UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

2013

PROGRAMME: B.SC.

COURSE CODE: ABE 302

TITLE OF PAPER: IRRIGATION PRINCIPLES

ALLOWED TIME: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE.

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS

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SECTION ONE: COMPULSORY QUESTION

QUESTION ONE

a) A moist soil sample has a volume of 450 cm^3 and a wet mass of 786 g. The particle density is 2.65 g/cm^3 and the dry mass is 731 g. Determine the following;

i) The void ratio (11marks)
ii) The porosity (3marks)
iii) The percentage water content, and (3marks)
iv) The degree of saturation (3marks)

b) Given a level square field 400 m on a side. The field is planted with Alfalfa with a consumptive use of 6.0 mm/day. The available soil water holding capacity is 100 mm/m and the root depth of Alfalfa is assumed to be 1.7 m.

i) Assuming an MAD of 50%, calculate the net depth of water to be applied. (3 mark)
ii) The maximum irrigation interval. (2 marks)
iii) If the workers are allowed Sundays off and one day is set aside for downtime, how many days are available for irrigation? (2 marks)
iv) If laterals are moved twice a day, how long does each move cover? (2 marks)
v) Assuming a 75% efficiency, and that the system is operated continuously, what is the system flow rate in m^3/day and m^3/hr? (3 marks)
vi) Based on the calculated days in question iii) what is the new flow rate in m^3/day and m^3/hr? {3 marks}
vii) Assuming that the sprinklers are spaced 12.1 m apart, how many sprinklers are required per lateral? (2 marks)
viii) What is the average sprinkler discharge in m^3/hr and l/s? (3 marks)

SECTION TWO: ANSWER ANY TWO QUESTIONS

QUESTION TWO

a) A soil has a root depth of 40 cm. A farmer irrigates his field when the soil is at 16 percent volumetric water content. What is the soils volumetric water content at field capacity when the amount of irrigation is 50 mm. How much water in (m^3) must be added to the field if its area is 2.5 ha? Assume density of water equals 1.0 g/cm^3 and density of soil particles equals 2.65 g/cm^3. (10marks)

b) A soil has an initial water content of 0.1 cm^3/cm^3 and its moisture content at field capacity is 0.3 cm^3/cm^3. i) how deep will 10cm irrigation wet the soil (assuming no runoff and evaporation losses)? ii) how much water is needed to wet the soil to a depth of 125 cm? (10marks)

c) A farmer wants to know whether it is possible to irrigate a particular soil type in his farm. Discuss how you could help the farmer. (10marks)

d) Name three conditions necessary for evaporation to occur. (6marks)

QUESTION THREE

a) Sixteen (16) water application depths were measured along a furrow field after irrigation at the LUM farm (not necessarily in order).

80	70	68	74
78	66	64	70
52	56	54	64
74	60	56	86

From the readings determine;

i) the distribution uniformity (DU) and (12marks)

ii) the Christiansen Uniformity coefficient (CU). (6marks)

c) Name and explain any four (4) soil physical properties of interest to irrigators? (12marks)

QUESTION FOUR

a) At full development, a tomato crop is measured in an unrestricted soil profile to have an active root zone of 1.5 m. The maximum equivalent crop evapotranspiration at the mid-point of the growing season is 9 mm/day. Assume that each irrigation fills the soil profile up to field capacity. For a silty – clay soil of field capacity of 40% and permanent wilting point of 20%;

i) What is the total available moisture (TAM) of the soil? (4 marks)

ii) How many days are allowable between irrigations if 40 percent depletion of available water is allowed? (3 marks)

iii) How many days are allowable between irrigations if 60 percent depletion of available water is allowed? (3 marks)

b) Discuss any three advantages and three disadvantages of sprinkler irrigation methods when compared to furrow irrigation methods. (12marks)

c) Name and discuss four weather parameters that influence evapotranspiration (ET) (8marks)