Duration: 1hour

Max. Marks: 30

a) Answer all questions.
b) Make suitable assumptions if required.
c) Clearly indicate the steps involved in solving the problems.

ALL THE BEST!

1. Neatly draw and label the time space diagram of surface irrigation and show four important phases that characterise surface irrigation. (3)

2. a. What is the most important difference between a surface irrigation system and a sprinkler irrigation systems in terms of how water is distributed over the field. (2)

   b. How are the three forms of surface irrigation distinguished one from another? (1)

3. A flow of 1.5lps is introduced into a unit width of a sloping border (S_o=0.0005). The soil is a clay loam. The manning roughness was found to be 0.04. The flow reaches the midpoint of the 400m border in 102 min and the end of the field in 292min. Volume balance computations reveal that the infiltration characteristics are a=0.437, k=0.003. These numbers are based on assuming a f_0 value of 0.000078m^3/min/m. Now suppose on the same field we introduced a flow of 1.0 lps and found reached the midpoint in 76min and the end of the field in 179min. Would the a,k, f_0 values remain same or will be altered. (2)

4. A basin having an area of 0.12 hectare is irrigated for 2 hours with a water supply of 30lps. Prior to this irrigation event, the soil moisture deficit was 130mm. Assuming that the soil moisture deficit is completely replenished in the basin, what is the application efficiency and deep percolation ratio for this irrigation event. (4)

5. It was decided to design a furrow irrigation system having the following data obtained from field tests and evaluation.
Supply Discharge = 1.8m^3/~~s~~ min; Field area =200m x 100m. Target depth of application = 6cm. Initial field surveys showed that the field were comprised of a loam soil, sloped 0.8 percent over the 100 m direction and 0.1 percent over the 200 m direction. The furrows were placed on 0.5 m intervals across the 100 m direction (and running in the 200 m direction). The furrows were assumed to have a hydraulic section where $\mathbf{p_1}$ = 0.57 and $\mathbf{p_2}$ = 1.35.
During the evaluations noted, the infiltration functions characteristic of the field was found to be $Z = 0.00346\, t^{.388} + 0.000057\, t$. Assume $\mathbf{n}$ = 0.04. The advance time and inflow discharge was related by

$\cancel{Q_o = 0.009 t_l^{1.95}}$ $\quad q_0 = 2.14\, t_L^{-0.79}$ $\quad q_0 = m^3/min$, $t_L = min$

For the above data, evaluate the efficiency for a system having 5 sets without cutback (5)

6. Develop the volume balance equation with the help of a **neat** diagram. (3)

7. An evaluation was conducted on an existing furrow system during the first irrigation of the season. The field characteristics were found to be as follows. The soil was a sandy loam which gravimetric soil samples indicated had a soil moisture depletion averaging 9.5 cm prior to the irrigation. The field had a uniform slope of 0.0075 with 200 metre furrows spaced at 75 cm intervals across the field. The water supply to the field was a large tube-well capable of supplying water on demand. The furrow inflow was a steady value of 0.12 m^3/min during both irrigations. The remaining data are tabulated. The inflow to the tests was stopped at 390 minutes.

MEASURED ADVANCE AND RECESSION TRAJECTORIES

Advance Distance (m)	**Advance Time (min)**	**Recession Time (min)**
0	0.0	390
47	6.0	396
112	18.0	402
151	30.0	405
200	54.8	408

Assume p_1 =.444 and p_2 = 1.357, Q_{out} = the steady state runoff, .00095 m^3/sec . Estimate the infiltration function for the irrigation. (6)

Also, find the application efficiency. (2)

If the application efficiency is less that 40% , provide suitable measures to improving the performance. (2)

$n = 0.04$

Formulas

$$s_z = \frac{a + r(1-a) + 1}{(1+r)(1+a)}\,, \qquad I = \frac{a\,k}{2}\left[T_1^{a-1} + (T_1 - t_L)^{a-1}\right] + f_o\,, \qquad s_y = \frac{1}{L}\left[\frac{(Q_o - I\,L)\,n}{60\,S_o^{.5}}\right]^{.6},$$

$$T_2 = t_r - \frac{.095\,n^{.47565}\,s_y^{.20735}\,L^{.6829}}{I^{.52435}\,S_o^{.237825}}\,, \qquad T_2 = T_1 - \frac{Q_o\,T_1 - 0.77A_o\,L - s_z\,k\,T_1^a\,L - \dfrac{f_o\,L\,T_1}{1+r_1}}{Q_o - s_z\,a\,k\,L/T_1^{1-a} - \dfrac{f_o\,L\,T_1}{1+r_1}}\,,$$

$$T_2 = T_1 + \frac{Z_{req} - k\,T_1^a - f_o\,T_1}{\dfrac{a\,k}{T_1^{1-a}} + f_o} \qquad Q_{max} = \left(.V_{max}^{p2}\,\frac{n}{60\,p_1\,S_o^{.5}}\right)^{1/(p2-1)}\,, \qquad V_L = \frac{Q_o t_L}{L} - s_y A_o - \frac{f_o t_L}{(1+r)}\,,$$

$$V_{.5L} = \frac{2Q_o\,t_{.5L}}{L} - s_y\,A_o - \frac{f_o\,t_{.5L}}{(1+r)}\,, \qquad a = \frac{\log(V_L / V_{.5L})}{\log(t_L / t_{.5L})}\,, \qquad k = \frac{V_L}{s_z t_L^a}$$

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