



MACHAKOS UNIVERSITY
University Examinations for 2021/2022 Academic Year
SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING AND CIVIL ENGINEERING
FOURTH YEAR FIRST SEMESTER EXAMINATION FOR
BACHELOR OF SCIENCE (CIVIL ENGINEERING)
ECV 402: IRRIGATION ENGINEERING I

DATE: 30/8/2022

TIME: 11.00-1.00 PM

INSTRUCTIONS:

- *This paper comprises of FIVE questions. Answer **THREE** questions*
- *Question one is **compulsory** and carry 30 marks*
- *Answer any other **TWO** questions*

QUESTION ONE (30 MARKS)

- a) Differentiate between crop period and base period. (2 marks)
- b) A crop requires 800mm of water for a base period of 120days. Find the duty of water. (2 marks)
- c) Discuss the strategies that farmers can use in order to improve irrigation water application efficiency. (3 marks)
- d) Calculate the bulk density and porosity of a 250 g sample that contains 65 g of water when 55% of the pores are full of water. (4 marks)
- e) Discuss five factors that affects evapotranspiration. (3 marks)
- f) Discuss two parameters that have to be considered when preparing an irrigation schedule. (2 marks)
- g) By use of a single crop coefficient approach, draw and illustrate a generalized crop coefficient curve. (4 marks)
- h) Outline the strategies for use of saline water for irrigation. (4 marks)

- i) Assume that your university farm department planted tomatoes in the field from 1st February 2022. Calculate the water requirements from the information given on the following table (6 marks)

Crop	Total growing period	Initial stage	Crop development stage	Mid-season stage	Late season stage
Tomato	150	35	40	50	25
Kc		0.45	0.75	1.15	0.8
ETo	Feb = 5	March = 5.8	April = 6.3	May = 6.8	June = 7.1

QUESTION TWO (20 MARKS)

- a) Differentiate the following terminologies as used in irrigation engineering.
- Crop water requirement and Irrigation requirement (2 marks)
 - Gross irrigation depth and net irrigation depth (2 marks)
- b) The net peak crop water requirement for a 10-hectare scheme is 6.0 mm/day. The available moisture for the clay loam is 0.130 m/m and depletion is allowed up to around 46%. The root zone depth is 70 cm. Assuming a field application efficiency of 50%, calculate the following
- The number of days that irrigation should take place in order to replenish the soil moisture. (2 marks)
 - Net and gross irrigation requirements for this scheme. (2 marks)
 - Volume of water abstracted per day (2 marks)
- c) The following data was collected by students from college of agricultural engineering during their long-term irrigation and drainage engineering project in the university farm.
- Moisture content at Field capacity by weight (22%)
 - Moisture content at Permanent wilting point by weight (10%)
 - Root zone depth of the test crop (100cm)
 - Dry unit weight of soil (1400kg/m³)
 - Maximum permissible depletion of moisture (60%) of AMC
 - Class A pan evaporation (5mm/day)
 - Crop factor at the particular stage of growth (0.8)
 - Rainfall (10mm)
 - Losses in the field application of water supplied (20%)
- Calculate the equivalent water depth, frequency of irrigation (6 marks)

- d) Outline the factors that influences water infiltration rates. (4 marks)

QUESTION THREE (20 MARKS)

- a) Briefly describe the CROPWAT Model (5 marks)
- b) Describe how Soil texture and structure influences movement and retention of water in a soil sample. (4 marks)
- c) Outline various methods of irrigation based on their water application. (2 marks)
- d) Describe the general steps that you would follow while determining the crop evapotranspiration. (4 marks)
- e) Discuss the suitability of using drip irrigation system as compared to sprinkler irrigation system. (5 marks)

QUESTION FOUR (20 MARKS)

- a) Discuss the factors that you would consider when selecting an irrigation system. (6 marks)
- b) You have been given class A evaporation pans to estimate potential evapotranspiration in the field. Outline the procedures that you would follow. (4 marks)
- c) Discuss the problems associated with poorly managed irrigation systems. (4 marks)
- d) You collected an undisturbed clay soil sample (1.63kgs) from an irrigation field, three days after irrigation, after oven drying, it weighed 1.29kg. Calculate the following assuming the bulk and particle density of clay soil is 1.3 and 2.65 g/cm³ respectively.
- i. Gravimetric and Volumetric water content. (2 marks)
 - ii. Porosity of the soil sample. (2 marks)
 - iii. Assuming that the soil sample will retain 12% water by weight at PWP, calculate the available water that this soil will hold. (2 marks)

QUESTION FIVE (20 MARKS)

- a) Discuss the various components of surface irrigation systems. (6 marks)
- b) Outline the importance of drainage in agricultural land. (4 marks)
- c) By use of a well labeled diagram, explain how you would measure soil moisture tension in the field by use of a tensiometer. (4 marks)
- d) Orange trees whose average rooting depth is 1.5m grows on a soil which has 63 % solid particles, and 37 % voids. After drainage, the 45 % of the void volume contains water and

55 % holds air. At the wilting point, the void volume is 25 % water. Calculate the soil water holding capacity (6 marks)