I.F.S. EXAM-2015

C-GEQ-O-BHFA

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.

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.

All questions carry equal marks. The number of marks carried by a question/part is indicated against it.

Answers must be written in ENGLISH only.

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.

SECTION—A

1. Answer the following :   8×5=40

   (a) Explain the rational formula for estimation of peak rate of runoff. Also write the assumptions and limitations of this formula.

   (b) Discuss the frequency factor method of frequency analysis and its use in soil and water conservation engineering.

   (c) Write the major objectives of watershed management programmes. Write the mathematical expressions for calculating form factor, elongation ratio, drainage density and circulatory ratio for a watershed.

   (d) What do you understand by gully erosion and how is it different from channel erosion? Also write the stages of gully development.

   (e) Find the distance of full protection due to a windbreak of height 12 m when the wind is blowing at an angle of 15 degree from windbreak. If the direction of wind changes 110 degree from the windbreak, determine the percentage change occurs in the distance of full protection. The minimum and actual wind velocities at 15 m height are 9 m/s and 18 m/s respectively.

2. (a) The soil erosion will be different for two storms having different rainfall intensities even if the total amount of rainfall is equal. Comment on the statement. Assume suitable data for the two storms, if necessary.   10

   (b) What is a waste weir in a contour bund design? Explain. Why do we need them? Where these should be located? Describe the clear overfall waste weir with diagram.   10

   (c) Describe the classification of bench terraces briefly with neat sketches. Derive an expression for the vertical drop D between two consecutive bench terraces, if the width of bench terrace is W, slope given for vertical face is 1 : 1 and land slope is S in %.   10

   (d) The ordinates of a 4-h unit hydrograph are given below. Derive the ordinates of a 12-h unit hydrograph for the same watershed using S-curve method :   10

Time (in h)	0	4	8	12	16	20	24	28	32	36	40	44
Ordinate of 4-h unit hydrograph (in m^3/s)	0	20	80	130	150	130	90	52	27	15	5	0

3. (a) Soil loss from a small experimental forest watershed is to be determined. It was decided to install multislot divisors. Describe the working of multislot divisors. How will you design it for this watershed?   10

   (b) Strip cropping is one of the important agronomic practices employed to control soil erosion. Explain different types of strip cropping. How is strip cropping laid out in the field? Describe.   10

(c) How will you check stability of permanent soil conservation structures against the following causes of failures? 10
    (i) Sliding
    (ii) Shear friction
    (iii) Overturning
    (iv) Tensile stresses

(d) Discuss photointerpretation. How does it differ from remote sensing? Discuss briefly the factors that aid in photointerpretation. 10

4. (a) What is water harvesting? Discuss the common techniques adopted for water harvesting. Write the limitations of water harvesting systems. 10

(b) What is rating curve? Explain different methods for extension of rating curves. Also write the merits and demerits of the methods. 10

(c) Discuss the characteristics and aids with regards to identifications of features in remote sensing images. 10

(d) Calculate the design dimensions of a contour bund in a medium deep soil having an average slope of 4%. The maximum expected rainfall during a 10-year recurrence interval is 20 cm. Infiltration capacity of the soil in the area is such that 20% of the rain infiltrates into the soil. The horizontal interval between bunds is 50 m. Assume the slope of seepage line to be 4 : 1. 10

SECTION—B

5. Answer the following : 8×5=40

(a) What is leaching requirement? Discuss how it is determined.

(b) Write short notes with sketches on the following drainage systems :
    (i) Herring-bone type
    (ii) Grid-iron type
    (iii) Random type
    (iv) Interceptor type

(c) A well penetrating aquifer which is underlain and overlain by impermeable layers was tested with a uniform discharge of 1000 litres/minute. The steady-state drawdowns measured in two observation wells which were at 1 m and 10 m radial distances from the centre of pumped well were 13·4 m and 4·2 m respectively. Determine the hydraulic properties of the aquifer, if its saturated thickness is 10 m.

(d) A wheat crop is to be irrigated using the check basin method. The size of each basin is 10 m × 8 m. The size of the available irrigation stream is 18 litres per second. The water-holding capacity of the root zone soil is 16%. The apparent specific gravity of the soil is 1·58. The soil moisture content before irrigation is 8·5%. Determine the irrigation duration, if the water application efficiency is 96%. The depth of root zone is 80 cm.

(e) What are the requirements of good storage structures on the farms? Describe it.

6. (a) Discuss the standard conditions that must be observed for installing a weir. Also write the limitations in the use of weirs. 10

   (b) Explain in brief the double-cylinder infiltrometer method for measuring infiltration. 10

   (c) What is farmstead? What factors govern the location of the farmstead on the farm? Discuss. 10

   (d) A stream of 150 litres/second was diverted from a canal and 6000 litres/minute was delivered to the field. An area of 2 ha was irrigated in 8 hours. The root zone depth of crop was 1·8 m. The loss of water from the field was 40 litres/second for 3 hours. The depth of water penetration varies linearly from 1·7 m at the head end of the field to 1·3 m at the tail end of the field. Determine the water conveyance, water application and water distribution efficiency. 10

7. (a) Describe the reasons for the following troubles of centrifugal pumps : 10
   (i) Pump fails to prime
   (ii) Pump fails to develop sufficient pressure on capacity

   (b) Determine the annual consumption of electrical energy by a motor-driven centrifugal pump installed in a shallow tube well. The pump discharge is 16 litres/second against a total head of 7 m. The pump efficiency is 70% and the motor efficiency is 84%. The drive efficiency may be assumed to be 100%. The pump is operated for 3500 hours per year. 10

   (c) Explain the design procedure of a drip irrigation system. 10

   (d) Determine the required capacity of a sprinkler system to apply water at the rate of 1·25 cm/h. Two 180 m long sprinkler lines are required. Sixteen sprinklers are spaced at 12 m intervals on each line. The spacing between the lines is 18 m. Allowing 1 hour for moving each 180 m sprinkler line, how many hours would be required to apply a 5 cm irrigation to a square 16 ha field? How many days are required, assuming 10-hour days? 10

8. (a) How can you distinguish between sand with or without organic matter? Explain. 10

   (b) Describe single auger hole method for measuring hydraulic conductivity. 10

   (c) Compare the stall barn and loose housing barn with respect to floor area, cost of construction, sanitary quality of milk, labour requirement and display of herd. 10

(d) The following data were obtained in determining the soil moisture content at successive depth in the root zone prior to applying irrigation water :

Depth of sampling (in cm)	Weight of moist soil sample (in g)	Oven-dry weight of soil sample (in g)
0–25	135	127
25–50	137	128
50–75	123	115
75–100	111	102

The bulk density of the soil in the root zone was 1·5 g/cm^3. The available holding capacity of soil was 17·8 cm/m depth. Determine the—

(i) moisture content at the 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 moisture content to field capacity ;

(iv) gross irrigation requirement at estimated field irrigation efficiency of 70%.   10

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