



UNIVERSITY OF SWAZILAND
SUPPLEMENTARY EXAMINATION PAPER
2015

PROGRAMME: B.SC.

COURSE CODE: ABE 302

TITLE OF PAPER: IRRIGATION PRINCIPLES

ALLOWED TIME: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: CALCULATOR

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS

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

SECTION ONE: COMPULSORY QUESTION**QUESTION ONE**

- a) Name and explain any three (3) soil physical properties of interest to irrigators? {6marks}
- b) 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 volume of water {3marks}
 - ii) The volume of air {3marks}
 - iii) The void ratio {2marks}
 - iv) The porosity {2marks}
 - v) The percentage water content, and {2marks}
 - vi) The degree of saturation {2marks}
- c) 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 soil's 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 THREE

- 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 FOUR

- 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 center pivot irrigation methods. {12marks}