BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

AEH 301

Department Of Engineering and Physics
Bachelor of Science (Honours) in Agricultural Engineering
Irrigation and Drainage Engineering

3 HOURS (100 MARKS)

JUN 2024

INSTRUCTIONS

Answer any ***FOUR*** questions. Each question carries 25 marks.

Question 1

a. Briefly explain the following terms as used in irrigation:

i. Fertigation. **[2 marks]**
ii. Irrigation scheduling. **[2 marks]**
iii. Actual evapotranspiration. **[2 marks]**
iv. Sub- surface drainage. **[2 marks]**
v. Crop water requirement. **[2 marks]**
vi. Effective rainfall. **[2 marks]**
vii. Irrigation system. **[2 marks]**

b. Discuss the different irrigation structures used to measure water discharge in any irrigation system. **[11 marks]**

Question 2

A level field plot measuring 96 m x 96 m is designed for irrigation with a solid set system having low discharge sprinklers. A uPVC mainline line runs through the centre of the plot, with aluminium laterals placed on both sides. The whole plot, planted to high value vegetables, is irrigated simultaneously. The selected sprinklers apply (Q_s) 0.110 m^3/hr at a pressure of 2.0 bars (20 m head of water). The laterals are spaced every 6 m on the main line while the sprinklers along them are spaced every 8 m. The height of the stand (riser) pipe is considered negligible. The head losses in the lateral and mainline are to be restricted to below 20% of the operating pressure.

i. Determine the length of each lateral. **[2 marks]**
ii. How many sprinklers are carried on each lateral? **[2 marks]**
iii. Determine the flow rate into each lateral. **[3 marks]**
iv. Size (practical) the lateral to satisfy the stated design criteria **[6 marks]**
v. Size the mainline (practical) to satisfy the given design criteria. **[6 marks]**
vi. Determine the available pressure on the last sprinkler on the last lateral in the solid set. **[6 marks]**

Question 3

a. A stream of 130 litres per second was diverted from a canal and 100 litres per second were delivered to the field. An area of 1.6 hectares was irrigated in 8 hours. The effective depth of root zone was 1.7 m. The runoff loss in the field was 420 cu. M. The depth of water penetration varied linearly from 1.7 m at the head end of the field to 1.1 m at the tail end. Available moisture holding capacity of the soil is 20 cm per metre depth of soil. It is required to determine the water conveyance efficiency, water

application efficiency, water storage efficiency, and water distribution efficiency. Irrigation was started at a moisture extraction level of 50% of the available moisture. **[14 marks]**

b. In irrigation, differentiate between total available moisture and field capacity. **[6 marks]**

c. Determine the consequences of not following a proper irrigation schedule. **[5 marks]**

Question 4

a. A short season variety of groundnut (16 weeks) is grown in Zimbabwe. The soil is a sandy loam with a water-holding capacity or total available moisture (SMta) of 100 mm/m. The allowable depletion P is 50%. The planting date is 5 October and a pre-irrigation wetted the first 30 cm of the soil. When should the first irrigation take place? Assume that the root zone depth during the first week will not exceed 10 cm or 0.10 m. The readings of the Class A pan are 7mm (6 Oct), 7mm (7 Oct) , 8mm (8 Oct), 7 mm (9 Oct). No rainfall was recorded during those days. **[15 marks]**

b. Explain the importance of irrigation in Zimbabwe. **[10 marks]**

Question 5

a. Explain the factors that affect the selection of an irrigation method, in general. **[10 marks]**

b. Analyse the factors which affect choice of an irrigation method. **[15marks]**

Question 6

a. ''Irrigation has caused more harm than good to agriculture''. Discuss. **[25 marks]**

End of paper