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)

INSTRUCTIONS

NOV 2024

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

Question 1

a. Briefly explain the following terms as used in irrigation:
   i. Consumption use of water. **[2 marks]**
   ii. Irrigation requirement. **[2 marks]**
   iii. Permanent wilting point. **[2 marks]**
   iv. Surface drainage. **[2 marks]**
   v. Weirs. **[2 marks]**
   vi. Potential evapotranspiration. **[2 marks]**
   vii. Water use efficiency **[2 marks]**

b. Discuss the approaches of irrigation scheduling **[11 marks]**

Question 2

a. In surface (flood) irrigation system design, when you are undertaking preliminary canal layouts based on the contour map of the design area (see attached figure 1), explain where and why you would:
   i. Locate or place the main canal? **[4 marks]**
   ii. Locate and orient the distributary or lateral canals? **[4 marks]**
   iii. Locate the main drain or outfall? **[4 marks]**

b. The attached figure (Figure 1) is a contour map of an area where you are designing a surface irrigation system and you are tasked with laying out the canals such that you command as much of the irrigable area as possible.
   i. On the contour map, indicate and label the alignment of the supply canal and main canal to command the maximum possible area. **[10 marks]**
   ii. Approximately how much area are you able to command? **[3 marks]**

Question 3

a. Imagine you are an irrigation designer and you are faced with the following two scenarios and have to select an appropriate irrigation method for each case. Indicate what method you would select and the reasons why.
   i. A commercial farmer irrigating sugarcane, but faced with erratic power supply. **[6 marks]**
   ii. A group of unsophisticated smallholder farmers with small parcels of land but producing high value crops for a nearby market. **[6 marks]**

b. During irrigation system design:
   i. Why is it important to use a cycle time (t_c) or irrigation interval determined using peak actual crop evapotranspiration. (ET_c) **[4 marks]**

ii. What are the consequences of underestimating total available water (TAW) **[4 marks]**

c. The concepts of 'irrigation depth' and 'depth of soil wetted by an irrigation' tend to be confusing to young irrigation designers. Show your understanding of irrigation depth by solving the following problem:

i. A closed border measuring 3m wide by 100m long is irrigated with a stream size of $3m^3/hr$ for 2 hours. Determine the depth of irrigation (mm) effected in this case. **[5 marks]**

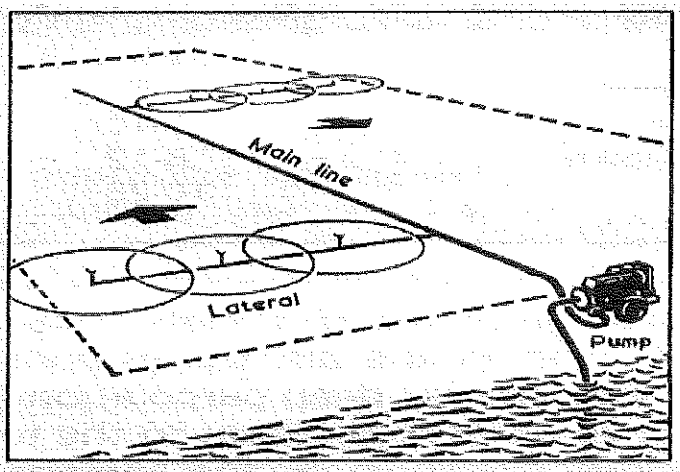
Question 4

a. Figure 1 below shows a plan of a simple sprinkler irrigation layout system having a main line running in the middle of the field and 2 laterals feeding from the main line on a 9m x 12m layout. Each lateral carries 3 sprinklers with each sprinkler operating at $350kN/m^2$ with 3mm nozzles discharging $0.68m^3/hr$. For this system, determine the:

i. Irrigation group size (ha) **[4 marks]**

ii. System capacity (m^3/hr) **[4 marks]**

iii. Number of sprinklers per group **[2 marks]**



Simple sprinkler layout (Illustration: Wright Rain)

Figure 1

b. Briefly discuss the common reasons why farmers do not practice proper irrigation scheduling. **[15 marks]**

Question 5

a. Explain the merits and demerits of surface irrigation systems. **[10 marks]**

b. Explain the methods of irrigation efficiencies and their calculations. **[15 marks]**

Question 6

a. Discuss how you would minimize the irrigation water losses. **[15 marks]**

b. Explain the merits and demerits of using drip irrigation system to your crops. **[10 marks]**

Please hand in this page if you have answered question 2.

