UNIVERSITY OF ESWATINI
FINAL EXAMINATION PAPER

PROGRAMME: BSC ABE. II

COURSE CODE: ABE201

TITLE OF PAPER: AGROCLIMATOLOGY

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

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SECTION I   COMPULSORY

QUESTION 1

a) Explain the difference between the following:
   (i)   Rayleigh scattering and Mei scattering   [5 marks]
   (ii)   Planetary albedo and earth surface albedo   [5 marks]
   (iii)   Thermal conductivity and thermal diffusivity in soils   [5 marks]
   (iv)   Lapse rate and dry adiabatic cooling   [5 marks]

b) (i) Below is the wind profile equation used to estimate the variation of wind speed with height. Explain the various parameters in this equation, including the 0.4 value.

$$u(z) = \frac{u^*}{0.4} \, ln\frac{z-d}{z_m}$$

[10 marks]

(ii) Wind speed was measured at 3 m height over a sorghum crop which was 0.8 m tall, and the wind speed was found to be 4.7 m/s. Estimate the wind speed at 2 m height.

[5 marks]

c) Explain with the aid of a diagram, the relationship between sunlight and leaf conductance to carbon dioxide.

[5 marks]

SECTION II   ANSWER ANY TWO QUESTIONS

QUESTION 2

a)   Write short notes on the following forms of radiation:

    (i)   Exo-atmospheric radiation
    (ii)   Clear-sky solar radiation   **[5 marks]**
    (iii) Net radiation   **[5 marks]**
                                                   [5 marks]

b)   Discuss the following laws as they are used to describe the behaviour of electromagnetic radiation (EMR):

    (i)   Stefan-Boltzmann Law
    (ii)   Wien's Law   **[5 marks]**
    (iii) Kirchhoff's Law   **[5 marks]**
                                                     [5 marks]

QUESTION 3

a)   Explain how the following factors may be drivers of climate change:

    (i)   Radiative forcing from anthropogenic aerosols
    (ii)   Radiative forcing from Greenhouse Gases   **[5 marks]**
    (iii) Radiative forcing from land surface changes   **[5 marks]**
                                                     [5 marks]

b)   Discuss the three types of drought.

                                              [15 marks]

QUESTION 4

a) Below are recorded temperatures (maximum and minimum) for Bhunya area between February 19 and February 21.

Date	Maximum °C	Minimum °C
19 February	29.9	12.6
20 February	32.1	11.2
21 February	34.0	11.1

Calculate the modelled air temperature at 10 am and 5 pm on the 20th February.

$\Gamma(t) = 0.44 - 0.46 \sin(\omega t + 0.9) + 0.11 \sin(2\omega t + 0.9)$
Where $\omega = \pi/12$, and t is the time of day in hours (t =12 at solar noon)

The temperature for any time of day is given by:

$T(t) = T_{x,i-1}\Gamma(t) + T_{n,i}[1-\Gamma(t)]$ $\quad 0 < t \leq 5$
$T(t) = T_{x,i}\Gamma(t) + T_{n,i}[1-\Gamma(t)]$ $\quad 5 < t \leq 14$
$T(t) = T_{x,i}\Gamma(t) + T_{n,i+1}[1-\Gamma(t)]$ $\quad 14 < t < 24$

[15 marks]

b) Explain the concept of heat unit system in crop growth and development; also mention the system's limitations.

[15 marks]