



**UNIVERSITY OF SWAZILAND
MAIN EXAMINATION PAPER**

**PROGRAMME: BSC IN LAND AND WATER MANAGEMENT
YEAR 4**

COURSE CODE: LUM 403

TITLE OF PAPER: IRRIGATION WATER MANAGEMENT

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**

QUESTION 1

- a) A maize crop is irrigated by furrow irrigation. The crop is planted in a uniform loam soil and river water, which has an EC_w of 1.4 dS/m, is used for irrigation. The crop evapotranspiration is 760 mm/season. The irrigation application efficiency is 0.62. Given that for a 100 percent yield potential for maize, the EC_e should not exceed 1.7 dS/m, how much additional water must be applied for leaching, assuming the inefficiency is due to deep percolation.

[20 marks]

- b) Below is an extract from an executive summary of a study carried out to determine the feasibility of establishing a 2, 000 ha irrigation scheme in the Lowveld part of Swaziland. A layman in the field needs some clarification on this report, read and explain a few points where clarification is sought.

“The predominant soil in the area is a deep clay loam. 10% of the area is reportedly having infiltration problems. The soil was sampled to be tested for some specific parameters such as electrical conductivity, pH, and some elemental contents of the soil (sodium, magnesium and calcium). The 10% portion, which was soil A, was found to be sodic, having a sodium adsorptive ratio (SAR) of 4.89, exchangeable sodium percentage (ESP) of 18 and an extract electrical conductivity of 3.2. There is bound to be infiltration problems with these values also considering the nature of the soil (clay loam), it requires a good structure for it to have good drainage, which is made impossible by the higher level of sodium in the soil. Using water with electrical conductivity of just 0.9 dS/m results in severe reduction in rate of infiltration. The pH is also high (8.9) which render some nutrients unavailable to plants. A recommended action to solve this problem is amending the soil with gypsum. A total of 1, 836 tonnes will be required for the 200 ha.

To avoid accumulation of salts with the use of water with salinity of 0.9 dS/m, additional water over and above the net irrigation is required to leach down salts. However, with sprinkler having a field application efficiency of 0.7, calculations suggested no need for additional water for leaching”.

Explain;

- the concepts of SAR and ESP, how they relate to each other and how they are used to determine the suitability of the soil for crop production. [5 marks]
- and how water of lower electrical conductivity would result in severe reduction in rate of infiltration [5 marks]
- the chemical composition of gypsum and how it can achieve intended purpose when added to the soil [5 marks]
- why there would be no need of additional water for leaching in the situation above. [5 marks]

QUESTION 2

What do the following terms mean with regard to canal design for furrow irrigation system.

- i) Freeboard
- ii) Command
- iii) Seepage
- iv) Wetted perimeter
- v) Stream size

[6 marks for each = 30 marks]

QUESTION 3

Irrigation scheduling is important in the efficient and effective use of water. When there is proper scheduling, over and under-irrigation will be avoided.

- define irrigation scheduling **[6 marks]**
- explain how over-irrigation and under-irrigation come about **[12 marks]**
- discuss the effect of over-irrigation/under-irrigation on productivity, profitability and on the environment **[12 marks]**

QUESTION 4

In general terms, efficiency is defined as the ratio of output to the input.

- a) Describe the following efficiencies in the context of irrigation management.
 - i) Conveyance efficiency
 - ii) Field application efficiency **[10 marks]**
- b) Another significant concept in irrigation water management is the water use efficiency which is defined as the crop yield per unit quantity of water used.

Sugarcane grown in Malkerns has a water requirement of 1533 mm, but only rainfall of 525 mm is received. The irrigated cane yield is normally 120 tonnes/ha of which 13% is sugar. If rainfed, the yield would be 4.3 tonnes sugar/ha. The sugarcane is always irrigated so as not to experience any water stress. If the irrigation system efficiency is 80%, and the soil water at planting is insignificant, calculate;

- i. the general WUE
- ii. the irrigation WUE **[20 marks]**