UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER

PROGRAMME: BSC ABE 4

COURSE CODE: ABE 403

TITLE OF PAPER: IRRIGATION DESIGN AND MANAGEMENT

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.

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SECTION I   COMPULSORY

QUESTION 1

a) Discuss any 5 factors that one would consider when choosing an irrigation
   system, giving examples where relevant.   **[25 marks]**

b) Explain briefly how the following climatic factors affect the rate of
   evapotranspiration.

   (i)   Air temperature
   (ii)   Sunlight
   (iii)   Wind   **[6 marks]**

c) Discuss the following soil water parameters (characteristics) as used in irrigation
   management:

   (i)   Field capacity
   (ii)   Permanent wilting point
   (iii)   Readily available water   **[9 marks]**

SECTION II   ANSWER ANY TWO QUESTIONS

QUESTION 2

Sugarcane is to be irrigated by furrows at 1.2 m spacing, on a loam soil. The design crop water requirements have been determined as 8 mm/day, with a maximum allowable deficit of 50 mm and a design application efficiency of 60%. The conveyance efficiency is expected to be 90%. Irrigation is always to field capacity. The length of each furrow is 300m, and the stream size suggested is 2.5 l/s.

Determine the following:

i)   Net irrigation   [2 marks]

ii) Irrigation interval   [2 marks]

iii) Gross irrigation   [3 marks]

iv) Volume of water irrigated per furrow   [4 marks]

v)   Irrigation time   [4 marks]

a) What do the following terms mean with regard to canal design for furrow irrigation system.   [3 marks for each]

i)   Freeboard

ii)   Command

iii)   Seepage

iv)   Wetted perimeter

v)   Stream size

QUESTION 3

a) Write short notes on the following types of sprinkler irrigation:
   (i)   Hand move sprinkler
   (ii)   Gun type sprinkler
   (iii) Centre pivot
   (iv)   Low energy precision application (LEPA)   **[16 marks]**

b) Calculate the Centre Pivot (CP) irrigation system capacity (Qs, L/s) and peak application rate (mm/h) at the distal end of the CP, for the following:

Crop = maize
Climate = Hot
ET_{peak} = 7 mm/d
Centre Pivot irrigation application efficiency, E_a = 87 %
Desired actual irrigation interval for the peak season, f = 1 d
Total time to complete an irrigation event, T = 22 h
Impact sprinkler selected with an effective wetted diameter, D_w = 20 m (distal sprinkler)
Length of the centre pivot lateral, R_s = 405 m   **[14 marks]**

QUESTION 4

a) Clogging is a problem in trickle irrigation due to the narrow passages and small orifices. Thus the quality of water used in irrigation should be of a high standard, but sometimes there is no alternative supply with good quality water. Filtration and chemigation will thus be required. Describe the two processes as they are carried out in trickle irrigation system maintenance.   **[15 marks]**

b) Irrigation performance can be measured in terms of *efficiency, uniformity and adequacy*. Clearly explain what these are, the factors affecting them, and how they can be determined for a sprinkler system.

                                                                    [15 marks]