National University of Lesotho

BSc. and BSc. Ed. Examination

PG 4411: Agrometeorology

January, 2024 Marks: 100 3 Hours

Instructions:

- Answer any **four (4)** questions.
- Where applicable illustrate your answer with equations and diagrams.

Question 1

Briefly discuss the physical reasons which render the following practices potentially effective anti-frost measures, and in what circumstances are such measures likely to be most or least successful:

(a) Consolidation of top soil
(b) Smudging by smokes and vapours
(c) Sprinkling
(d) Using wind machines
(e) Thermal insulation

[25]

Question 2

(a) Compare and contrast the effects on soil temperature, soil moisture and the practical implications of
   i) A cover crop
   ii) A mulch of organic material
   iii) A mulch of some artificial material such as plastic
   (15)

(b) How much heat will flow by conduction in four hours through a column of wet marshy soil with a cross-sectional area of 10 cm^2 and a depth of 5 cm, if the top of the column is 6.0 K warmer than the bottom? (4)
   Let $\kappa = 0.84$ J m^{-1} K^{-1} s^{-1}

(c) Briefly discuss the effects of cold rain on soil temperature. (6)

[25]

Question 3

(a) Write a brief account of hail as an agricultural hazard and also explain why it is difficult to obtain hail statistics. (15)

(b) ‘A state of drought exists when annual rainfall is 75 percent of average or when monthly rainfall is 60 percent.’ Briefly criticize this incomplete specification of drought from the standpoint of:

i. A Water engineer
ii. A farmer (10)

[25]

Question 4

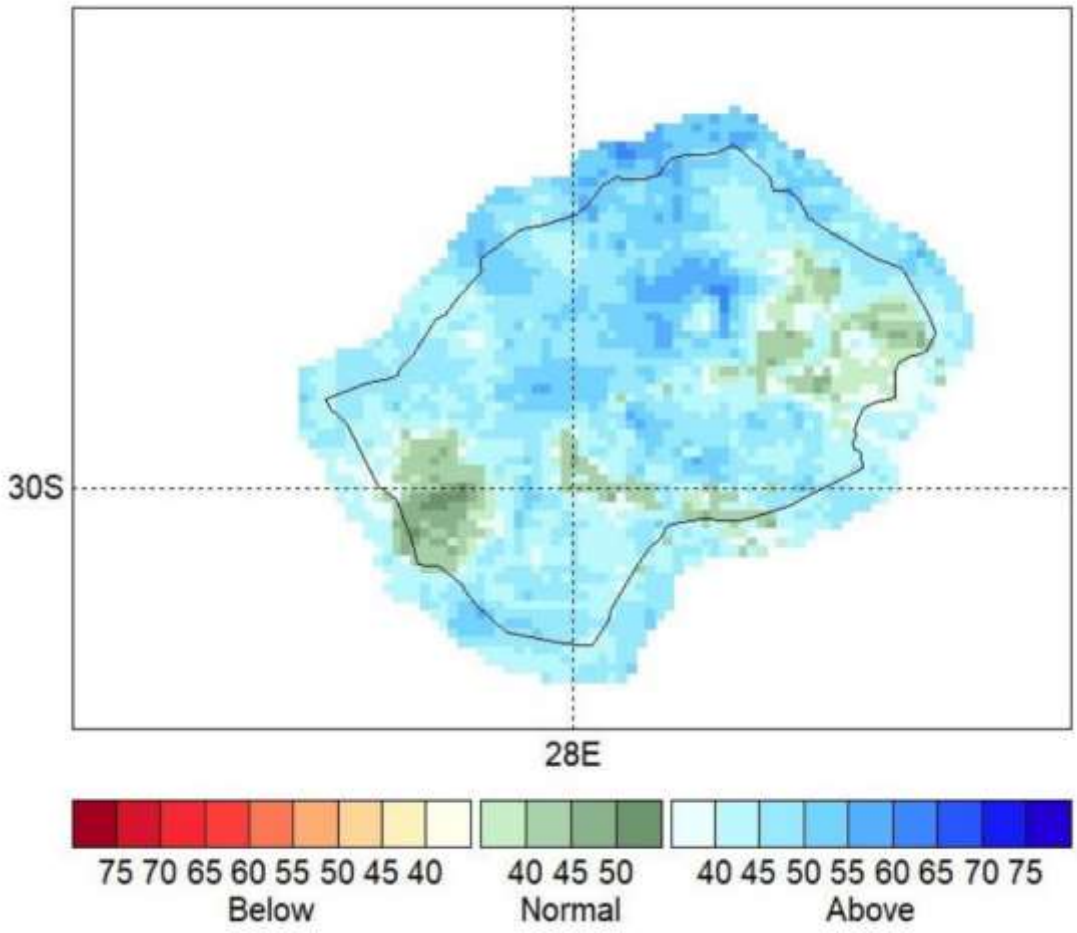
At night the reading of an exposed ‘grass minimum’ thermometer is below that of a thermometer in the screen.

(a) Explain why this is the case. (10)
(b) Discuss the expected differences in reading ‘grass minimum’ thermometers which are exposed over grass, over bare ground and over stone respectively. (15)

[25]

Question 5

The 2023/2024 rainy season outlook has been given as follows:



December-January-February 2023/2024 Probabilistic Forecast

Based on the probabilistic forecast given above, determine the amount of rainfall that can be expected at Botha-Bothe using the 1981-2011 historical rainfall data.

Table 1. December – January – February historical rainfall (1981/82 – 2010/11)

Year	December rainfall (mm)	January rainfall (mm)	February rainfall (mm)
1981/82	95.3	89.5	22.5
1982/83	49.2	65.0	83.6
1983/84	84.6	70.8	32.2
1984/85	73.6	64.8	83.4
1985/86	150.7	71.2	70.5
1986/87	48.8	64.6	100.4
1987/88	82.1	118.5	139.5
1988/89	127.0	130.3	205.0
1989/90	57.3	20.1	160.0
1990/91	72.9	284.2	149.0
1991/92	114.7	53.0	71.1
1992/93	56.8	83.6	92.2
1993/94	117.5	164.8	97.3
1994/95	72.5	89.6	73.6
1995/96	102.7	122.2	113.2
1996/97	91.4	104.0	119.8
1997/98	121.0	227.5	119.6
1998/99	102.0	71.0	52.9
1999/00	194.5	184.2	106.8
2000/01	176.9	62.5	112.2
2001/02	102.6	190.0	61.3
2002/03	147.3	89.4	136.9
2003/04	64.0	213.2	65.6
2004/05	125.8	214.3	92.8
2005/06	21.8	247.4	179.5
2006/07	187.3	303.0	95.6
2007/08	68.5	37.5	34.0
2008/09	82.8	47.1	58.5
2009/10	136.4	98.7	67.0
2010/11	168.0	118.5	139.5

[25]

Question 6

(a) 'A good year of snow is an indication of abundant harvest.' Analyse the truth of this statement, indicating the climatic regimes and circumstances in which it could be valid, and explain why a 'good' snow cover could be beneficial. (10)

(b) The climate of a country plays an important role in determining its capacity of crop production. With particular reference to the case of Lesotho, briefly discuss how primary climatic factors such as temperature and precipitation (or moisture) affect crop scheduling and hence the agricultural activity of a country. (15)

[25]