



MACHAKOS UNIVERSITY

University Examinations for 2024/2025 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR DEGREE IN
BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECV 402: IRRIGATION ENGINEERING I

DATE: 22ND JANUARY, 2025

TIME: 11.00 AM – 1.00 AM

INSTRUCTIONS:

Answer question **ONE (Compulsory)** and **any other TWO** questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Discuss the various categories of irrigation systems in Kenya. (3 marks)
- b) Discuss the factors that affects irrigation development in Kenya. (4 marks)
- c) Discuss various strategies that the government of Kenya is using to improve irrigation development and management. (4 marks)
- d) Discuss the various classification of Soil Water. (3 marks)
- e) Discuss various methods that can be used to increase irrigation water application efficiency in an irrigation scheme. (4 marks)
- f) Determine the crop water need of tomatoes using the following information. (6 marks)

Month	Jan	Feb	March	April	May	June	July
ET _o (mm/day)	4.0	5.0	5.8	6.3	6.8	7.1	6.5
Duration of growing period (150 days)							
Planting date: 1 st February, 2024 (Direct planting)							

Crop	Growing period	Initial stage	Crop development stage	Mid season stage	Late season stage

Tomatoes	150	35	40	50	25
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- g) A 12-hectare field is to be irrigated with a sprinkler system. The root zone depth is 0.9 m and the field capacity of the soil is 28% while the permanent wilting point is 17% by weight. The soil bulk density is 1.36 g/cm^3 and the water application efficiency is 70%. The soil is to be irrigated when 50% of the available water has depleted. The peak evapotranspiration is 5.0 mm/day and the system is to be run for 10 hours in a day. Determine the following: (6 marks)
- The net and gross irrigation depths
 - Irrigation period
 - Area to be irrigated per day and
 - The system capacity.

QUESTION TWO: 20 MARKS

- Discuss the criteria used to determine suitability of irrigation water. (4 marks)
- Discuss the effects of using saline water for irrigation purposes. (5 marks)
- Discuss various management practices that may be used when using poor quality irrigation water. (5 marks)
- The Moisture Content at Field Capacity of a Clay Loam Soil is 28% by Weight. While that at Permanent Wilting Point is 14% by Weight. Root Zone Depth is 1 m and the Bulk Density Is 1.2 g/cm^3 . Calculate the following;
 - volume of water needed to be pumped for irrigation per hectare if the Irrigation Efficiency is 0.7. (4 marks)
 - shortest Irrigation Interval if the peak ET is 7.5mm/day. (2 marks)

QUESTION THREE (20 MARKS)

- Differentiate between crop and base period as used in irrigation engineering. (2 marks)
- Discuss four structural factors that influences the soil water holding capacity. (4 marks)
- Describe five important functions of water in crop growth and development. (5 marks)
- With an aid of a well labeled diagram, discuss how you would install and determine soil moisture content in the field using tensiometers. (5 marks)
- After how many days will you supply water to soil in order to ensure sufficient irrigation of the given crop, if (i) Field Capacity of soil is =28%, (ii) Permanent wilting point = 13%, (iii)

Density of soil = 1.3gm/cm^3 , (iv) Effective depth of root zone = 70 cm, (v) Daily consumptive use of water by the given crop = 12mm/day, assume RAM = 80% of AM.

(4 marks)

QUESTION FOUR (20 MARKS)

- a) Define the term field drainage. (2 marks)
- b) Calculate the minimum leaching requirement when using irrigation water having an EC of $1800\ \mu\text{S/cm}$. The farmer is prepared to accept a 10% yield loss. It is known that water of $1700\ \mu\text{S/cm}$ EC would cause this (acceptable) yield loss. (2 marks)
- c) Discuss three adverse effects of poor agricultural land drainage. (6 marks)
- d) Discuss the main factors which are considered in the design of sub-surface drainage systems. (4 marks)
- e) With an aid of well labeled diagrams, describe the four arrangements of subsurface drainage systems. (6 marks)

QUESTION FIVE (20 MARKS)

- a) Calculate for the month of April, the mean ET_0 in mm/day using Blaney-Criddle method given that Latitude -35°North , the mean T_{max} and T_{min} in the month of April is 29.5°C and 19.4°C respectively while the mean daily percentage of annual daytime hours is 0.29. (2 marks)
- b) Discuss the four main weather parameters that affect crop evapotranspiration. (4 marks)
- c) Discuss four factors that affects water infiltration rate in agricultural lands. (4 marks)
- d) Discuss five factors that you would consider when selecting an appropriate irrigation method. (5 marks)
- e) Discuss the suitability and limitations of using drip irrigation system against sprinkler in arid and semi-arid lands. (5 marks)