

457

1. F. S. - 2009

B-JGT-J-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.

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, not exceeding 150 words for each :
  - (a) What is the importance of measurement of soil losses from area under controlled conditions ? List the devices that can be used for measuring runoff and sediment outflow from runoff plots. 10
  - (b) Define Universal Soil Loss Equation and discuss in brief its applications. 10

- (c) Discuss biological measures suitable for soil erosion control. 10
- (d) What is a diversion drain ? How are diversion drains designed ? 10
- (e) Compute the value of earthwork made and percentage area lost during the construction of bund on 40 ha land, which has slope of 3.2%. The details of bund are below : 10
- Vertical Interval (VI) = 2.0 m
  - Base width = 3.0 m
  - Top width = 0.75 m
  - Height of bund = 1.5 m
2. (a) Compare Broad based Terraces and Narrow based Bunds in their functioning, construction and maintenance. 10
- (b) List different methods available for Gully Control. Describe them in brief. 10
- (c) Discuss in brief the utility of Farm Ponds. List different types of Farm Ponds depending upon the source of water and their location with respect to land surface. 10
- (d) Calculate the spacing and the number of spurs to control a stream bank of 240 m length both sides, if the length of spur is 9 m and angle of projection is  $30^\circ$  from the top. 10

3. (a) Discuss in brief the following terms : 8
- (i) Mean Annual Rainfall
  - (ii) Rainfall Intensity
  - (iii) Frequency of Rainfall
  - (iv) Relationship between Intensity and Duration of Rainfall
- (b) Describe briefly the Rational Formula for estimating peak runoff rate from a watershed. 12
- (c) For calculation of earthwork in land grading, discuss the Four Point Method for determining the volume of cut-fill. What are the recommended cut-fill ratios for fine textured, coarse textured and organic soils ? 10
- (d) Differentiate among hydrologic, hydraulic, and structural designs used in the design of a structure. Discuss the check(s) against sliding in structural design. 10
4. (a) Differentiate between spectral band and revisit cycle. 5
- (b) Write short notes on :  $2 \frac{1}{2} \times 4 = 10$
- (i) Unsupervised and Supervised classifications
  - (ii) NDYI
  - (iii) NDVI
  - (iv) Electromagnetic spectrum
- (c) Describe briefly three segments of a Satellite system. 6

(d) Discuss in brief the following methods for determining the capacity of Farm Pond : 10

(i) Trapezoidal rule

(ii) Simpson rule

(e) What is a grassed waterway and how is it designed ? 9

## SECTION B

5. Answer any *four* of the following, not exceeding 150 words for each :

- (a) An irrigation stream of 24 litres per second is diverted to a check basin of size 10 m × 8 m. The water holding capacity of the soil is 13%. The average soil moisture content in the crop root zone prior to applying water is 6%. How long should the irrigation stream be applied to the basin to replenish the root zone moisture to its field capacity, assuming no loss due to percolation? The average depth of crop root zone is 1.2 m. The apparent specific gravity of the root zone soil may be assumed to be an appropriate value. 10
- (b) What are the hydraulics of wells? List important properties of the aquifer material that influence the water holding and water transmitting characteristics of the aquifer. 10
- (c) Describe in brief Warabandi system of water allocation in canal irrigation. 10
- (d) Define Most Economical Channel Section. Derive an equation for the most economical channel section for a rectangular cross section having bottom width 'b', and depth 'd'. 10
- (e) Differentiate between Mole drain and Tile drain. Briefly describe layout of different types of tile drain system. 10

6. (a) Differentiate the following :

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- (i) Specific yield and Specific storage
- (ii) Permeability and Transmissibility
- (iii) Unsteady flow and Steady flow
- (iv) Uniform flow and Non-uniform flow

(b) An engine driven pump is installed in an open well. The discharge obtained from the pump was 10 litres per second. The static water level was 15 m and the pumping water level was 18 m from the ground level. The total losses due to friction in pipes and accessories may be assumed to be 15 percent of the total static water head. What should be the horse power required for lifting the water ? If the pump efficiency is 60 percent and drive efficiency is 80 percent, calculate the BHP of the engine required to drive the pump.

12

(c) Differentiate between the following with the help of neat sketches :

(i) Direct and Reverse circulation hydraulic rotary.

(ii) Volute and Diffuser types of pump.  $2 \times 5 = 10$

(d) Discuss in brief the Orifice and Parshall Flume devices used for measuring irrigation water. What are their relative merits and demerits ?

