TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:

BSC IN CIVIL ENGINEERING

ECE 2413 : IRRIGATION ENGINEERING II

END OF SEMESTER EXAMINATION

SERIES:APRIL2016

TIME:2HOURS

DATE:12May2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, Drawing Instruments, Scientific calculator, examination pass and student ID

This paper consists of five questions.

Attemptquestion ONE (Compulsory) and any other TWO questions.

Question ONE (Compulsory – 30 Marks)

(a)Design a drip irrigation system for the following data:

Area: 30 acres = 400m x 300m

Topography: Flat

Crops: Citrus

Spacing: 6m x 6m

Water source: Tubewell at the centre of the field. Suction lift: 3m; Delivery head: 3m; Tubewell discharge is 15l/s. Use a lateral of inside diameter of 16mm, Diameter of submain of 62.5mm and a mainline diameter of 100mm. Use Hazen – William equation; C=150. Emitter discharge is 4lph. Divide the area into 4 blocks with a main line of 150m.

The Christiansen friction factor F is given by:

$$F = \frac{1}{m+1} + \frac{1}{2N} + \frac{(m-1)^{1/2}}{6N^2}$$

Where N=Number of emitters (openings) along the lateral; m= exponent of velocity = 1.852 for Hazen- William equation

(i)Calculate headlosses in lateral, submain and mainline (6 marks)

(ii)Calculate flows in laterals, submain and mainline (6 marks)

(iii)Total dynamic head (4 mark)

(iv)Power requirements (4 mark)

(b)Given a hose-move sprinkler irrigation system for cotton. Area and crop: An area of approximately 2.0 ha planted with cotton at the beginning of August. The field is square and level. Soil, water and climate: Medium texture soil of good structure, with good infiltration and internal drainage. The soil available moisture (Sa) is 110 mm/m depth. The water is of good quality with no salinity or toxicity hazards; the source is a tube-well equipped with a pumping unit delivering 36 m^3/hr. The peak irrigation demand is in October, at the midseason growth stage of the crop. Crop water requirements and irrigation scheduling: The pan average readings in October are 5.6 mm/day. This figure multiplied by 0.66 (pan correction factor) gives an ETo of 3.7 mm/d. The crop factor kc for cotton at this stage is taken as 1.05, the root depth 1.0 m and the moisture depletion 50 percent. Application efficiency is 75%.
Calculate
(i)Calculate the maximum irrigation interval (3 marks)
(ii)Calculate the gross irrigation dose in m^3 (3 marks)

(c)The Nabusenga dam has a 70 m long AC outlet pipe with a diameter of 225 mm. What are the friction losses for discharges of 78.3 l/sec and 32.6 l/sec, including 20% extra for minor losses? C=140. Minimum head available is 3.38m. Compare and comment on the frictional losses with the minimum head available. (4 marks)

Question Two (20 Marks)

(a) A discharge of 1.58 m^3/sec has to be abstracted from River Nyando, into an open conveyance canal at Ahero iirigation scheme. The base flow water level of the river is 126.34 m. The design water level in the canal is 124.90 m and the water depth is 0.60 m. The weir coefficient is 1.60. The width of the intake is 1.50 m and the length of the weir is 0.50 m. What will be the elevation of the weir? (4 marks)

(b) Discuss the different types of pumps (4 marks)

(c)Discuss the operation and maintenance of pump (4 marks)

(d)An irrigation pipeline with 200mm inside diameter and 340m in length made of new PVC is laid along a horizontal grade. The required flow rate in the pipe at steady state is 40l/s. Using Hazen-Williams equation, where C=150, calculate the friction loss along the pipe. (4 marks)

(d)Assuming a tree spacing of 6mx6m, a P_w of 50% and an A_w of $4m^2$ for loamy soils, what would be the number of emitters per plant? (4 marks)

Question Three (20 Marks)

(a)Outline the types of irrigation highlighting their advantages and disadvantages. (6 Marks)

(b)Describe why assessment of water is needed in irrigation systems. (4 Marks)

(c)Outline the disadvantages and ill-effects of irrigation. (5 Marks)

(d)Briefly discuss how sustainable irrigation can be achieved (5 Marks)

Question Four

(a) Define the following
(i) Weir (2 marks)
(ii) Barrage (2 marks)

(b) A rectangular channel 6 m wide carries 168 m^3/min at a depth of 0.9m. What height of a rectangular weir must be installed to double the depth?
Discharge coefficient of Weir may be taken as 0.85 (6 Marks)

(c) What is the irrigation frequency at peak demand using the given data: Effective root depth=1m; Available soil moisture=120mm/m; Moisture depletion for a drip system is 20%; Tree spacing =6mx6m; NIR=6.04mm/day. (4 Marks)

(d)A 14 Ha drag hose sprinkler irrigation scheme in Naivasha, designed to satisfy 20hrs/day pumping at peak demand requires a discharge of $57m^3$/s. Its TDH is 56m (20m static lift, 30m sprinkler operating head and 6m friction losses). The net irrigation requirements are $131250m^3$/year. Assume 75% irrigation efficiency, pump efficiency of 69%, overall derating of 20%. Assume a motor efficiency of 88%.

Calculate the energy requirements. (6 marks)

Question Five (20 Marks)

(a) Briefly discuss the importance of drainage in irrigation scheme. (4 Marks)

(b)Irrigation water is to be pumped from a river through a pipe system to the command point of the farm. The flow rate is 13.3l/s. Assume an allowable velocity of 1.5m/s. Calculate the required diameter of the pipe required. (8 Marks)

(c)Briefly discuss different structures used in an irrigation system (4 Marks)

(d)Briefly compare gravity fed and pump fed irrigation systems. (4 Marks)