



MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FOURTH YEAR SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 402: IRRIGATION ENGINEERING I

DATE: 7/3/2023

TIME: 8.30-10.30 AM

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 (COMPULSORY) (30 MARKS)

- a) Define the term irrigation. (2 marks)
- b) A particular irrigation block in Mwea irrigation scheme has a Culturable Command Area (C.C.A) of 200 hectares out of which 150 hectares of land was cultivated for the first season and 100 hectares of land was cultivated for the second season. First, define the term Culturable Command Area as used in irrigation engineering and calculate the intensity of irrigation for each season? (3 marks)
- c) Outline the advantages and disadvantages of irrigation practices. (3 marks)
- d) Outline the strategies for use of saline water for irrigation. (3 marks)
- e) Discuss the importance of water in plant growth and development. (5 marks)
- f) Assume that your university farm department planted tomatoes in the field from 1st February 2021. Calculate the water requirements from the information given on the following table. (7 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

Month	February	March	April	May	June
ETO	5.0	5.8	6.3	6.8	7.1

- g) 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. (3 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 TWO (20 MARKS)

Define the following terminologies as used in irrigation engineering.

- a) Irrigation scheduling. (2 marks)
- b) Gross irrigation depth. (2 marks)
- c) Net irrigation depth. (2 marks)
- d) Gross Command Area. (2 marks)
- e) The following data was collected by students from college of agriculture during their long-term irrigation and drainage engineering project in the university farm.
 - i. Moisture content at Field capacity by weight (22%)
 - ii. Moisture content at Permanent wilting point by weight (10%)
 - iii. Root zone depth of the test crop (100cm)
 - iv. Dry unit weight of soil (1400kg/m³)
 - v. Maximum permissible depletion of moisture (60%) of AMC
 - vi. Class A pan evaporation (5mm/day)
 - vii. Crop factor at the particular stage of growth (0.8)
 - viii. Rainfall (10mm)
 - ix. Losses in the field application of water supplied (20%)Calculate the equivalent water depth, frequency of irrigation (8 marks)
- f) Outline the factors that influences water infiltration rates. (4 marks)

QUESTION THREE (20 MARKS)

- a) Define and discuss the importance of soil texture and structure in irrigation engineering. (5 marks)
- b) Outline various methods of irrigation based on their water application (4 marks)

- c) 45 m³ of water was pumped into an irrigation farm distribution system. Only 38 m³ of water was actually delivered to a turn out (at head ditch) which is 2 km away from the well. Compute the Conveyance Efficiency. (3 marks)
- d) Draw and label a neat diagram of a typical sprinkler head. (3 marks)
- e) Discuss the suitability of using drip irrigation system as compared to sprinkler irrigation system. (5 marks)

QUESTION FOUR (20 MARKS)

- a) Outline various components that you would address while undertaking feasibility study of an irrigation project (4 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) From the following information, calculate the ETo (2 marks)
 - i. Type of pan: Class A evaporation pan
 - ii. Water depth in pan on day 1 = 150 mm
 - iii. Water depth in pan on day 2 = 144 mm (after 24 hours)
 - iv. Rainfall (during 24 hours) = 0 mm
 - v. K pan = 0.75
- d) Differentiate between crop period and base period. (2 marks)
- e) A crop requires 800mm of water for a base period of 120days. Find the duty of water. (2 marks)
- f) Outline the main components of a drip irrigation system. (3 marks)
- g) Discuss the problems associated with poorly managed irrigation systems. (3 marks)

QUESTION FIVE (20 MARKS)

- a) Discuss the factors that affect evapotranspiration. (3 marks)
- b) Outline the importance of drainage in agricultural land. (4 marks)
- c) Define the following terms
 - i. Available Moisture. (2 marks)
 - ii. Field capacity. (2 marks)
 - iii. Differentiate between temporary wilting and ultimate wilting point. (2 marks)
- d) A farmer in Makueni county grows pawpaw trees with an average root depth of 1.5 m. The soil 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. (7 marks)