

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY  
DEPARTMENT OF CIVIL AND WATER ENGINEERING  
FACULTY OF INDUSTRIAL TECHNOLOGY  
BACHELOR OF ENGINEERING (HONOURS) DEGREE  
PART III SECOND SEMESTER EXAM.- AUGUST- 2009  
IRRIGATION SYSTEMS DESIGN TCW 3204**

**INSTRUCTIONS**

Answer any four (4) questions. Each question carries equal marks. Time : 3 Hours  
Total Marks: 100

**QUESTION I**

- (a) Describe the five major factors that govern the total amount of water required by a crop during its vegetation period from germination to maturity. (13 marks)
- (b) A sprinkler system is designed to produce a precipitation rate of 10.2mm per hour and its spacing  $21 \times 21 \text{m}^2$ . Calculate the sprinkler discharge in  $\text{m}^3 / \text{hr}$ . (12 marks)

**QUESTION 2**

Define the following terms:

- (i) gravitational water
- (ii) Field capacity
- (iii) permanent wilting point
- (iv) water holding capacity
- (v) available water (12 marks)

(b) The following design parameters for a border irrigation system are applicable:

- mannings roughness coefficient,  $n$  = 0.15
- Border length  $L$  = 25m
- Reduced level at head of border = 105.43bm
- Reduced level at end of border = 104.93bn
- Width of border,  $W$  = 25
- Water discharge into border  $Q$  =  $2.5 \text{m}^3 / \text{sec}$
- Net infiltration opportunity time,  $T_n$  = 30 minutes

Calculate the recession lag time in minutes. (13 marks)

**QUESTION 3**

(a) Describe the various methods of surface irrigation and give examples of at least two crops that would be suitable to grow using each one of the methods. (12 marks)

(b) The following design parameters for a furrow irrigation system are applicable:

- Inflow spacing = 24l/s
- Furrow spacing = 1.2 m
- Length of furrow = 250m
- Advance time for system water  $T_t$  = 50 mins
- Net infiltration opportunity time,  $T_n$  = 30 mins
- The system is an open- ended gradient furrows.

Calculate the gross water application depth for the furrow. (13 marks)

#### **QUESTION 4**

(a) Distinguish between evaporation, transpiration, evapotranspiration and crop evapotranspiration, ( $ET_{crop}$ ). (9 marks)

(b) Calculate the depth of water required to meet the water loss, due to  $ET_{crop}$ , given the following conditions,

- (i)  $ET_{crop}$  = 40mm
- (ii) Precipitation, P = 70/ month. (8marks)

(c) Describe the advantages and disadvantages of sprinkler and drip irrigation systems. (8 marks)

#### **QUESTION 5**

(a) Describe the factors that affect the choice of a surface irrigation method. (10 marks)

(b) Calculate the head loss due to friction for a sprinkler irrigation system given the following conditions:

- (i) Distance of the first sprinkler from main line = 15m
- (ii) Sprinkler spacing along lateral = 15
- (iii) Number of sprinklers per lateral = 10
- (iv) Length of lateral = 150m
- (v) K =  $1.22 \times 10^{12}$
- (vi) C for aluminum pipes = 120
- (vii) Flow in lateral Q = 45l/sec
- (viii) Diameter of lateral = 100mm
- (ix) M = 1.852 (15 marks)

