UNIVERSITY OF ESWATINI
FINAL EXAMINATION PAPER

PROGRAMME: BSC ABE 3, BSC AGRON 3, AND BSC HORT 3

COURSE CODE: ABE303/ ABE 302

TITLE OF PAPER: IRRIGATION PRINCIPLES/ PRINCIPLES OF IRRIGATION

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

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SECTION I COMPULSORY

QUESTION 1

a) A soil sample is taken with a soil probe and is taken to the laboratory for soil water determination. The sample volume is 100 cm^3, the total wet mass of the soil including the container is 188 g, the total oven dried mass including the container is 155 g, and the container weighs 21 g. Assuming a soil particle density of 2.65 g/cm^3, calculate:

(i) Soil (dry) bulk density **[5 marks]**
(ii) Soil water content (mass basis) **[5 marks]**
(iii) Soil water content (volume basis) **[5 marks]**
(iv) Estimated porosity **[5 marks]**

b) Given the following information on sprinkler irrigation system, calculate:

(i) Portion of water lost through deep percolation relative to gross irrigation (%) **[5 marks]**

(ii) Application efficiency **[5 marks]**

(iii) Irrigation adequacy **[5 marks]**

Average depth infiltrated into the soil – 120 mm
Average gross depth of water applied – 140 mm
Average depth stored in the root zone – 85 mm
Soil moisture deficit at time of irrigation – 90 mm

c) Available moisture is the difference between field capacity and permanent wilting point. Explain how soil texture affects the available portion of soil moisture. Give examples using the various textural classes. **[5 marks]**

SECTION II ANSWER ANY TWO QUESTIONS

QUESTION 2

a) Explain how in the field and/or laboratory the various levels of soil moisture (saturation, field capacity and permanent wilting point) can be determined.

[15 marks]

b) Define the following potentials (heads) as used in soil physics:

i) Osmotic head **[5 marks]**
ii) Gravitational head **[5 marks]**
iii) Matric head **[5 marks]**

QUESTION 3

a) In irrigation scheduling, two major questions have to be answered, when to apply and how much water to apply. Various instruments can be used to answer these questions, and one of the instruments used is the neutron probe. Describe how this instrument works, in your description including the mechanism, how it is calibrated, and also stating the advantages and disadvantages.

[15 marks]

b) Explain the causes of pressure variation in sprinkler irrigation and how it affects the application uniformity of the system.

[15 marks]

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QUESTION 4

a) Describe the process of soil salinization, i.e. what it is, how it affects crop growth and the measures that can be taken to prevent it from occurring.

[15 marks]

b) Discuss how irrigation scheduling is carried out using the two types of irrigation scheduling (**fixed interval** and **fixed application**). Also explain the advantages and disadvantages of both approaches.

[10 marks]

c) Show proof that soil porosity (n) equals volumetric moisture content (Θ_v) at saturation, where:

$$n = 1 - \frac{\rho_b}{\rho_s}$$

[5 marks]