

UNIVERSITY OF RUHUNA, FACULTY OF AGRICULTURE
FIRST EXAMINATION IN BSc. AGRICULTURAL RESOURCE AMANGEMENT AND
TECHNOLOGY
FIRST EXAMINATION IN BSc. GREEN TECHNOLOGY (PART I)
JUNE – 2022
HYDROLOGY AND CLIMATOLOGY – EN1101

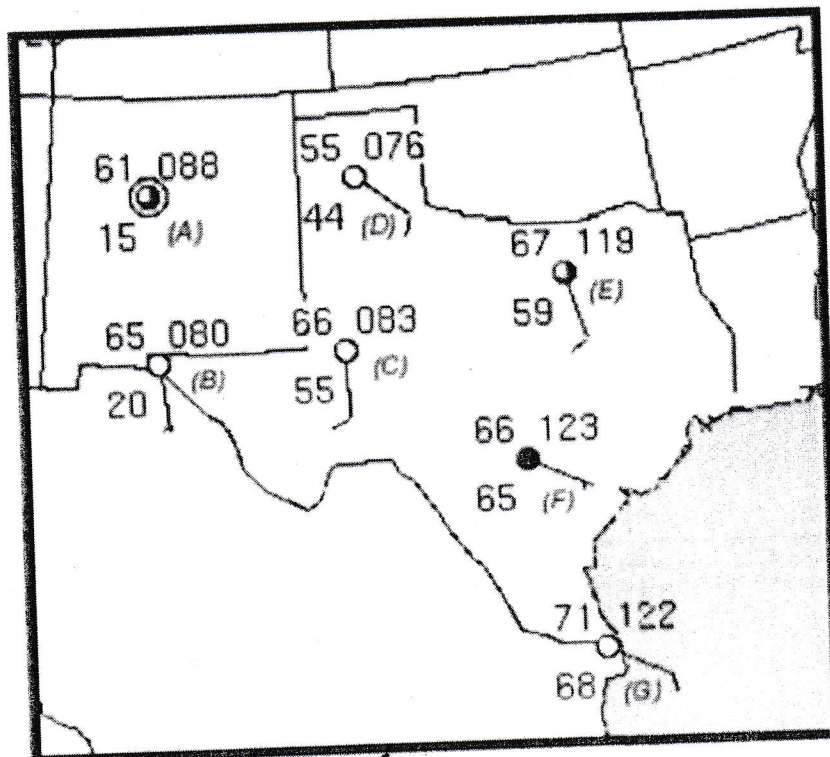
INDEX NO:

STRUCTURED AND ESSAY TYPE (TIME 2 1/2 HOURS)

- Answer **all** questions in PART A
- Answer to the structured questions in PART A must be done in the spaces provided.
- Answer only **Two** questions from PART B
- Answers to Essay type questions in PART B must be done on the answer books
- All questions carry equal marks
- Only non-programmable calculators are permitted.
- Mobile phones are NOT permitted.

PART A: STRUCTURED TYPE

1. The following image is part of an actual synoptic weather map of 11 March 2021. It shows A-G stations (50 Marks)



(I)

- a) Which station is reporting the lowest temperature?.....
What is that temperature?.....
- b) Which station is reporting the highest dewpoint?.....
What is that dewpoint?.....
- c) Which station is reporting the highest air pressure?.....
What is that pressure?.....
- d) Which station is reporting the lowest air pressure?.....
What is that pressure?.....
- e) Which station probably has the highest relative humidity?.....
- f) Where is the air at that station coming from?.....
- g) Which station is probably in the driest air mass?.....
How do you know?.....

