TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECE 2405 : ENGINEERING IRRIGATION I

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2016

TIME: 2 HOURS

DATE: 15 Dec 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

-Drawing instruments.

This paper consists of five questions.

Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question ONE (Compulsory – 30 Marks)

(a) Define the following parameters

(i) Irrigation (1 mark)

(i) Delta (2 marks)

(ii) Base Period (2 marks)

(iii) Permanent Wilting Point (2 marks)

(b)A farm is situated in Taveta area. The crops to be grown are horticultural crops. The area to be irrigated is 18 Ha. The farmer would like to irrigate using a drag line system. The system efficiency (n_s) =82%. Soil basic infiltration rate = 10mm/hr. Water holding capacity (WHC) =100mm/m. Class A pan peak evaporation rate (E_o) =6.2mm/day; Crop factor (f) =0.7;

Rainfall(R) =0mm; Percentage allowable depletion (α) =50%; Effective root depth = 0.3m

Calculate:

(i)Readily Available Water (2 marks)

(ii)Gross Irrigation Requirement (3 marks)

(iii)Cycle Length/Irrigation Interval (3 marks)

(c) The net peak crop water requirement for Mbooni irrigation scheme in Makueni is 6.00 mm/day. The field capacity and permanent wilting point for the clay loam is 172 mm/m and 38mm/m respectively. The depletion is allowed upto 62%. The root zone is 0.75m.

After how many days should irrigation take place to replenish the soil moisture? (5 marks)

(d)The base period, duty of water and area under irrigation for various crops under a canal system are given in the table below. If the losses in the reservoir and canals are respectively 15%, 25%, determine the reservoir capacity. (10 marks)

Crop	Wheat	Sugarcane	Cotton	Rice	Vegetable
Base period B (days)	120	320	180	120	120
Duty, D (ha/cumec)	1800	1600	1500	800	700
Area irrigated (ha)	15000	10000	5000	7500	5000

Question TWO (20 Marks)

(a) What data is required to design farm irrigation system? (2 marks)

(b) Write the net irrigation requirement that is derived from the field balance equation (2 marks)

(c) Irrigation water is to be pumped from a river through a piped system to the command point of the farm. The flow rate is 28l/s. Assume an allowable velocity of 1.5m/s. Calculate the required diameter of the pipe. (3 marks)

(d)A discharge of 78.30 l/sec has to be delivered through a 7 km long canal with a wetted cross-section of 0.19 m^2. When should the headwork gate be opened, if water has to reach the field at 07.00 hours? (5 marks)

(d) Border Point One irrigation scheme in Mandera has an area of 100 Ha. The Reference Evapotranspiration (ET_O) is estimated at 6.5 mm/day (Woodhead simplified) and the crop factor for horticultural crops $K_c = 0.85$

The number of hours of irrigation per day (HPD) = 8 hrs.

The conveyance efficiency, field canal efficiency and field application efficiency are 83%, 80% and 82% respectively.

Calculate the required scheme design flow. (8 marks)

Question THREE (20 Marks)

(a)(i) Define Reference Evapotraspiration (1 mark)

(ii) What factors affect Evapotranspiration (2 marks)

(iii) Name five methods used in measuring Evapotranspiration (2 marks)

(iv) What causes Evapotranspiration (1 mark)

(b) Briefly discuss sustainable irrigation and how irrigation efficiencies can be increased (4 marks)

(c) River Thiba has a flow of 650 l/s. The base flow for the river to allow for environmental needs is 100 l/s. The community in Gatundu uses this river for domestic purposes.

Their domestic needs are 150 l/s. The surrounding industries also use this river. The industries water demand is 110 l/s. What is the maximum hectarage that can be irrigated using this river?

Assuming the potential evaporation for the area is 5.0 mm/day and the K_c for crop is 0.85. (10 marks)

Question FOUR (20 Marks)

(a)A stream size of 150l/s was released from the diversion headwork to irrigate a land of area 1.8 Ha. The stream size when measured at the delivery to the field channels is 120l/s. The stream continued for h hours. The effective root zone depth is 1.80m. The application losses in the field are estimated to be 440m^3. The depth of water penetration was 1.80m and 1.20m at the head and tail of the run respectively. The available water holding capacity of the soil is 21cm/m and irrigation was done at 60% depletion of AMC. The stream size delivered to the plot was 100 l/s.

Calculate:

(i)Conveyance efficiency (2 marks)

(ii)Field canal efficiency (2 marks)

(iii)Water application efficiency (3 marks)

(b) What are the factors considered in choosing an irrigation system? (3 marks)

(c) Discuss the Environmental Impacts of Irrigation (3 marks)

(d) What are the benefits of Irrigation Water Reuse? (2 marks)

(e) What are the major causes of salinity? (2 marks)

(f)What strategies should the Government put in place to increase the area under irrigation?

(3 marks)

Question FIVE (20 Marks)

(a) What are the objectives of canal lining in an irrigation system? (2 marks)

(b) Name different types of materials used in canal lining. (2 marks)

(c) Assume a concrete lined trapezoidal irrigation canal with a depth of water of 2m. The base width is 5m and the side slope is equal to 1:2. Manning coefficient n can be taken as 0.015 and the bed slope So=0.001. Calculate the discharge. (8 marks)

(d) Design a rectangular irrigation canal for Mwea irrigation scheme to carry a flow of 22.5 m^3/s

The slope of the canal is 1.15% . Assume Manning's coefficient n = 0.016; Normal depth d = ½ of width of the irrigation canal. (8 marks)