



MACHAKOS UNIVERSITY

University Examination 2019/2020

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING AND CIVIL ENGINEERING
FOURTH YEAR FIRST SEMESTER EXAMINATION FOR
BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECV 402 IRRIGATION ENGINEERING I

DATE: 17/12/2019

TIME: 8.30-10.30-10.30 AM

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (30 MARKS)

- a) Define the term irrigation. (2 marks)
- b) With an aid of a well labeled diagram, draw a typical sprinkler head (3 marks)
- c) Outline the strategies for use of saline water for irrigation. (3 marks)
- d) Discuss the importance of water in plant growth and development (4 marks)
- e) Discuss the factors that affect infiltration rates of water into the soil (3 marks)
- f) The following data was obtained by civil and structural engineering students from Machakos University while undertaking an irrigation experiment at University farm. The moisture content, two days after they had stopped irrigation was 28% while that at Permanent Wilting Point was 14% by weight. Root Zone Depth of the test crop was 1 m, Bulk Density was 1.2 g/cm^3 and Maximum Allowable Depletion (MAD) was 50%. The peak ET was 7.5mm/day and the irrigation efficiency was 0.7. Calculate the following;
 - i. Net depth of irrigation. (2 marks)
 - ii. Readily Available Moisture (1 mark)
 - iii. Gross Depth of irrigation. (2 marks)
 - iv. Volume of water per hectare. (1 mark)
 - v. Irrigation Interval. (1 mark)

- 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. solve 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. Derive how you would get the porosity of the above soil sample from soil phase diagram (2 marks)
 - iii. Calculate the porosity of the soil sample (2 marks)
 - iv. 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)

- a) During an experiment to determine evapotranspiration, the water depth in an evaporation pan on the first day was 411mm and on the second day (after 24 hours), was 409mm however, during this time, the rainfall recorded was 7mm. Calculate the evapotranspiration given that the K_{pan} was 0.9. (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 at Mua Hill near Machakos town grows orange 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)

QUESTION THREE (20 MARKS)

- a) Define the term crop evapotranspiration (ET_c) and explain its dependent factors (4 marks)
- b) Define and discuss the importance of soil texture and structure in irrigation engineering. (4 marks)
- c) Discuss the various irrigation methods basing on their water application (4 marks)
- d) A certain farmer in the northern frontier districts of Kenya has two (2) choices to make between sprinkler and drip irrigation method. What is the best advice that you can give

basing on the advantages and disadvantages of each method.
marks)

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QUESTION FOUR (20 MARKS)

- a) Outline various components that you would address while undertaking feasibility study of an irrigation project (4 marks)
- b) Outline the principles of operation of a class A evaporation pan (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 900mm 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) Define the following terminologies as used in irrigation engineering.
 - i. Irrigation scheduling (2 marks)
 - ii. Net irrigation depth (2 marks)
 - iii. Soil erosion (2 marks)
- b) By use of a well labeled diagram, explain the crop coefficient curve. (3 marks)
- c) By use of a well labeled diagram, discuss how you would carry out an infiltration rate in the field by use of double ring infiltrometers. (5 marks)
- e) Wheats (130 days duration) are grown on a silt-loam soil on Nov.15 in Kathonzwi, Makueni County. Long-term monthly average of daily reference evapotranspiration (ET₀) and crop coefficient (k_c) values are given below. Determine
 - i. total seasonal net irrigation water requirement (4 marks)
 - ii. gross irrigation water requirement assuming application efficiency of 95% and farm conveyance efficiency 90% (2 marks)

