

AGRICULTURAL ENGINEERING

PAPER—I

Time Allowed : Three Hours

Maximum Marks : 200

**QUESTION PAPER SPECIFIC INSTRUCTIONS**

**Please read each of the following instructions carefully  
before attempting questions**

There are EIGHT questions in all, out of which FIVE are to be attempted.

Question Nos. 1 and 5 are compulsory. Out of the remaining SIX questions, THREE are to be attempted selecting at least ONE question from each of the two Sections A and B.

The number of marks carried by a question/part is indicated against it.

Unless otherwise mentioned, symbols and notations have their usual standard meanings.

Assume suitable data, if necessary and indicate the same clearly.

Neat sketches may be drawn, wherever required.

Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in the Question-cum-Answer Booklet must be clearly struck off.

Answers must be written in ENGLISH only.

## SECTION—A

1. Answer the following :

8×5=40

- (a) Name different soil conservation regions of India with salient soil conservation problems in these regions.
- (b) Explain different types of engineering measures of soil erosion control. Mention the design criteria of contour bund.
- (c) Explain briefly the application of remote sensing in water resources studies.
- (d) Explain the stability analysis of retention walls and dams.
- (e) Design a parabolic shaped waterway to carry a flow of  $3 \text{ m}^3 / \text{sec}$  down a slope of 4 percent. An excellent stand of dub grass is to be maintained in the waterway. Assume the necessary data required for calculation and draw a parabolic cross-section. The maximum flow velocity allowed is  $2.5 \text{ m/sec}$ .
2. (a) What is universal soil loss equation? Explain in detail various parameters involved in the computation of soil loss using this equation. 10
- (b) Explain the measures for controlling gully formation. 10
- (c) Explain the types of computer-assisted operations in digital image interpretation and analysis. 10
- (d) Calculate the height of contour bund to be constructed on a land slope of 5 percent. Assume the following :  
(i) Rainfall excess for 24 hours duration is 80 cm  
(ii) 15 m is horizontal interval  
(iii) Depth of water flow over the weir is 30 cm 10
3. (a) Write about design factors and layout to install shelter belt against wind erosion. 10
- (b) Explain different methods for measurement of soil losses from agricultural watersheds (use diagrams wherever required). 10
- (c) Explain different types of spillways used in gully control. Compare the structural and design features of these spillways. 10
- (d) Calculate the volume of excavation required to construct a dugout farm pond, if—  
(i) average depth of the pond is 5.0 m;  
(ii) bottom width is 15.0 m;  
(iii) side slope to be used is 2:1;  
(iv) bottom length is 25.0 m. 10

4. (a) Write about the methods used for computation of earthwork. Also, write in brief about different machineries/equipments used for land grading. 10
- (b) Write short notes on :
- (i) Grassed waterway
  - (ii) Nalla bunding
  - (iii) Movement of soil particles in wind erosion
  - (iv) Vegetative measures for soil erosion control
  - (v) Rational method for estimating runoff 10
- (c) Construct a hyetograph from the rainfall data provided in the table :

Time (h)	Time interval (min)	Rainfall depth received in time interval (mm)
Rain started at 12 : 36 p.m.		
12 : 43 p.m.	7	1.0
12 : 52 p.m.	9	1.2
1 : 02 p.m.	10	1.5
1 : 05 p.m.	3	1.5
1 : 19 p.m.	14	6.5
1 : 26 p.m.	7	4.6
1 : 37 p.m.	11	2.6
1 : 49 p.m.	12	1.8
2 : 03 p.m.	14	1.2
Rain stopped at 2 : 03 p.m.		

10

- (d) Compute the peak runoff rate of 15 years return period from a watershed area of 150 ha to design the field diversion. The sub-watersheds of 50 ha, 75 ha and 25 ha are kept under cultivation ( $c = 0.5$ ), forest cover ( $c = 0.3$ ) and grassland ( $c = 0.3$ ), respectively. The other details are as follows :
- (i) The maximum length of watercourse = 2500 m
  - (ii) Relief = 50 m
  - (iii) Slope of watershed = 2.5%
  - (iv) Watershed soil is clay; values of  $a$ ,  $b$ ,  $k$  and  $n$  are 0.1483, 0.50, 7.176 and 0.9459, respectively 10

