"Investing in Africa's Future"

COLLEGE OF HEALTH, AGRICULTURE & NATURAL SCIENCES

NAAE 302: IRRIGATION AND WATER MANAGEMENT

END OF SECOND SEMESTER FINAL EXAMINATIONS

APRIL 2022

LECTURER: MR. W. ZENDERA

DURATION: 3 HOURS

INSTRUCTIONS

Answer any FIVE Questions

Use Answer Sheets Provided

Begin Your Answer for Each Question on a New Page

Credit is Given for Neat Presentation

Question 1

a) With the aid of a diagram briefly explain how the infiltration rate of a soil varies with time during irrigation.   [2 marks]
b) With the aid of a diagram describe the characteristic moisture extraction pattern in soils by crops crops.   [8 marks]
c) Explain the need for accurate water requirement data in irrigated agriculture.   [6 marks]
d) Sketch a graph to show how the crop coefficient (Kc) varies with the stage of growth of a plant.   [4 marks]

Question 2

a) Define the following terms:
     i.   Seasonal consumptive use.   [2 marks]
     ii.   Peak period consumptive use.   [2 marks]
b) A water budget approach indicates that at the end of day on the 14th of June a wheat crop had a moisture deficit of 50 mm. The wheat was being grown in a 20 ha field with loam soils. The available water content (AWC) is 180 mm/m and the agronomist had recommended a moisture depletion of 50%. The effective root zone depth was 1 m. The ETc values and effective precipitation values are indicated in table 1

Date	ETc (mm)	Pe (mm)	Moisture Deficit (D_i mm)
June 15	7	0	
June 16	6	5	
June 17	8	0	
June 18	7	0	
June 19	8	6	
June 20	9	0	
June 21	8	0	
June 22	10	0	

    i.   Calculate the depth of water to be applied at the time of irrigation.   [4 marks]
   ii.   Determine the date of irrigation.   [6 marks]
  iii.   Calculate the flow rate (l/s) required if irrigation is to be applied for 8 hours each day and only 4 days are set aside for irrigation assuming 70 % system efficiency.   [6 marks]

Question 3

a) The following data were obtained in determining the soil moisture content at successive depth in the root zone prior to applying irrigation water.

Depth of sampling (mm)	Weight of moist sample (g)	Weight of oven dry soil (g)
0-250	143.6	126.82
250-500	133.28	125.95
500-750	118.95	113.32
750-1000	110.92	102.64

The bulk density of the soil in the root zone was 1.5 g/cm^3. The moisture content of the soil at field capacity was 178 mm/m. Determine

i.   The moisture content at the different depth in the root zone   [8 marks]
ii. Moisture content in the root zone at the time of irrigation   [4 marks]
i.   Net depth of water to be applied to bring the moisture content to field capacity.   [4 marks]
ii. Gross irrigation at an estimated field irrigation efficiency of 75%   [4 marks]

Question 4

A dragline sprinkler irrigation system with sprinkler spacing of 18 m x 18 m was evaluated. A representative block was selected with four sprinklers 18 x 18 m spacing on each corner. Twelve Catch cans were placed equally spaced between the four sprinklers. After a one hour test, the following the following amounts of water (mm) were recorded.

	Row		
	1	2	3
Amount recorded (mm)	5.2	4.4	3.9
	4.2	4.7	3.7
	3.1	4.6	4.0

A flow measurement was taken before the test and a 20 litre container was filled in 40.5 seconds. A flow meter was also placed in the drag line of one of sprinklers during the test and measured a reading of 1.80 m^3/hr during the test.

Calculate the following:

a) The flow rate m^3/h for the system [4 marks]
b) The gross application rate (mm/h) of the system [4 marks]
c) Christiansen's uniformity coefficient (CU) [4 marks]
d) Distribution uniformity value (DU) [4 marks]
e) Application efficiency (Ea). [4 marks]

Question 5

a) What are the essential components of a sprinkler irrigation system? Give a typical layout plan of a sprinkler system. [10 marks]
b) A farmer wants to irrigate 2.1 ha of sugarcane crop, the field measuring 210 m long and 100m wide to a depth of 7.5 cm with a sprinkler system applying water at a rate of 1.5 cm/h. two laterals each 100 m long and spaced 15 m apart are used. Ten sprinklers are fitted on each lateral at 10 m interval each. Two hours are required to move the lateral each time. Determine
   i. The capacity of the sprinkler system, [5 marks]
   ii. The time required to irrigate the area [5 marks]

Question 6

a) Describe some of the best practices a pump user can employ to prevent cavitation. [8 marks]

b) With the aid of a diagram explain the following pump performance regulating approaches.
    i.   Operating two pumps in series. [3 marks]
    ii.   Operating two pumps in parallel, [3 marks]
    iii. Change of impeller, [3 marks]
    iv.   Throttling. [3 marks]

Question 7

a) If not practiced well, irrigation can lead to some very serious detrimental effects. Discuss some of the effects of poor irrigation practices. [10 marks]

b) With the aid of diagrams describe the effects of having the following poor furrow irrigation practices:
    i.   Stream size too small, [3 marks]
    ii.   Stream size too large, and [3 marks]
    iii. Furrow spacing too wide. [4 marks]

End of Examination Paper