Uganda Martyrs University

Faculty of Agriculture and Environment

Masters of Science in Agro-ecology Year 1 2023 Intake

Final Assessment April, 2024

Module: MAE 4101: Agrometeorology and Ecosystems Modelling

Date: Saturday, 20th April, 2024 Time: 2:00pm – 05:00pm

Instructions:

- **Attempt 4 questions with a minimum 2 questions selected from each section.**
- Begin each question on a fresh page.
- *Do not write on the Question paper*

SECTION A: AGROMETROLOGY

1. In the last one decade, the globe has experienced a great change in climate patterns that have impact on a number of livelihoods for the population. With the knowledge you gained from this course module
   a. With examples differentiate between climate change and climatic variability **(5 Marks)**
   b. With examples, explain any five (5) causes of climate change globally **(10 Marks)**
   c. With examples discuss any five (5) effects of climate change on household livelihoods **(10 Marks)**

2. You have been recruited as a climate change specialist advising government on climate change related matter, given your knowledge in climate change,
   a. Discuss any six (6) mitigation measures you would advise the government to undertake to reduce the impacts and effects of climate change. **(13 Marks)**
   b. Explain any six (6) adaptation strategies that you would recommends government to adopt in order to reduce the effects of climate change on the household livelihoods? **(12 Marks)**

3. The atmosphere can be considered as a series of concentric layers or shells surrounding the earth and is the mostly commonly used method to describe atmospheric temperature. The structuring of the atmosphere has far reached implication on the day today weather conditions.
   a. With the knowledge you have acquired from this module and with illustrations explain the different layers in the atmosphere? **(15 Marks)**
   b. With examples, explain any five (5) application of climatology in our daily life engagement? **(10 Marks)**

4. a. With proper illustrations, explain the hydrological cycle including the different processes involved and their implication on the water balance? **(15 Marks)**

b. Using the knowledge on the moisture transport and air ground exchange, examine the different movement regimes including the location where they occur that influence the climate on global scale? **(10 Marks)**

SECTION B ECOSYSTEM MODELING

5. a. Define the following terms as used in explaining the amount of water in the soil that is utilized or not by the plant.
   i. Field capacity (FC) **(2 Marks)**
   ii. Permanent wilt point (PWP). **(2 Marks)**
   iii. Total plant available water (AW) **(2 Marks)**

b. State the water budget equation **(3 Marks)**
c. With illustrations, explain the different component of the water budget and their determinants key in influencing the water balance in the atmosphere and on earth? **(16 Marks)**

6. The ministry of Agriculture, Animal and Fisheries Industry has hired you as consultant in Ecosystem modeling to help in designing a simple pond.
   a. As a consultant you are planning the layout of a small housing development on 16.2 ha of land. According to local ordinance, you must retain any increased runoff due to development from the 2-yr, 24-hr rainfall event (86 mm). Prior to development, the area was able to infiltrate and store approximately 50 mm of this rainfall event. With the increase of impervious land cover (e.g. houses and roads), it is expected that infiltration and storage will be reduced to 30 mm. Determine the pond volume required to store the difference in expected runoff. **(12 Marks)**

   b. A soil sample collected from the 16 acres of land has a wet weight of 238 g. After drying at 105°C for 24 hrs, the soil sample dry weight is 209 g. Careful measurement of the soil sample determines the volume of the soil core is 135 cm3. Determine the available water storage, in both mass and volume basis, in the soil profile.
   c. What was the original water content of the soil on a gravimetric basis (mass of water per total mass) **(5 Marks)**

   d. What is the volumetric basis (volume of water per volume of bulk soil)? **(5 Marks)**
   e. What is the implication of the calculations i and ii on the plant growth and development? **(3 Marks)**

7. Explain the following terms as used ecosystem modelling?
   i) Model building **(5 Marks)**
   ii) Model validation **(5 Marks)**
   iii) Deterministic models **(3 Marks)**

iv) Stochastic models **(3 Marks)**
v) Linear regression models **(3 Marks)**
vi) Binary choices models **(6 Marks)**

8. An Agrometrological student from Uganda Martyrs University undertook a study on determining the factors that influence the population of snails along River Katonga in Kayabwe Subcounty. The student undertook an experiment including counting the population of snails for a particular period of 1 years and also used sensors to monitor the physical, chemical, and biological characteristics along River Katonga including measuring PH, Temperatures etc. A model was run to explain the relationship between snail population and other physical, chemical, and biological characteristics as shown in the model output below.

Depend variable (Sanil population)	**Coefficients**	**Standard Error**	**P Values**
Closeness of river to snail population	-0.81	0.042	0.0000
Management of the snail sites	0.691	21.90	0.0500
Quantity of available feed materials	0.234	1.686	0.0300
Temperatures	0.51	5.789	0.6780
Flooding of the site	-0.065	0.269	0.0000
Soil pH	0.098	24.9	0.9900
Depth of the soils in metres	0.107	17.19	0.0900
Velocity/Speed of running water	-0.54	17.72	0.0600
Population of useful organisms	0.119	0.105	0.0001
Constant	-0.657	137.35	0.6420
R squared		0.867	

a. Using the knowledge you have acquired in ecosystem modelling interpret and explain the finding as in indicated in table above? **(20 Marks)**
b. Using the findings from the model as an agro meteorological student with expertise in ecological/ecosystem modelling, list five (5) policy recommendation you would make to Ministry of Water and Environment in regards to increasing the snail population along river katonga? **(5 Marks)**

END