## SECTION—B

5. Answer the following :

8×5=40

- (a) Explain the components of canal network in a large irrigation project using diagram.
- (b) Write short notes on (with sketches/diagrams, wherever required) :
- (i) Cavity tube wells
  - (ii) Dug-cum-bore wells
  - (iii) Driven wells
  - (iv) Filter points
- (c) What are the causes of waterlogging and soil salinity in an irrigated agriculture/agricultural field?
- (d) For a particular soil, moisture at field capacity is 29% (w/w) and irrigation is to be applied at a moisture content of 19% (w/w). The apparent specific gravity is 1.30 and depth of the soil to be wetted is 1 m. Determine—
- (i) hectare-cm of water per hectare of land;
  - (ii) time required to irrigate 10 hectares of land with a  $0.10 \text{ m}^3 / \text{sec}$  stream, if the efficiency of irrigation application is 75%.
- (e) A cylindrical silo of 2.5 m diameter and 20 m in height is filled with wheat. Calculate the load on the bottom only. The silo is made of steel with smooth walls. The characteristics of stored wheat are as follows :
- (i) The minimum bulk density =  $720 \text{ kg/m}^3$
  - (ii) The maximum bulk density =  $830 \text{ kg/m}^3$
  - (iii) The minimum angle of internal friction =  $25^\circ$
  - (iv) The maximum angle of internal friction =  $30^\circ$
  - (v) The minimum angle of friction on smooth sheeting =  $18^\circ$

6. (a) Explain in detail the direct and indirect methods of soil moisture measurement/determination. 10
- (b) Write in brief about different types of centrifugal pumps based on various criteria. 10
- (c) Explain irrigation efficiency and also explain its different types along with formulas to compute them. 10

- (d) Calculate the cost of fencing a square farm of 25 ha fenced by barbed wire using cement concrete posts. Take the following values :
- (i) Posts : ₹ 335 per post of cement
  - (ii) Corner posts : ₹ 500 per post
  - (iii) Cost of barbed wire is ₹ 1,000 per 100 m
  - (iv) Cost of earthwork @ ₹ 50 per pit
  - (v) Cost of cement concrete @ ₹ 100 per pit
  - (vi) Labour charges for fixing wire are ₹ 3,000
  - (vii) Cost of gate is ₹ 15,000

Assume the 1.80 m high angle iron posts spaced 3 m apart with 6 lines of barbed wires are used. 10

7. (a) What is curve number method? Write the steps involved in the curve number method. 10
- (b) Give the details of different greenhouse construction materials and covering materials. 10
- (c) The following data were obtained in determining the soil moisture content at successive depths in the root zone prior to applying irrigation water :

<i>Depth of sampling (cm)</i>	<i>Wt. of moist soil sample (gm)</i>	<i>Oven dry wt. of soil sample (gm)</i>
0-25	134.60	126.82
25-50	136.28	127.95
50-75	122.95	115.32
75-100	110.92	102.64

The bulk density of the soil in the root zone was 1.50 gm/cc. The available moisture-holding capacity of the soil was 17.8 cm/m depth. Determine—

- (i) moisture content at different depths in the root zone;
  - (ii) moisture content in the root zone at the time of irrigation;
  - (iii) net depth of water to be applied to bring the moisture content to field capacity;
  - (iv) gross irrigation requirement at an estimated field irrigation efficiency of 70%. 10
- (d) Write on the following :
- (i) Vertical drainage
  - (ii) Hydroponic system for growing plant
  - (iii) Layout of tile drainage system
  - (iv) Different types of dairy barn in brief
  - (v) Well development 10

8. (a) Briefly explain various irrigation water measurement devices that can be installed in an irrigation channel. Use appropriate diagrams, wherever necessary. 10
- (b) What are the steps involved in the design of sprinkler irrigation system? Provide the formula, wherever required. 10
- (c) Explain different filtration systems used in drip irrigation. 10
- (d) A pump lifts 95000 litres of water per hour against a total head of 20 m. Compute the water hp. If the pump has an efficiency of 75%, what size of prime mover is required to operate the pump? If a direct drive electric motor having an efficiency of 85% is used to operate the pump, compute the cost of electrical energy in a month of 30 days. The pump is operated for 12 hours per day for 30 days. The cost of electrical energy is ₹ 5 per unit. 10

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