



UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER

PROGRAMME; BSC YEAR 3 (ABE, AGRONOMY & HORTICULTURE)

COURSE CODE: ABE 302

TITLE OF PAPER: PRINCIPLES OF IRRIGATION

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

INSTRUCTIONS: ANSWER QUESTION ONE AND TWO OTHER QUESTIONS.

DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF
INVIGILATOR

Question 1: Compulsory question

- a) 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.
- Assuming an MAD of 50%, calculate the net depth of water to be applied. (3 mark)
 - The maximum irrigation interval. (2 marks)
 - If the workers are allowed Sundays off and one day is set aside for downtime, how many days are available for irrigation? (2 marks)
 - If laterals are moved twice a day, how long does each move cover? (2 marks)
 - 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)
 - Based on the calculated days in question iii) what is the new flow rate in m^3/day and m^3/hr ? (3 marks)
 - Assuming that the sprinklers are spaced 12.1 m apart, how many sprinklers are required per lateral? (2 marks)
 - What is the average sprinkler discharge in m^3/hr and l/s ? (3 marks)
- b) A soil sample has a dry mass of 200 g. It has a 28.0 percent water content on a mass basis. Its saturated water content is 37 percent on a mass basis. Assume density of water equals 1.0 g/cm^3 and soil particle density equals 2.65 g/cm^3 .
- Find, the mass of water,
 - volume of pores, and
 - volume of air of the sample at 28.0 percent water content. (10marks)
- c) Explain the following terms
- Potential Evapotranspiration
 - Actual Evapotranspiration
 - Crop Coefficient
 - Gross Irrigation
 - Gravitational Potential (10marks)

Question 2

- 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 100 cm^3 soil sample is taken in the field which weighs 174 g at the time of sampling. The oven dry weight of the sample is 0.155 kg. Compute the volumetric water content, the porosity, and air field porosity. (10marks)
- c) At full development, a tomato crop is measured in an unrestricted soil profile to have an active root zone of 150 cm. The maximum equivalent crop ET at the midpoint 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 (field capacity = 40 % and permanent wilting point = 20 %) how many days are allowable between irrigations if 40 % depletion of available water is allowed? What if 60 % depletion is allowed? (10marks)

Question 3

- a) A soil has an initial water content of $0.1 \text{ cm}^3/\text{cm}^3$ and its moisture content at field capacity is $0.3 \text{ cm}^3/\text{cm}^3$. 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)
- b) Discuss the following methods of real time irrigation scheduling. Use example where necessary.
- i) Plant indicators
 - ii) Soil water content
 - iii) Soil water potential
 - iv) Water balance method
 - v) Profit and loss method

(20marks)

Question 4

- a) Discuss any four soil water potentials and explain why each is important in moisture distribution in the soil. (18marks)
- b) Discuss any three advantages and three disadvantages of sprinkler irrigation methods when compared to centre pivot irrigation methods. (12marks)