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B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2013

AGRICULTURAL AND IRRIGATION ENGINEERING

SIXTH SEMESTER

AI 9353 DRAINAGE ENGINEERING AND LAND MANAGEMENT

(Regulation 2008)

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Define land drainage.
2. Abbreviate SWATRE, SALTMOD, DRAINMOD, SGMP
3. Calculate the mass density of water at 30° C.
4. What are the steady state and unsteady state equations?
5. What are the components of a water-balance study of the unsaturated zone?
6. Represent the role of different factors in the optimisation, design, and evaluation of drainage systems using a flowchart.
7. What are the objectives of drainage?
8. Write down the conditions for ideal tubewell
9. Classify the soil according to their salinity level
10. What is the role of Gypsum in soil reclamation?

Part – B (5 x 16 = 80 marks)

11. (i) Explain the types of drainage. (4)
(ii) Explain in detail the design considerations for drainage systems. (4)
(iii) What are the components of a drainage system? Describe using a neat sketch. (4)
(iv) Briefly describe the three most common techniques used to drain excess water. (4)

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12. a) (i) In an agricultural area, high water tables occur. A subsurface drainage system is to be installed to control the watertable under the following conditions:

Agricultural drainage criteria:

- Design discharge rate is 1 mm/d;
- The depth of the watertable midway between the drains is to be kept at 1.0 m below the soil surface.

Technical Criteria:

- Drains will be installed at a depth of 2 m;
- PVC drain pipes with a radius of 0.10 m will be used.

A deep augering revealed that there is a layer of low conductivity at 6.8 m, which can be regarded as the base of the flow region. Auger-hole measurements were made to calculate the hydraulic conductivity of the soil above the impervious layer. Its average value was found to be 0. 14 m/d. Calculate the drain spacing. (10)

(ii) A confined aquifer has a source of recharge. K for the aquifer is 50 m/day, and n is 0.2. The piezometric head in two wells 1000 m apart is 55 m and 50 m respectively, from a common datum.

The average thickness of the aquifer is 30 m, and the average width of aquifer is 5 km.

Compute a) the rate of flow through the aquifer, (b) the average time of travel from the head of the aquifer to a point 4 km downstream.

***assume no dispersion or diffusion** (6)

OR

b) (i) In an irrigated area, a drainage system is needed to control the watertable under the following conditions:

Agricultural drainage criteria:

- The maximum permissible height of the watertable is 1 m below the soil surface;
- Irrigation water is applied every 10 days, and the field application losses percolating to the watertable are 25 mm for each irrigation.

Technical design criteria:

- Drains are installed at a depth of 1.8 m;
- PVC drainpipes with a radius of O. 10 m are used.

Soil data:

- The depth of the impervious layer is 9.5 m below the soil surface;
- The average hydraulic- conductivity of the soil is 1.0 m/d, and the drainable pore

(10)

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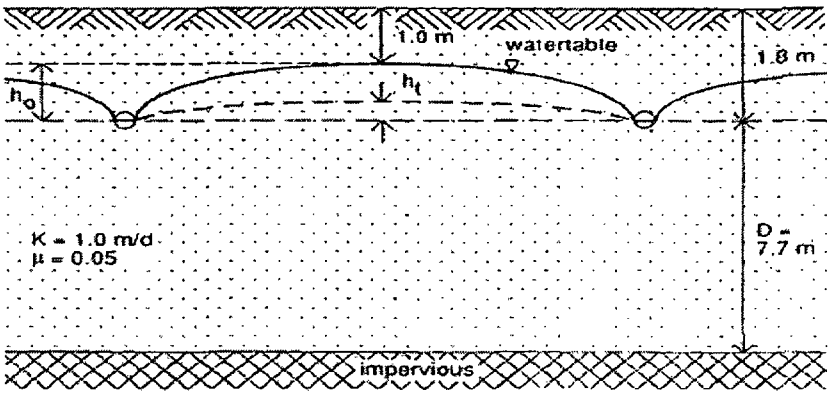

(ii) Tabulate the steady state equations for five different soil profiles. (6)

13. a) i. Write down the characteristic features of the water balance method (4)
ii. Explain briefly about the water balance of the unsaturated zone, water balance of the land surface and the groundwater balance (12)

OR

b) Explain briefly about the effects of field drainage systems on agriculture (16)

14. a) Explain briefly about the operation and maintenance of drainage system (16)

OR

b) i. Explain briefly about the methods of tubewell development (6)
ii. Explain mole drainage with its purposes and design the mole leg , expander and foot with neat sketch (10)

15. a) i. Discuss the importance of rice cultivation in the leaching process. (5)
ii. Write the effect of salts on the physical properties of the soils. (3)
iii. Explain briefly about the salinity assessment methods. (8)

OR

b)i. Explain briefly about the three categories of the environmental impacts (6)
ii. What is Bio drainage and explain the impact of bio drainage on depressing the groundwater table (10)

Table 8.1 Values for the equivalent depth d of Hooghoudt for r_0 = 0.1 m, D and L in m (Hooghoudt 1940)