(II) Match each term in the left-hand column to the statement that it best exemplifies

(50 Marks)

1. Albedo	A. The meteorological conditions in a given place on a given day
2. Carbon taxes	B. An international group of scientists that evaluates scientific studies related to climate change to thoroughly and objectively assess the data
3. Precautionary principle	C. Governmental fees imposed on activities (such as fossil fuel use) that release CO ₂ into the atmosphere
4. Climate change	D. The ability of a surface to reflect away solar radiation
5. Mitigation	E. Acting in a way that leaves a safety margin when the data are uncertain or severe consequences are possible
6. Anthropogenic	F. The warming of the planet that results when heat is trapped by Earth's atmosphere
7. Adaptation	G. Long-term patterns or trends of meteorological conditions
8. Weather	H. Caused by or related to human action
9. Greenhouse gases	I. Efforts intended to help deal with a problem that exists, such as climate change
10. Climate	J. The observed and ongoing rise in the Earth's average temperature that is contributing to climate change
11. Global warming	K. Efforts intended to minimize the extent or impact of a problem such as climate change
12. Intergovernmental Panel on Climate Change (IPCC)	L. Alteration in the long-term patterns and statistical averages of meteorological events
13. Greenhouse effect	M. Molecules in the atmosphere that absorb heat and reradiate it back to Earth

e) In a watershed that is 10 km^2 , annual precipitation is 40cm, and the evaporation rate is 0.02 cm/day. Estimate the volume of annual runoff (m^3). Assume that storage and ground water flux are negligible **(30 Marks)**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

f) Mention following statements are True or False **(20 Marks)**

- i. Transpiration from plants and evaporation from continental areas account for the majority of the water vapor added to the atmosphere each year
- ii. It is possible to change the relative humidity even if moisture is not added to or removed from the air.
- iii. Hot air with a low relative humidity may actually contain more water vapor than cool air with a high relative humidity.
- iv. Dry air is less dense than humid air with the same temperature.
- v. One common instrument uses human hair to measure relative humidity.
- vi. Dew is more likely to form on a clear night than on a cloudy night.
- vii. Frost occurs when dew freezes.
- viii. The relative humidity must reach 100% before water vapor can begin to condense onto condensation nuclei.
- ix. The relative humidity is often near 100% in the polar regions.
- x. A sling psychrometer directly measures the relative humidity.

2. Rainfall record in a catchment from 2000 to 2020 is given in the below table.

Year	Rainfall (mm)	Moving averages (C)
2000	2008	
2001	2180	
2002	1560	
2003	1425	
2004	1655	
2005	1875	
2006	1100	
2007	975	
2008	1250	
2009	1890	
2010	2000	
2011	2150	
2012	1900	
2013	1700	
2014	1500	
2015	1450	
2016	1310	
2017	1900	
2018	980	
2019	1200	
2020	1100	

i) Calculate average annual rainfall of the given catchment **(10 marks)**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

ii) Calculate 3-year moving averages and fill the values in the column (C) **(40 marks)**.

.....

.....

.....

.....

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

iii) Plot moving averages curve in the given graph paper (30 marks)

iv) Forecast change of rainfall trend. (20 marks)

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

PART B: ESSAY TYPE (Answer TWO questions only)

1.

i. Define Followings (10 Marks)

- (a) Relative humidity (b) Dewpoint

ii. An air mass is at a temperature of ^{1.5}20° C with relative humidity of 75%.

- Find: a) saturation vapor pressure
b) actual vapor pressure
c) the deficit in saturation and
d) dew point.

(Use following Table)

(40 Marks)

Saturation vapour pressure as a function of temperature t
(Negative values of t refer to conditions over ice; 1 mm Hg = 1.33 mbar)

