FOURTH YEAR SECOND SEMESTER EXAMINATIONS
FOR
BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: CSE 454
COURSE NAME: IRRIGATION ENGINEERING I

Instructions to candidates
- This paper consists of **FIVE (5)** questions
- Answer **Question ONE** any other **THREE (3)** questions
- All symbols have their usual meanings unless otherwise stated
- Ensure you have **THREE (3)** Cartesian graph paper
- Time allowed is **THREE (3)** hours

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Question ONE Compulsory (40 marks)
a) Differentiate between infiltration and percolation   (2 marks)
b) Briefly explain the following terms used in irrigation
     i. Available moisture
     ii. Crop water requirement
     iii. Irrigation water requirements   `   (6 marks)
c) A client needs to invest in irrigated agriculture on a farm bought recently in semi-arid area.
     i. Discuss the advantages and disadvantages of possible system that you may advice the client to try   (5 marks)
     ii. State the various components of a typical system suggested in for the client in (i) above   (4 marks)
d) Briefly discuss the advantages and disadvantages of irrigated agriculture   (8 marks)
e) Two experiments were undertaken to determine the infiltration rate of a soil and length of furrow to keep deep percolation minimal. A test furrow of wetted perimeter of 0.75m and length 30m was used to determine infiltration rates and data in Table 1 was obtained

Table 1

Average contact time (mins)	Furrow inflow (l/s)	Furrow outflow (l/s)
8	0.84	0.12
11	0.84	0.36
14	0.84	0.42
19	0.84	0.50
29	0.84	0.55

In furrow length test the data obtained is given in Table 2

Table 2

Distance of furrow (m)	Advance time (mins)
0	0.0
10	0.3
20	0.7
30	1.2
40	2.0
50	3.8
60	6.0

Given that the desired depth of irrigation is 180 mm, estimate appropriate furrow length
(15 marks)

Question TWO (20 marks)
a) Consider a crop with a rooting depth of 0.6m grown in a field with the following data:
B.d = 1.25 g/cm^3, FC = 16%, PWP = 8%, MAD = 60% of TAWC.
Compute the Design Net Water Requirement (DeNWR) (4 marks)
b) Briefly explain the following terms used in furrow irrigation system
 i. Intake opportunity time
 ii. Advance stream
 iii. Cut back stream
 iv. Quarter time rule (6 marks)
c) Briefly explain the main factors that need to be considered when selecting an appropriate surface irrigation system (10 marks)

Question THREE (20 marks)
a) Explain the factors that govern design of border irrigation system (6 marks)
b) The selection of an irrigation system/method depends on two factors: Technical feasibility and Economics. Discuss (14 marks)

Question FOUR (20 marks)
a) Briefly explain the following:
 i. Five (5) causes of water logging (5 marks)
 ii. Three (3) preventive measures of water logging (3 marks)
 iii. Two (2) curative measures of water logging (2 marks)
b) A cotton crop is to be grown in an area designated for sprinkler system. The following data is available: DRZ = 0.8m, ETc = 6mm/day, MAD = 70%, FC =28%, PWP = 16%, B.d = 1.2g/cm^3. A period of 2 days is required for various farm operations and the system efficiency is 85%. If the water is sprinkled at a rate of 8 mm/hr, computed
 i. Net water requirement (NWR) (2 marks)
 ii. Gross water requirement(GWR) (2 marks)
 iii. Irrigation interval (II) (2 marks)
 iv. Design interval (2 marks)
 v. Duration of water application (2 marks)

Question FIVE (20 marks)
a) An orchard is to be irrigated using drip irrigation system whose water application efficiency is about 80 percent. The trees are spaced at 3m x 6m and irrigated for 12 hours per day. If the conventional evapotranspiration rate is 7.6 mm/day and 75 percent of the area is shaded by trees in the orchard. Determine the following:
 i. Drip irrigation design ET rate
 ii. Required discharge per tree (l/s)
 iii. Discharge of each emitter, if four emitters are used per tree
 iv. Average operating pressure head, if a medium long path emitter is used.
 Assume the emitter constant is 7.3 x 10^{-5} and emitter discharge exponent, x is 0.63
(8 marks)

b) The following data were collected from a double ring infiltrometer. The cross section area of the inner ring was 500cm². Determine the infiltration rate equation $I = at^n$, where I is infiltration rate (cm/min), t is intake opportunity time (min) and a and n are constants   (12 marks)

Time (minutes)	Cumulative infiltration (cm^3)
0	0
2	270
4	450
6	620
8	770
10	900
20	1420
40	2410