L →	5 m	7.5	10	15	20	25	30	35	40	45	50	L →	50	75	80	85	90	100	150	200	250
D												D									
0.5 m	0.47	0.48	0.49	0.49	0.49	0.50	0.50	0.50	0.50	0.50	0.50	0.5	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	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	0.97	0.97	0.98	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	1.82	1.82	1.83	1.85	1.00	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	2.52	2.54	2.56	2.60	2.72	2.70	2.83
1.50	0.70	0.88	0.97	1.11	1.19	1.25	1.28	1.31	1.34	1.35	1.36	4	2.71	3.04	3.08	3.12	3.16	3.24	3.46	3.58	3.66
1.75	0.70	0.91	1.02	1.20	1.30	1.39	1.45	1.49	1.52	1.55	1.57	5	3.02	3.49	3.55	3.61	3.67	3.78	4.12	4.31	4.43
2.00	0.70	0.91	1.08	1.28	1.41	1.5	1.57	1.62	1.66	1.70	1.72	6	3.23	3.85	3.93	4.00	4.08	4.23	4.70	4.97	5.15
2.25	0.70	0.91	1.13	1.34	1.50	1.69	1.69	1.76	1.81	1.84	1.86	7	3.43	4.14	4.23	4.33	4.42	4.62	5.22	5.57	5.81
2.50	0.70	0.91	1.13	1.38	1.57	1.69	1.79	1.87	1.94	1.99	2.02	8	3.56	4.38	4.49	4.61	4.72	4.95	5.68	6.13	6.43
2.75	0.70	0.91	1.13	1.42	1.63	1.76	1.88	1.98	2.05	2.12	2.18	9	3.66	4.57	4.70	4.82	4.95	5.23	6.09	6.63	7.00
3.00	0.70	0.91	1.13	1.45	1.67	1.83	1.97	2.08	2.16	2.23	2.29	10	3.74	4.74	4.89	5.04	5.18	5.47	6.45	7.09	7.53
3.25	0.70	0.91	1.13	1.48	1.71	1.88	2.04	2.16	2.26	2.35	2.42	12.5	3.74	5.02	5.20	5.38	5.56	5.92	7.20	8.06	8.68
3.50	0.70	0.91	1.13	1.50	1.75	1.93	2.11	2.24	2.35	2.45	2.54	15	3.74	5.20	5.40	5.60	5.80	6.25	7.77	8.84	9.64
3.75	0.70	0.91	1.13	1.52	1.78	1.97	2.17	2.31	2.44	2.54	2.64	17.5	3.74	5.30	5.53	5.76	5.99	6.44	8.20	9.47	10.4
4.00	0.70	0.91	1.13	1.52	1.81	2.02	2.22	2.37	2.51	2.62	2.71	20	3.74	5.30	5.62	5.87	6.12	6.60	8.54	9.97	11.1
4.50	0.70	0.91	1.13	1.52	1.85	2.08	2.31	2.50	2.63	2.76	2.87	25	3.74	5.30	5.74	5.96	6.20	6.79	8.99	10.7	12.1
5.00	0.70	0.91	1.13	1.52	1.88	2.15	2.38	2.58	2.75	2.89	3.02	30	3.74	5.30	5.74	5.96	6.20	6.79	9.27	11.3	12.9
5.50	0.70	0.91	1.13	1.52	1.88	2.20	2.43	2.65	2.84	3.00	3.15	35	3.74	5.30	5.74	5.96	6.20	6.79	9.44	11.6	13.4
6.00	0.70	0.91	1.13	1.52	1.88	2.20	2.48	2.70	2.92	3.09	3.26	40	3.74	5.30	5.74	5.96	6.20	6.79	9.44	11.8	13.8
7.00	0.70	0.91	1.13	1.52	1.88	2.20	2.54	2.81	3.03	3.24	3.43	45	3.74	5.30	5.74	5.96	6.20	6.79	9.44	12.0	13.8
8.00	0.70	0.91	1.13	1.52	1.88	2.20	2.57	2.85	3.13	3.35	3.56	50	3.74	5.30	5.74	5.96	6.20	6.79	9.44	12.1	14.3
9.00	0.70	0.91	1.13	1.52	1.88	2.20	2.57	2.89	3.18	3.43	3.66	60	3.74	5.30	5.74	5.96	6.20	6.79	9.44	12.1	14.6
10.00	0.70	0.91	1.13	1.52	1.88	2.20	2.57	2.89	3.23	3.48	3.74	∞	3.88	5.38	5.76	6.00	6.26	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										

Table 8.2 The geometry factor (a) obtained by the relaxation method (after Van Beers 1979)

$\frac{K_b}{K_t}$	$\frac{D_b}{D_t}$					
	1	2	4	8	16	32
1	2.0	3.0	5.0	9.0	15.0	30.0
2	2.4	3.2	4.6	6.2	8.0	10.0
3	2.6	3.3	4.5	5.5	6.8	8.0
5	2.8	3.5	4.4	4.8	5.6	6.2
10	3.2	3.6	4.2	4.5	4.8	5.0
20	3.6	3.7	4.0	4.2	4.4	4.6
50	3.8	4.0	4.0	4.0	4.2	4.6