t (°C)	e _s									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
-10	2.15									
-9	2.32	2.30	2.29	2.27	2.26	2.24	2.22	2.21	2.19	2.17
-8	2.51	2.49	2.47	2.45	2.43	2.41	2.40	2.38	2.36	2.34
-7	2.71	2.69	2.67	2.65	2.63	2.61	2.59	2.57	2.55	2.53
-6	2.93	2.91	2.89	2.86	2.84	2.82	2.80	2.77	2.75	2.73
-5	3.16	3.14	3.11	3.09	3.06	3.04	3.01	2.99	2.97	2.95
-4	3.41	3.39	3.37	3.34	3.32	3.29	3.27	3.24	3.22	3.18
-3	3.67	3.64	3.62	3.59	3.57	3.54	3.52	3.49	3.46	3.44
-2	3.97	3.94	3.91	3.88	3.85	3.82	3.79	3.76	3.73	3.70
-1	4.26	4.23	4.20	4.17	4.14	4.11	4.08	4.05	4.03	4.00
0	4.58	4.55	4.52	4.49	4.46	4.43	4.40	4.36	4.33	4.29
0	4.58	4.62	4.65	4.69	4.71	4.75	4.78	4.82	4.86	4.89
1	4.92	4.96	5.00	5.03	5.07	5.11	5.14	5.18	5.21	5.25
2	5.29	5.33	5.37	5.40	5.44	5.48	5.53	5.57	5.60	5.64
3	5.68	5.72	5.76	5.80	5.84	5.89	5.93	5.97	6.01	6.06
4	6.10	6.14	6.18	6.23	6.27	6.31	6.36	6.40	6.45	6.49
5	6.54	6.58	6.54	6.68	6.72	6.77	6.82	6.86	6.91	6.96
6	7.01	7.06	7.11	7.16	7.20	7.25	7.31	7.36	7.41	7.46
7	7.51	7.56	7.61	7.67	7.72	7.77	7.82	7.88	7.93	7.98
8	8.04	8.10	8.15	8.21	8.26	8.32	8.37	8.43	8.48	8.54
9	8.61	8.67	8.73	8.78	8.84	8.90	8.96	9.02	9.08	9.14
10	9.20	9.26	9.33	9.39	9.46	9.52	9.58	9.65	9.71	9.77
11	9.84	9.90	9.97	10.03	10.10	10.17	10.24	10.31	10.38	10.45
12	10.52	10.58	10.66	10.72	10.79	10.86	10.93	11.00	11.08	11.15
13	11.23	11.30	11.38	11.45	11.53	11.60	11.68	11.76	11.83	11.91
14	11.98	12.06	12.14	12.22	12.29	12.38	12.46	12.54	12.62	12.70
15	12.78	12.86	12.95	13.03	13.11	13.20	13.28	13.37	13.45	13.54
16	13.63	13.71	13.80	13.90	13.99	14.08	14.17	14.26	14.35	14.44

iii. For a given month, a 121-ha lake has 0.43 m³/s of inflow, 0.37 m³/s of outflow, and the total storage increase of 1.97 ha-m. A USGS gauge next to the lake recorded a total of 3.3 cm precipitation for the lake for the month. Assuming that infiltration loss is insignificant for the lake, determine the evaporation loss, in cm over the lake for the month (50 Marks).

2.

i. Distinguish between the different forms of precipitation (20 Marks)

ii. Outline sources of error when recording readings and record-keeping by precipitation gauge (20 Marks)

iii. What is the relationship between intensity, duration and frequency of rainfall? (20 Marks)

iv. The following are the monthly pan evaporation data (Jan-Dec) at Mapalana in 2020 year in cm.

17.7, 15.3, 18.8, 26.0, 29.6, 22.4, 17.7, 17.7, 17.7, 22.4, 17.7, 17.7, 17.7.

The water spread area in a lake nearby in the beginning of January in that year was 2.80 km² and at the end of the December it was measured as 2.55 km². Calculate the loss of water due to evaporation in that year. Assume a pan coefficient of 0.7 (40 Marks)

3.

- i. Define climatology (10 marks)
- ii. Distinguish the difference between climatology and meteorology (20 marks)
- iii. State examples of application of climatology (20 marks)
- iv. List climate elements (10 marks)
- v. Briefly describe climate factors that control climate elements (20 marks)
- vi. Explain Solstice and Equinox (20 marks)

4.

- i. Define peak runoff. (10 marks)
- ii. Briefly explain factors affecting runoff. (10 marks)
- iii. What are commonly used runoff estimation methods? (10 marks)
- iv. For a small catchment of 100 km² area, following are the observations of flow from a 4-hr. duration storm. The values of base flow are given. Derive and plot 4-hour unit hydrograph. Calculate the rainfall excess (Direct runoff depth) due to the storm. (70 marks)

Date	Hour	Flow (cumec)	Base flow (cumec)
Day 1	0000	5	5
	0400	90	5
	0800	130	5
	1200	175	5
	1600	140	5
	2000	100	5
	Day 2	0000	65
0400		35	5
0800		20	5
1200		5	5

@@@@@@@@@@@@GOODLUCK@@@@@@@@