



**UNIVERSITY OF SWAZILAND  
FINAL EXAMINATION PAPER**

**PROGRAMME: BSC AGRIC IV (L&WM)**

**COURSE CODE: LUM 408**

**TITLE OF PAPER: IRRIGATION THEORY AND PRACTICE**

**TIME ALLOWED: TWO (2) HOURS**

**SPECIAL MATERIAL REQUIRED: NONE**

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO  
OTHER QUESTIONS.**

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GRANTED BY THE CHIEF INVIGILATOR**

**SECTION I: COMPULSORY QUESTION****QUESTION 1**

- (a) Describe what is meant by scanning curves in a soil water retention curve and how they develop (10 marks)
- (b) A steady state water flow to a water table is established during sprinkler irrigation at an application rate of 5 mm/h. The saturated hydraulic conductivity of the soil is 120 cm/day and the water table is 100 cm below the soil surface. Tensiometers are installed at points A and B, 10 and 40 cm below the soil surface, respectively. During the water flow through the profile, matric potential increased linearly from the soil surface to the water table, with values of -36 cm and -21 cm at points A and B, respectively. Assuming that both surface runoff and storage are negligible, determine:
- the hydraulic conductivity of the soil at the matric potential that is established in the upper part of the soil profile (15 marks)
  - how many times greater the hydraulic potential gradient is at point C, 25 cm below the soil surface, than at the water table. (15 marks)

**SECTION II: ANSWER TWO QUESTIONS FROM THIS SECTION****QUESTION 2**

Write short notes on:

- soil mulch theory (10 marks)
- hysteresis in soil water process (10 marks)
- irrigation system capacity (10 marks)

**QUESTION 3**

A farmer is irrigating a vegetable crop which has effective root zone depth of 80 cm. The moisture contents of the soil at field capacity and permanent wilting point are 24 % and 10 % by volume, respectively. The farmer irrigates when 60 % of the available moisture remains in the soil. The sprinklers used, discharge 36 m<sup>3</sup>/day each and have a wetted diameter of 30 m and spaced 15 m along a lateral. The spacing between laterals is 18 m. The efficiency of the irrigation system is 80%. The peak water use rate of the crop in the area is 8 mm/day. Determine the:

- application rate (in mm/hr) of each sprinkler (5 marks)
- minimum irrigation set time of the system (20 marks)
- irrigation interval at the peak water use rate (5 marks)

**QUESTION 4**

Briefly but concisely, discuss the potentials and challenges of center pivot system and drip irrigation systems in the irrigation sector in Swaziland.

(30 marks)

**SOME USEFUL EQUATIONS**

$$q = \frac{S_L \times S_M \times I}{3600} \quad (1)$$

where

q = required discharge of individual sprinkler (l/s)

S<sub>L</sub> = spacing of sprinklers along the lateral (m)S<sub>M</sub> = spacing of lateral along the main (m)

I = optimum application rate (mm)

$$Q = 2.778 \frac{I_g \times A}{N_{op} \times T_{op}} \quad (2)$$

where

Q = system capacity (l/s)

I<sub>g</sub> = gross irrigation requirement (mm)N<sub>op</sub> = number of days of operation per irrigation (d)T<sub>op</sub> = hours of operation per day (h/d)