Student Number: _____

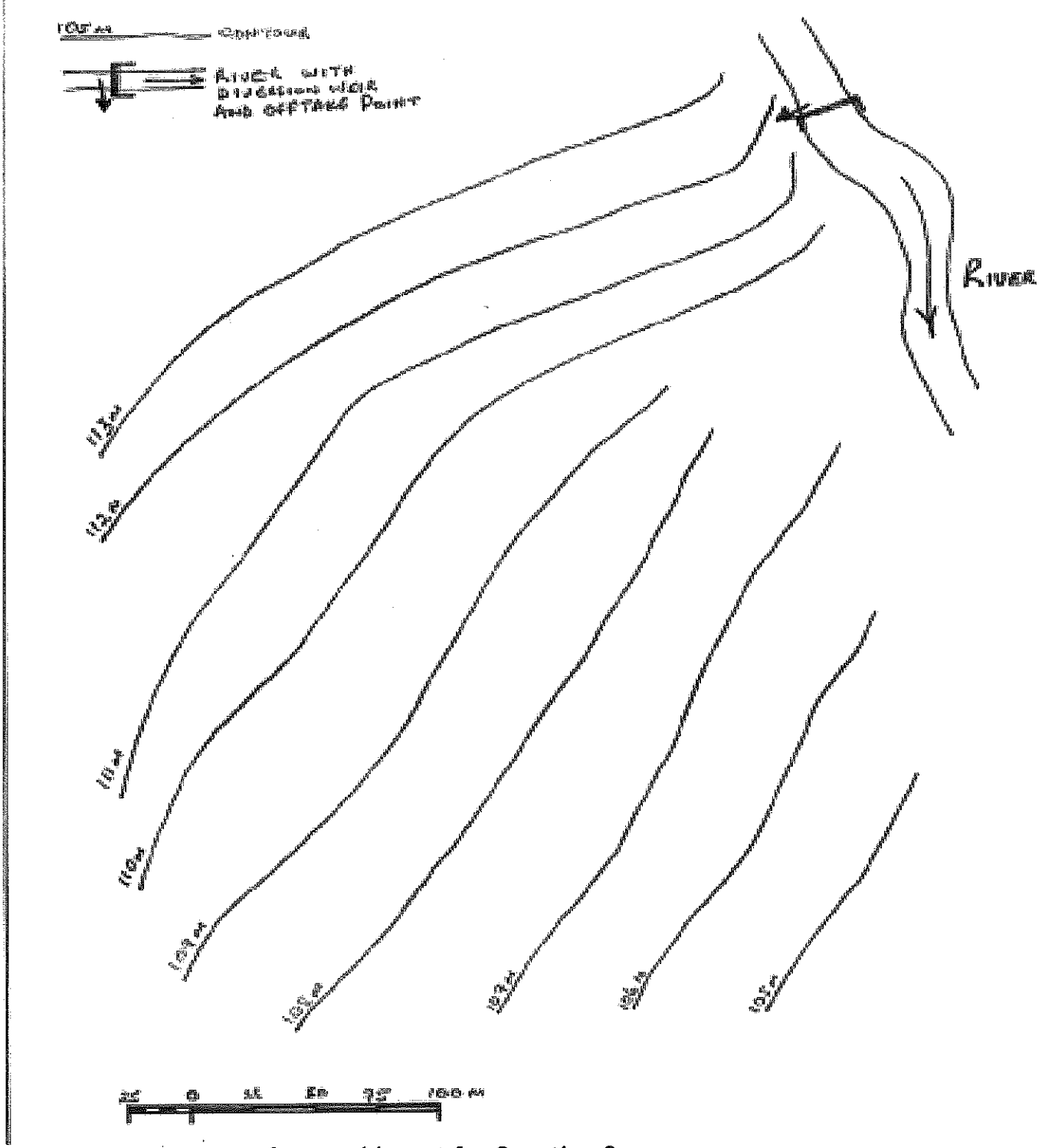


Figure 2: Contour map for canal layout for Question 2

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