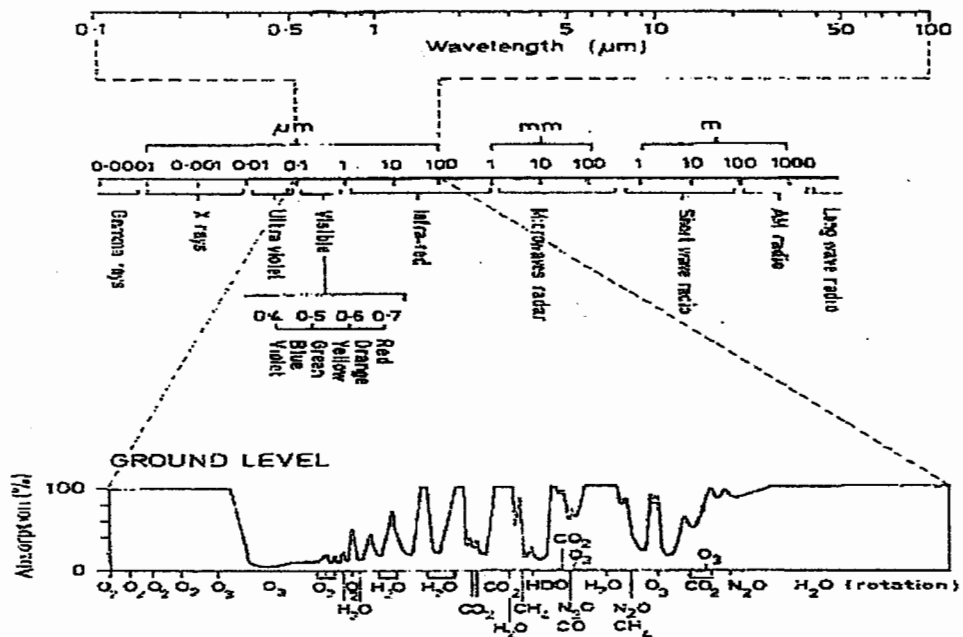
[10 marks]

Figure 1: Electromagnetic spectrum, also showing the extent of absorption (Henderson-sellers and Robinson, 1986)

Question Four

- a. To relate crop growth and developmental response to temperature, the Heat Unit System was developed. It suggests that a species of a plant will need a certain number of heat units from sowing to maturity, and these accumulate daily. A heat unit is the measurement of departure of the mean daily temperature above a minimum threshold. Discuss the shortcomings of this theory.

[10 marks]

- b. Extraterrestrial radiation at a certain latitude and season was estimated at 28 MJ/m². Only 60% of that reached the earth surface. Calculate how much more/less energy was captured by a woodland surface than a stormy desert in MJ/m². /5
- c. A solar panel of area 2.5 m² with an absorptive index of 93.25% was also used on the same day to capture the radiation. Calculate the energy captured by the panel in MJ for that particular day. /5

[10 marks]

- d. Describe two of the major stages of rainfall formation explaining the conditions necessary for the processes to take place. [10 marks]