

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 $1/4^{\text{th}}$ 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 = $2.2 \text{ m}^3/\text{s}$
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 m³

Water lost due to evaporation, etc. = 15%

Area of plot = 100 m²

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 m³. 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 $Q = 2.5 A^{0.6}$ (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

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AGRICULTURAL ENGINEERING

Paper—II

Time Allowed : Three Hours

Maximum Marks : 200

INSTRUCTIONS

Candidates should attempt Question Nos. 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 each part of a question is indicated against each.

Answers must be written in English only.

Assume suitable data if considered necessary and indicate the same clearly in your answer.

Unless indicated otherwise, symbols, notations and abbreviations have their usual meanings.

SECTION—A

1. Answer any **FOUR** of the following (not exceeding 150 words each) :

(a) Differentiate between the following :

(i) Raspbar cylinder and spike tooth cylinder.

- (ii) Hollow cone nozzle and Solid cone nozzle.
- (iii) Tilt angle and Disc angle.
- (iv) Helical gear and Herringbone gear.
- (v) Coefficient of friction and Coefficient of traction. 10

(b) Differentiate between the following :—

- (i) Active Solar heating and Passive Solar heating.
- (ii) Solar altitude and Solar azimuth.
- (iii) Thermochemical conversion and Biochemical conversion.
- (iv) Total solids and Volatile solids.
- (v) Floating drum and Fixed dome type biogas plants. 10

(c) Discuss the effects of following in brief :—

- (i) Higher crop moisture content on cylinder loss from power thresher.
- (ii) Tandem wheel arrangement of drive wheels of a tractor on tractive ability. 10

(d) What are the differences between :—

- (i) A root plough and a grubber ?
- (ii) A carryall scraper and a buckscraper ? 10

(e) List the major differences between :—

- (i) Circular saw and Chain saw.
- (ii) A blade terracer and a land plane. 10

2. (a) Write in brief :—
- (i) Will there be any side draft occurring during operation of a tandem disc harrow ? If yes, specify reasons.
 - (ii) Why is the centre of resistance not a fixed point on a mould board plough ? 10
- (b) Define the following terms :—
- (i) DBHP
 - (ii) BMEP
 - (iii) Centre of pull
 - (iv) Virtual hitch point
 - (v) Engine displacement volume. 10
- (c) Draw neat figures showing arrangement of discs in a single action, tandem and offset disc harrows. Describe how the depth of penetration is controlled in these harrows. 10
- (d) Draw neat figures showing different spray patterns obtained using nozzles in agricultural sprayers. Discuss in brief about use of these patterns for application of pesticides. 10
3. (a) Describe in brief :—
- (i) Use of a breather in a tractor engine.
 - (ii) Use of a camshaft in valve system of a tractor engine. 10

- (b) A tractor with a total weight of 28.5 kN has a front wheel reaction of 9.0 kN when it is placed on a horizontal surface. The wheel base is 2083 mm. The tractor is pulling a drawbar load of 12 kN. The pull is parallel to the ground and the drawbar height is 580 mm. Calculate the weight transfer. Also discuss the effect of weight transfer on front and rear wheel reactions. 10
- (c) A petrol engine working on Otto cycle has a clearance volume of 20% of the stroke volume. The engine consumes 8.17 litres of petrol per hour when developing 32 IHP. The specific gravity of petrol is 0.76 and its calorific value is 10,500 kCal/kg. Determine indicated thermal efficiency of the engine taking $K = 1.4$ for air. 10
- (d) Draw a neat sketch showing details of sliding mesh type gear box having four forward and one reverse speed and explain its working. 10
4. (a) Draw a neat figure showing components of a Deenbandhu type biogas plant. How will you decide its major dimensions if it is to be used to provide biogas to a 5 hp dual-fuel CI engine to be used for five hours daily ? 10
- (b) Write short notes on :—
- (i) Absorber plates for air collectors.
- (ii) Flow paths in liquid type collector arrays. 10

- (c) What are the different unit operations performed in raising potato crop in a totally mechanized farm ? How will you estimate energy requirement in harvesting of potato in such a farm ? 10
- (d) Draw a neat figure showing a savonious rotor and arrieus rotor type wind mills. Discuss their merits and demerits. 10

SECTION—B

5. Answer any **FOUR** of the following in not more than **150** words each :—
- (a) Differentiate between the following :— 10
- (i) Equilibrium moisture content and Equilibrium relative humidity.
 - (ii) Capacitance and Thermal capacity.
- (b) Differentiate between the following :— 10
- (i) Linear transducer and Non-linear transducer.
 - (ii) Deflection mode and Null mode.
- (c) Differentiate between a parallel port and USB port and discuss their uses in a PC. 10
- (d) Differentiate between :— 10
- (i) A burr mill and a hammer mill.
 - (ii) A disc type huller and a roller type huller.
- (e) Write the equations for determining capacity of a belt conveyor, a chain conveyor and a screw conveyor and describe the symbols used. 10

6. (a) Define the following terms :—
- (i) Sensitivity
 - (ii) Hysteresis
 - (iii) Span
 - (iv) Calibration
 - (v) Linearity. 10
- (b) Draw a process flow diagram showing the different operations performed in a modern seed processing plant indicating the equipment needed and their selection criteria. 10
- (c) Draw a neat sketch of a hydraulic brake dynamometer and describe its working. 10
- (d) Draw a neat figure showing a Wheatstone bridge and discuss deflection method and null method of application in the bridge. 10
7. (a) Draw neat figure showing details of mounting of strain gauges for the measurement of tensile, compressive and shear loads. Also discuss selection of gauges for above applications. 10
- (b) Discuss the different types of automatic recording mechanisms used in measuring instruments. 10
- (c) Briefly discuss the utilisation of sugarcane bagasse in different forms in modern agro-based industries. 10

(d) List the different components of a seed cleaning machine and discuss the factors affecting performance of a seed cleaner. 10

8. (a) Write short notes on :—

(i) HTST pasteurizer.

(ii) Vacuum type milk bottle filler. 10

(b) Draw a neat schematic diagram indicating various steps in a modern rice mill for production of parboiled rice and discuss the factors affecting a rice mill capacity. 10

(c) Discuss in brief working of an LSU drier. 10

(d) Draw neat sketch of a cyclone separator and discuss its working principle. 10