



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR**

FOURTH YEAR SECOND SEMESTER EXAMINATIONS

**FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL
ENGINEERING**

COURSE CODE: CSE 454

COURSE TITLE: IRRIGATION ENGINEERING I

DATE: MONDAY 2ND NOVEMBER 2020 TIME: 9.00 – 11.00 AM

Instructions to candidates

1. This paper consists of **FIVE (5)** questions
2. Answer question **ONE (Compulsorily)** and **ANY** other **THREE (3)** questions
3. Candidates are not allowed to write anywhere on the question paper
4. All symbols have their usual meanings unless otherwise stated
5. Time allowed is **TWO (2)** hours

MMUST observes **ZERO** tolerance to examination cheating

This Paper Consists of 5 Printed Pages. Please Turn Over.

Question ONE {Compulsory (25 marks)}

- a) Consider a homogeneous soil, in which the DRZ is divided into four equal parts. Each layer contains 30mm of water. Starting at the top, the plant extracts 40, 30, 20 and 10% respectively of TAWC of the DRZ. The four layers define the DRZ. Irrigation is scheduled when 40% of water in the soil is remaining. Determine the total water which is extracted (7 marks)
- b) Figure Q1 (b) was obtained while evaluating a border length. Explain what could have occurred in the field and probable solutions (7 marks)
- c) 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 (minutes)	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 (minutes)
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 50 mm, estimate appropriate furrow length (11 marks)

Question TWO (15 marks)

- a) Determine the required capacity of a sprinkler system to apply water at the rate of 1.25 cm/hr. Two 186 metres long sprinkler lines and sixteen sprinklers spaced at 12m interval on each line are required. The spacing between lines is 18m (2 marks)
- b) Allowing 1 hour for moving each of 186m sprinkler line describe in (a) above:
- How many hours would be required to apply 5cm irrigation to a square field of 16 hectares? (2 marks)
 - How many days are required assuming 10 hour day? (7 marks)
- c) Using the data given in the table below, determine the DeNWR (4 marks)

	Top layer	Bottom layer
Depth (m)	0.3	0.3
Bb (g/cm ³)	1.3	1.2
FC (%)	14	15
PWP (%)	8	10
MAD (%)	70	

Question THREE (15 marks)

- a) Explain parameters that may influence the decision on choice of surface irrigation system (5 marks)
- b) Determine the uniformity coefficient from the following data obtained from a field test on a square plot bounded by four sprinklers (10 marks)

S	15.7	13.2	S
15.0	15.0	15.2	16.5
15.0	15.0	18.2	16.2
17.0	18.5	15.1	10.7
12.2	20.3	12.4	14.5
S	15.3	13.2	S

Note: S indicates location of sprinklers

Question FOUR (15 marks)

- a) Explain the factors that govern the design criteria of Border irrigation system (4 marks)
- b) Explain the parameters to be considered in design of Basin irrigation system (5 marks)
- c) A wheat crop is to be irrigated using Border irrigation system. The following data is available. The size of the Border is 10m x 8m. The size of the available irrigation stream is 18 l/s. The water holding capacity of the root zone is 16%. Soil moisture before irrigation is 8.5%. The apparent specific gravity of the soil is 1.58. The depth of root zone is 80cm. Water application efficiency is 95%. Determine:
- The irrigation duration (3 marks)
 - If irrigation is to be done when 40% of moisture is remaining what will be the irrigation duration (3 marks)

Question FIVE (15 marks)

- a) Explain the functions of the following irrigation structures: (5 marks)
- Weir
 - Canal head regular
 - Scouring sluice
 - Guide wall
 - Apron
- b) Water is applied in an irrigated area every 10 days. The field application of water results in 0.025m/day discharge from deep percolation. The effective porosity is 0.05 and maximum permissible height of water table is 1m above the drains. The drain level is 1.8 below the soil surface and there is an impervious layer at 5.8m below the soil surface. An auger test gave the value of permeability K of 1m/day and the pipe drains of 10cm radius are used. Determine a range (e.g. 45 to 50m) of the drainage spacing. (10 marks)

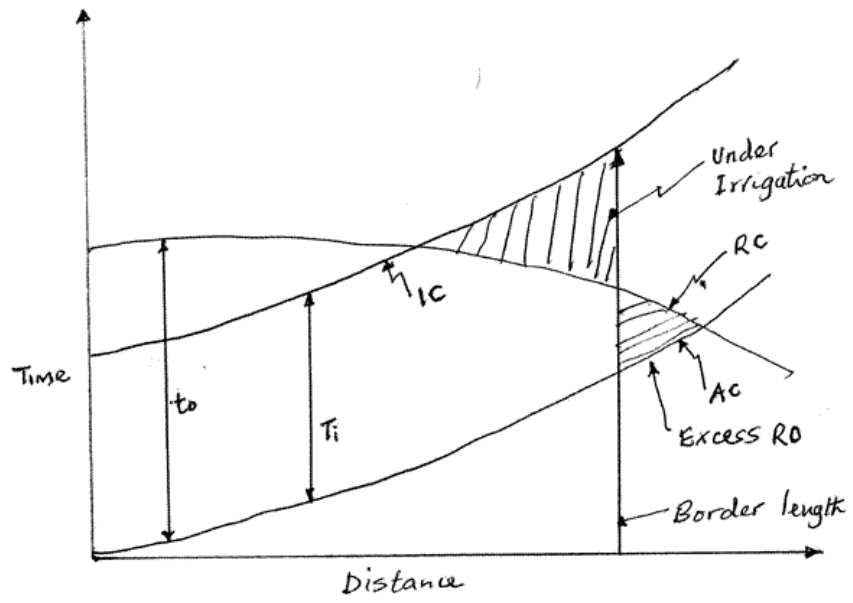


Figure Q1(b)

