

CSM—10/24
PART—II/PAPER—VI
AGRICULTURAL ENGINEERING
PAPER—I

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Time : 3 Hours

Full Marks : 250

*The question paper contains **18 (Eighteen)** questions
in **GROUP—A, (12)** and **GROUP—B, (06)** together.*

GROUP—A

*Candidates to attempt **10 (ten)** questions within word limit of **250**.*

*Each question carries **15** marks.*

1. The following data shown as (X) in the Table below from a levelling job are illegible owing to the exposure of sudden rainfall. Find those missing data marked as X :

Station	Readings, m			Rise, m	Fall, m	RL, m	Remarks
	BS	IS	FS				
A	2.375					245.0	BM
B		X		0.615		X	
C	X		2.070		X	X	CP1
D	X		3.120		0.190	X	CP2
E		3.015		0.450		X	
F		X		0.150		X	
G	2.665		2.405	X		X	CP3
H		X			0.140	X	
I			X	0.780		X	

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2. A trapezoidal irrigation canal of 10 m bottom width and side slopes 1.5 H : 1 V is to be constructed on a ground which is level in the transverse direction. The intended depths of the canal bed from the present ground surface at 40 m intervals are given below :

0.90 m, 1.25 m, 2.15 m, 2.50 m, 1.85 m, 1.35 m and 0.85 m

Calculate the volume of earthwork required using trapezoidal formula and prismoidal formula.

3. Define and describe field capacity and permanent wilting point. What do you understand by available water capacity and readily available water? Why are these important?
4. Explain the different types of irrigation efficiencies, including the major factors affecting each. How can the overall project efficiency be improved in a canal irrigation system?
5. What is the drainage coefficient? Discuss its usage. A command area of 2500 hectares is to be provided with surface drainage in a heavy clay soil region of coastal Odisha. The area grows crops during the kharif (June-October) season, when the maximum rainfall expected over a 24-hour period is 220 mm. The runoff coefficient for this saturated soil is 0.80. The crop can tolerate a maximum of 48 hours of water ponding on the surface. Determine the drainage coefficient in mm/day and the required capacity of the main drain, if it drains the entire 2500 ha command.
6. What are the assumptions of the Hooghoudt's equation for the spacing of drains? Subsurface drains are to be constructed for lowering the water table from 0.6 m to 1.2 m below the ground level in 10 days. Tile drains are to be placed 2.0 m below the ground surface. Impervious layer exists at 4.8 m below the ground level. The drainable porosity is 8% and hydraulic conductivity is 0.8 m/day. Determine the spacing between the drains using Hooghoudt's equation.

7. The ordinates of a 4-h unit hydrograph are given below. If there is 4 cm and 6 cm of effective rainfall occurring uniformly for two consecutive 4-h intervals, calculate the direct runoff hydrograph.

Time(h)	0	2	4	6	8	10	12	14	16	18	20	22	24
4-h UH ordinates (m^3s^{-1})	0	9	24	50	66	72	65	53	28	20	11	6	0

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8. What do you understand by development of well? Mention its objectives and working principle. Find the discharge from a confined well if steady drawdowns observed in two observation wells 90 m and 160 m away are 5 m and 3 m, respectively. The thickness of the aquifer is 10 m and hydraulic conductivity is 14 m/day.

9. What are the main differences among drop spillway, chute spillway and drop-inlet spillway?

Annual average soil loss from a watershed has been measured as $20 \frac{\text{t}}{\text{ha} \cdot \text{year}}$. The watershed has 8% land slope and 84 m maximum slope length. Assume all other factors same and dimensionless exponent for slope factor = 0.5. What should be the maximum slope length to reduce the annual average soil loss from the watershed to $10 \frac{\text{t}}{\text{ha} \cdot \text{year}}$?

10. Describe the various agronomical and biological measures of water erosion control. What are the specific features of each of these measures? How do the agronomical and biological measures of water erosion control differ from engineering or mechanical measures?
11. Classify the different types of roofs used in farm structures. Explain the construction features, advantages, disadvantages and suitability of any four types that are widely used in Indian scenario.
12. What do you mean by sprinkler irrigation? How does it differ from trickle irrigation? Differentiate between these two methods of irrigation. Work out the capacity of a sprinkler system to apply water at the rate of 1.5 cm/h. Two sprinkler lines 200 m long each with 18 sprinklers are spaced at 11 m intervals on each line. The sprinkler lines are spaced at 16 m intervals.

GROUP—B

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Candidates to attempt **05 (five)** questions within word limit of **300**.

Each question carries **20** marks.

- 13.** What is gully erosion? Discuss the stages and classification of gullies. Enumerate the conditions under which permanent gully control structures are recommended.
- 14.** Write a short note on the land capacity classification of Indian soils. Explain the conceptual framework of the SCS-CN method.
- 15.** Describe the four phases of surface irrigation process with the help of a line diagram. Define and show the infiltration opportunity time in the diagram. Why is infiltration opportunity time important? In an 80 m long and 5 m wide border, a stream of 8 lps was delivered from the upper end to irrigate a wheat crop. The stream was cut off as soon as it reached the lower end of the border in 70 min. Layer-wise soil moisture contents before irrigation and at field capacity are given below. Determine the application efficiency, if the root zone depth is 90 cm and apparent specific gravity of soil is 1.4.

Depth, cm	Moisture content (%)	
	Before irrigation	At field capacity
0 – 30	8.7	15.4
30 – 60	11.8	15.8
60 – 90	14.6	16.2

- 16.** What are the components of a catchment area treatment plan? Three wells, each having a diameter of 10 cm, are installed at the vertices of an equilateral triangle 10 m apart, in a confined aquifer 15 m thick. The radius of influence of each well is 500 m and K is 20 m/day. The drawdown is 2 m. Find the percentage decrease in the discharge of each well due to well interference.

17. What do you understand by leaching requirement? Derive an expression for it. Estimate the leaching requirement when Electrical Conductivity (EC) value of the saturation extract of soil is 10 mmho/cm at 25% reduction in the yield of a crop. The EC of irrigation water is 1.2 mmho/cm. What is the depth of water required to be applied to the field, if the consumptive use requirement of the crop is 80 mm? EC value of the leached water may be assumed to be twice the same of saturated soil extract.

18. Define farm pond and mention its purposes. Explain the process to calculate the capacity of a farm pond using contours. A hill slope having 15% slope is to be provided with bench terraces. The vertical interval of the terraces should be 1.5 m. Determine the length of the terrace and the earthwork per ha. What will be the area lost, if the batter slope given is 1 : 1?

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