

Department Of Engineering and Physics
Bachelor of Science (Honours) in Agricultural Engineering
Design and Operation of Pressurised Irrigation Systems

3 HOURS (100 MARKS)

INSTRUCTIONS

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

MAR 2023

Question 1

- a. Briefly explain the following terms:
- | | |
|---|-----------|
| i. Centre pivot sprinkler. | [2 marks] |
| ii. Exchangeable sodium percentage (ESP). | [2 marks] |
| iii. Fertigation. | [2 marks] |
| iv. Net irrigation requirement. | [2 marks] |
| v. Soil permeability. | [2 marks] |
| vi. Main drainage system. | [2 marks] |
| vii. Friction losses (= head or pressure loss). | [2 marks] |
- b. The net irrigation dose (d) for an area of 1 ha is 19.8mm, i.e. 198 m³. The water delivered during irrigation is 280 m³. What is the application efficiency? [11 marks]

Question 2

Describe the frequent observations, procedures and checks that should be carried out during the irrigation season to ensure the proper functioning and good performance of the system. [25 marks]

Question 3

Design a hose move sprinkler for cotton, given the preliminary data below

Area and crop

An area of approximately 2.0 ha planted with cotton at the beginning of August. The field is square and level.

Soil, water and climate

Medium texture soil of good structure, with good infiltration and internal drainage. The soil available moisture (Sa) is 110 mm/m depth. The water is of good quality with no salinity or toxicity hazards; the source is a tube-well equipped with a pumping unit delivering 36 m³/h. The peak irrigation demand is in October, at the midseason growth stage of the crop.

Crop water requirements and irrigation scheduling

The pan average readings in October are 5.6 mm/d. This figure multiplied by 0.66 (pan correction factor) gives an ETo of 3.7 mm/d. The crop factor kc for cotton at this stage is taken as 1.05, the root depth 1.0 m and the moisture depletion 50 percent. Then, ETc cotton = 3.7 × 1.05 = 3.88 mm/d. The net application depth is Sa 110 mm × root depth 1.0 m × depletion 0.5 = 55 mm. The maximum permissible irrigation interval in October

is $55 \text{ mm} \div 3.88 \text{ mm/d} = 14 \text{ days}$. The irrigation frequency depends on many factors and in no case should exceed the maximum permissible irrigation interval. The system's application efficiency is 75 percent, therefore, the gross application depth at peak is: $55 \text{ mm} \div 0.75 = 73.3 \text{ mm}$. The gross irrigation dose is: $73.3 \text{ mm} \times 10 \times 2.0 \text{ ha} = 1\,466 \text{ m}^3$.
[25 marks]

Question 4

Using an example for any irrigation system, explain the tender procedure for the supply of any irrigation equipment.
[25 marks]

Question 5

Outline the minimum engineering investigation requirements for a centre pivot (CP) system to enable the successful planning, designing and implementation at the farm level.
[25 marks]

Question 6

Give details on the parameters and evaluation criteria to be measured when using wastewater is to be used for irrigation purposes.
[25 marks]

End of paper