EGERTON UNIVERSITY

UNIVERSITY EXAMINATIONS

NJORO CAMPUS

SECOND SEMESTER 2012/2013

FOURTH YEAR EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN AGRICULTURAL ENGINEERING

AGEN 455: IRRIGATION AND DRAINAGE ENGINEERING I

STREAM: 2009 (Y4) B. SC. AGEN **TIME:** 2 HOURS

DAY/TIME: MONDAY, 08.30 – 11.30 am **DATE:** 27-05-2013

INSTRUCTIONS:

1. The paper contains **SIX (6)** questions.
2. Attempt any **FIVE (5)** questions
3. All questions carry equal marks.
4. Clearly indicate the number of each question and subsection.
5. Show all workings for each question
6. Aid materials are provided at the back
7. Each question should be answered complete as a package
8. **EACH QUESTION SHOULD BE STARTED ON A NEW PAGE.**

QUESTION ONE

(a) Define the following terms as used in irrigation:

(i) Net application depth

(ii) Gross application depth

(iii) Reservoir storage efficiency

(iv) Conveyance efficiency

(v) Application efficiency

(vi) Irrigation system efficiency

(6 marks)

(b) A well is used to supply water to a quarter hectare of furrow irrigated plot in which a crop of Irish potatoes is grown. The soil has been tested and found to be a well drained clay loam. The well discharges into a canal at the end of which has been installed a Parshall flume. Downstream of the flume the water enters a field ditch from which it is applied into furrows using siphon tubes. Before irrigation started, the soil was found to be at 20 percent moisture content expressed on volume basis. The intention is to raise the soil moisture level in the crop root zone to field capacity. For six hours during which irrigation was done, the following were recorded.

- Well discharge $Q_w = 8.5$ L/s
- Parshall flume discharge $Q_p = 6.9$ L/s
- Total discharge from siphons $Q_s = 6.4$ L/s

(i) Identify and state any two applicable efficiencies **(2 marks)**

(ii) Determine the value of each efficiency **(6 marks)**

QUESTION TWO

(a) Define the following terms with respect to soil and water relations.

(i) Air filled porosity.

(ii) Mechanical composition of soil.

(iii) Gravitational water.

(iv) P^F- curve.

(v) Hydraulic conductivity.

(vi) Infiltration.

(6 marks)

(b) The following results were obtained in a soil moisture study

Depth of soil layer (cm)	Field Capacity (% by volume)	Permanent wilting point (% by volume)
0 - 12	14	6
12-25	22	10
25-75	27	13

(i) Determine the total water holding capacity of the layered soil.

(ii) Determine the total available water for tomatoes assumed to have maximum root depth of 60 cm.

(iii) Determine the readily available water for tomatoes (Assumed to have a MAD value of 0.5).

(iv) Determine the number of days before next irrigation if the water use rate for tomatoes is 5 mm per day. **(8 marks)**

QUESTION THREE

(a) Define the following terms with respect to crop water relations:

(i) Evapotranspiration rate.

(ii) Specific crop evapotranspiration.

(iii) Effective precipitation.

(iv) Fetch distance.

(v) Irrigation system capacity.

(vi) Log wind law. **(6 marks)**

(b) A farmer in Njoro wants to grow tomatoes during the months of January, February, and March. The following is the weather data for Njoro during the three months.

Month	Mean Temperature (°C)	Wind Speed (m/s)	Minimum Relative Effective Humidity (%)	Rainfall (mm)
January	21	2	20	33
February	23	4	40	49
March	25	6	60	54

(i) Identify with justification and state, the most appropriate ET determination method. **(2 marks)**

(ii) Estimate the total amount of water required by the crop each month. **(2 marks)**

(iii) Estimate the total amount of water required by the crop during the season. **(2 marks)**

(iv) Estimate the irrigation water requirement during the season **(2 marks)**

QUESTION FOUR

(a) State and in each case describe briefly any **three (3)** plant indicator methods of irrigation scheduling. **(3 marks)**

(b) State and in each case describe briefly any **three (3)** soil indicator methods of irrigation scheduling. **(3 marks)**

(c) The following information is given for a field under irrigation:

- Readily available water (RAW) = 20 mm
- Depth of water in soil at saturation = 10 cm
- Depth of water in soil at field capacity = 8 cm

- Soil is at field capacity the morning of day one in the following table of climatic data.

Day	ET_c	Rainfall
1	7.9	0
2	6.4	0
3	5.3	3
4	10.4	0
5	3.0	15.0
6	8.9	0
7	10.2	0
8	7.9	0
9	5.8	2.0
10	4.6	3.0

Assuming no runoff was observed, determine the following:

(i) Days when irrigation was required.

(ii) Total depth of irrigation for the period (mm).

(iii) Depth of deep percolation (mm).

(iv) Soil moisture remaining in the soil at the end of 10 days.

(8 marks)

QUESTION FIVE

A drip irrigation lateral, 100 metres in length has been laid on a level land surface. The lateral carries 75 emitters placed from the furthest end, and spaced 1 metre apart. The lateral is made of black polythene pipe of nominal diameter 16 mm. Tests on the lateral pipe showed that head loss due to friction could be expressed as:

$$H_{LF} = 44Q^{1.8}$$

The flow into the lateral pipe is 0.3 m^3/s at a pressure head of 10 m. Sketch the layout and determine the following assuming coefficient of friction is 0.364.

(a) Total loss in head over the entire lateral pipe. **(7 marks)**

(b) Minimum and maximum operating heads for the two most remote emitters on the lateral. **(7 marks)**

QUESTION SIX

(a) Briefly discuss the primary functions of each of the following land drainage systems:

(i) Surface drainage system.

(ii) Groundwater drainage system.

(6 marks)

(b) Discuss the following layout patterns of groundwater field drainage system with respect to conditions for their applicability.

(i) Irregular or natural system.

(ii) Regular pattern.

(iii) Herringbone pattern.

(iv) Interceptor or cut-off drain.

(8 marks)

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