0465

IFoS 2010

B-JGT-K-BFA

AGRICULTURAL ENGINEERING

Paper I

Time Allowed : Three Hours | *Maximum Marks : 200*

INSTRUCTIONS

Candidates should attempt questions 1 and 5 which are compulsory, and any THREE of the remaining questions, selecting at least ONE question from each Section.

All questions carry equal marks.

Marks allotted to parts of a question are indicated against each.

Answers must be written in ENGLISH only.

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

Neat sketches may be drawn, wherever required.

SECTION A

1. Answer any ***four*** of the following :

(a) Define point rainfall and normal rainfall. A catchment has five rain gauge stations I, II, III, IV and V. The depth of annual normal rainfall recorded in these stations is 75·0, 68·0, 73·0, 79·5 and 85·0 cm respectively. In a year the rain gauges at station V went out of order and the rainfall recorded in the other four stations was 87·5, 77·2, 85·5 and 94·5 cm at I, II, III and IV respectively. What was the rainfall at station V in that year ? *10*

(b) Define the runoff. Discuss the Rational method for estimating the peak runoff rate in a watershed. What is the assumption and weakness of the Rational formula ? *10*

(c) What is sheet erosion ? How does it differ from rill erosion ? Differentiate the soil particles movement by surface creep and saltation. *10*

(d) In a pond the following elevations of contour lines and the areas within the contour lines were found :

Elevation of contour lines (m)	Area within the contour lines (ha)
75	0·05
77	0·23
79	0·55
81	0·85
83	1·30

Calculate the storage capacity of this pond. *10*

(e) Discuss the strip cropping and stubble mulches of crop residues as the measures for controlling wind erosion. *10*

2. (a) A variable grade graded bund of 300 m is to be constructed in a cultivated land of 4% surface slope: The bund channel is to be created by the embankment only and the horizontal distance between these two bunds is 50 m. Estimate the time of concentration and the total drop in head in designing this graded bund. Assume channel grade to be 0·1%, 0·12%, 0·13% and 0·15% for each $1/4^{th}$ length from upper section onwards. Show the sketch of the bund. *20*

(b) Using neat sketches, compare simple and diaphragm type of embankments. *10*

(c) With a neat sketch, describe the constructional details of a brush dam. *10*

3. (a) Design a parabolic shape grassed waterway with the following : *20*

Expected runoff = 2·2 m^3/s

Slope of the channel = 3·5%

Maximum permissible velocity = 2·0 m/s

Manning's n = 0·04

(b) Discuss the importance of people's participation in watershed development. *10*

(c) Give the sketch of a straight drop spillway and label it. In which situation is this suggested ? *10*

4. (a) Design a contour bund with the following : *20*

Land slope = 3%

Rainfall abstraction = 25%

The maximum rainfall expected in 10-year recurrence interval = 10 cm

Horizontal spacing between the bund = 50 m

Side slope of the bund = 1·5 : 1

Seepage line in bund soil = 5 : 1

(b) A bund is to be constructed of top width 2·0 m and side slope 1·5 : 1 by the soils of excavated channel 3·0 m deep, 2·0 m bottom width and 1 : 1 side slope. The channel and bund is constructed side-by-side of equal length. What is the height and bottom width of the bund ? *10*

(c) Write short notes on : *10*

(i) LANDSAT

(ii) Digital processing of remotely sensed data

SECTION B

5. Answer any ***four*** of the following :

(a) Define irrigation and irrigation channel. With the diagram differentiate irrigation and drainage channel. *10*

(b) Prove that for most economic trapezoidal channel section, half of the top width is equal to the length of the side. *10*

(c) Prove that the critical specific energy, $E_c = \frac{3}{2} y_c$ in a rectangular channel. *10*

(d) Describe the flow measurement in a channel with the help of Current meter method. *10*

(e) What do we mean by lining irrigation channel ? What are the advantages and disadvantages of it ? *10*

6. (a) Compute the most efficient bottom width of an open channel to carry a flow 2·2 m deep in silty loam soil. What is the discharge of channel if hydraulic gradient (slope) is 0·05% ? Assume Manning's n as 0·04. Assume any reasonable data, if necessary. *20*

(b) Irrigation was given to bring the soil in field capacity. Determine the field capacity of the soil from the following data :
Root zone depth = 1·5 m
Moisture content in the soil = 7·5%
Dry density of the soil = 1·5 g/cc
Water applied to soil = 50 m^3
Water lost due to evaporation, etc. = 15%
Area of plot = 100 m^2 *10*

(c) Discuss the infiltration opportunity time, advance and recession of flow related to border irrigation. *10*

7. (a) A stream of 150 lit/sec was diverted from a canal and 120 lit/sec was delivered to a wheat field of 1·75 ha. The irrigation continued for 7·5 hours. The effective root zone depth was 1·8 m. The run-off loss in the field was 450 m^3. The depth of water penetrated linearly from 1·8 m at the head end to 1·2 m at the tail end. The moisture holding capacity of the soil is 25 cm/m depth of soil. Irrigation was given at 50% depletion of available soil moisture. Determine the (i) water conveyance efficiency, (ii) water application efficiency, (iii) water storage efficiency, and (iv) water distribution efficiency. *20*

(b) Define water well. Derive an expression for discharge from a well completely penetrating in horizontal aquifer. *10*

(c) What are the sources of drainage problems ? What are the ill-effects of drainage ? *10*

8. (a) Design a most efficient trapezoidal drainage channel for an area of 10 km^2 assuming Manning's roughness coefficient 0·04, maximum permissible velocity 1·4 m/s and side slope 1 : 1. The rate of water removal is calculated by $Q = 2{\cdot}5\ A^{0{\cdot}6}$ (Q in cumec and A in km^2). *20*

(b) Determine the outflow from 250 m lengths of tiles spaced 15 m apart laid at a depth of 2 m above the impermeable layer if the water table is maintained at a height of 5 m from the impervious layer. Assume soil hydraulic conductivity as 20 cm/h. *10*

(c) Describe the plan of a cattle shed. *10*