Table 1: d – Values after Hooghoudt (1940)

APPENDIX B

d-VALUES HOOGHOUTD (1940)

$r = 0.10 m$

$L \rightarrow$														$L \rightarrow$					
5 m 7,5 10 15 20 25 30 35 40 45 50														50 75 100 150 200 250					
D														D					
0.5m 0.47 0.48 0.49 0.49 0.50 0.50														0.5m 0.50					
0.75	0.60	0.65	0.69	0.71	0.73	0.74	0.75	0.75	0.75	0.76	0.76	1	0.96	0.97	0.98	0.99	0.99	0.99	
1.00	0.67	0.75	0.80	0.86	0.89	0.91	0.93	0.94	0.96	0.96	0.96	2	1.72	1.80	1.85	1.90	1.92	1.94	
1.25	0.70	0.82	0.89	1.00	1.05	1.09	1.12	1.13	1.14	1.14	1.15	3	2.29	2.49	2.60	2.72	2.79	2.83	
1.50	0.88	0.97	1.11	1.19	1.25	1.28	1.31	1.34	1.35	1.36	1.36	4	2.71	3.04	3.24	3.46	3.58	3.66	
1.75	0.91	1.02	1.20	1.30	1.39	1.45	1.49	1.52	1.55	1.57	1.57	5	3.02	3.49	3.78	4.12	4.31	4.43	
2.00	1.08	1.28	1.41	1.5	1.57	1.62	1.66	1.70	1.72	1.72	1.72	6	3.23	3.85	4.23	4.70	4.97	5.15	
2.25	1.13	1.34	1.50	1.69	1.69	1.76	1.81	1.84	1.86	1.86	1.86	7	3.43	4.14	4.62	5.22	5.57	5.81	
2.50	1.38	1.57	1.69	1.79	1.87	1.94	1.99	2.02	2.02	2.02	2.02	8	3.56	4.38	4.95	5.68	6.13	6.43	
2.75	1.42	1.63	1.76	1.88	1.98	2.05	2.12	2.18	2.18	2.18	2.18	9	3.66	4.57	5.23	6.09	6.63	7.00	
3.00	1.45	1.67	1.83	1.97	2.08	2.16	2.23	2.29	2.29	2.29	2.29	10	3.74	4.74	5.47	6.45	7.09	7.53	
3.25	1.48	1.71	1.88	2.04	2.16	2.26	2.35	2.42	2.42	2.42	2.42	12.5	5.02	5.92	7.20	8.06	8.68	8.68	
3.50	1.50	1.75	1.93	2.11	2.24	2.35	2.45	2.54	2.54	2.54	2.54	15	5.20	6.25	7.77	8.84	9.64	9.64	
3.75	1.52	1.78	1.97	2.17	2.31	2.44	2.54	2.64	2.64	2.64	2.64	17.5	5.30	6.44	8.20	9.47	10.4	10.4	
4.00	1.81	2.02	2.22	2.37	2.51	2.62	2.71	2.71	2.71	2.71	2.71	20	6.60	8.54	9.97	11.1	11.1	11.1	
4.50	1.85	2.08	2.31	2.50	2.63	2.76	2.87	2.87	2.87	2.87	2.87	25	6.79	8.99	10.7	12.1	12.1	12.1	
5.00	1.88	2.15	2.38	2.58	2.75	2.89	3.02	3.02	3.02	3.02	3.02	30	9.27	11.3	12.9	12.9	12.9	12.9	
5.50	2.20	2.43	2.65	2.84	3.00	3.15	3.15	3.15	3.15	3.15	3.15	35	9.44	11.6	13.4	13.4	13.4	13.4	
6.00	2.48	2.70	2.92	3.09	3.26	3.26	3.26	3.26	3.26	3.26	3.26	40	11.8	13.8	13.8	13.8	13.8	13.8	
7.00	2.54	2.81	3.03	3.24	3.43	3.43	3.43	3.43	3.43	3.43	3.43	45	12.0	13.8	13.8	13.8	13.8	13.8	
8.00	2.57	2.85	3.13	3.35	3.56	3.56	3.56	3.56	3.56	3.56	3.56	50	12.1	14.3	14.3	14.3	14.3	14.3	
9.00	2.89	3.18	3.43	3.66	3.66	3.66	3.66	3.66	3.66	3.66	3.66	60	14.6	14.6	14.6	14.6	14.6	14.6	
10.00	3.23	3.48	3.74	3.74	3.74	3.74	3.74	3.74	3.74	3.74	3.74	∞	3.88	5.38	6.82	9.55	12.2	14.7	
∞	0.71	0.93	1.14	1.53	1.89	2.24	2.58	2.91	3.24	3.56	3.88								