10

7. (a) List sequencewise the important components of sprinkler system installed on the farm for irrigating the crop. Give a relation to determine the capacity of the sprinkler system. 12
- (b) Differentiate the following : 8
- (i) Water application efficiency and Water storage efficiency.
- (ii) Crop water use efficiency and Field water use efficiency.
- (c) Define sub-surface drainage. List benefits of sub-surface drainage. Discuss in brief sub-surface drainage methods. 10
- (d) What is the difference between Observation well and Piezometer ? Discuss in brief their practical utility. 10
8. (a) Define Fencing. List different types of fencing. What type of fencing should be used for 10
- (i) Experimental research farm
- (ii) Poultry yard
- (iii) Farm boundary
- (iv) Pasture land
- (v) Implement shed

- (b) Determine the size of an overhead tank for a farmstead demanding a maximum of about 50,000 litres of water per hour for two hours during noon and 30,000 litres of water per hour during the rest of the period. The tubewell is capable of supplying water at the rate of 10 litres per second. 10
- (c) Describe in brief Green House, Poly House and Shade House from construction point of view. How can the use of drip irrigation in poly houses be beneficial in raising vegetable crops? 10
- (d) Sand used in construction should be free from organic matter and clay. Discuss the tests which can be performed quickly to find these impurities. 10

**AGRICULTURAL ENGINEERING****Paper—II**

Time Allowed : Three Hours

Maximum Marks : 200

**INSTRUCTIONS**

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

The number of marks carried by each question is indicated at the end of the question.

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* questions (not exceeding 150 words each) : 10×4=40

- (a) What are the social considerations in agricultural mechanization?
- (b) With the help of a neat diagram, describe the operation of a solar photovoltaic water-pumping system in detail.

- (c) Discuss the common troubles and their remedies in electrical motors used in agricultural application.
- (d) A 5 m grain combine is operating at a forward speed of 4 km/h. The average width of cut is 4.6 m. The time required for emptying the grain tank averaged 8.5 min/ha. Turning, adjusting and other miscellaneous amounted to 12% of the effective operating time. Calculate (i) theoretical field capacity, (ii) effective field capacity and (iii) field efficiency.
- (e) In a mango orchard, the trees are planted at 10 m × 10 m spacing. An insecticide is to be applied at the rate of 100 L per tree using a blower sprayer. Each delivery nozzle is adjusted to give a discharge of 7.5 L/min at a pressure of 4 kg/cm<sup>2</sup>. Assuming the speed of travel as 1.6 km/h, calculate the number of nozzles required, if one-half is sprayed from each side.

2. (a) What are the common systems of cooling tractor engines? With the help of a diagram, explain the forced circulation liquid cooling method in a farm tractor used in the forest. 10
- (b) Explain the working of a hydraulic dynamometer used for measuring work and power of an engine. 10

- (c) Calculate the BHP of a 4-stroke cycle, 4-cylinder internal combustion engine of the following descriptions : 10

Diameter of the cylinder : 125 mm

Length of stroke : 150 mm

Speed of crankshaft : 1000 r.p.m.

Mean effective pressure : 7 kg/cm<sup>2</sup>

Frictional HP : 30

- (d) A seed drill is working at a speed of 2.5 km/h. It has ten (10) outlets for dropping seeds. Furrow openers are 18 cm apart from one another. The working efficiency of the machine is 70%. Calculate the time required to sow 5 hectare of land with this seed drill. 10

3. (a) Draw a valve timing diagram of a four-stroke IC engine. Explain its importance in smooth operation of IC engines. 10

- (b) Calculate the cost of threshing of wheat per quintal grain using a 5 h.p. electric motor-operated wheat thresher. The machine is used for different operating hours in a year. Take, cost of the thresher with motor = Rs 25,000, life of the machine = 10 years, annual use = 50 hours, interest rate = 13% per year, electric charge = Rs 6 per unit, labour wages = Rs 15 per hour, output of the thresher = 2 q/h. Assume any other data necessary, but state them clearly. 10

(c) Describe the power transmission system of a tractor with the help of a line diagram. 10

(d) Compute the cost of forage cutting in Rs per kg of power-operated chaff cutter installed in a forest with the following specifications : 10

Initial cost of chaff cutter : Rs 25,000

Interest rate : 18%

Life of the machine : 10 years

Capacity of the machine : 1000 kg/h

Working hours : 350 h/year

4. (a) Give a comparison between floating gas-holder and fixed-dome type biogas plants. Among them, which is more popular that gives trouble-free service? 10

(b) Explain the working, care and maintenance of a self-propelled vertical conveyor type rice harvester. 15

(c) A 3-bottom 60 cm trailed MB plough was operated at a speed of 5 km/h. If the depth of cut and total draft were observed as 25 cm and 3500 kg respectively, then compute the following : 15

(i) Unit draft in  $\text{kg/cm}^2$

(ii) Drawbar horsepower required to operate the plough

(iii) Rate of coverage in hectares per hour, assuming field performance index as 80 percent

### Section—B

5. Write short notes, not exceeding 150 words each, on any four of the following :  $10 \times 4 = 40$

(a) Vapour compression refrigeration system

(b) Kick's law and Bond's law in size reduction unit operation

(c) Application of microprocessors in data acquisition in deep forests

(d) Measurement and instrumentation for pressure measurement

(e) Problems associated in the use of buffalo milk for manufacturing (i) cheese and (ii) whole and skim milk powder

6. (a) With a simplified flow diagram, show the refining process of crude rice bran oil to obtain high-grade edible oil (salad oil).

15

(b) Differentiate the working and function between freeze drying and fluidized-bed drying.

10

(c) Apple juice containing 10% solids ( $C_p = 3.89 \text{ kJ/kg } ^\circ\text{C}$ ) is concentrated to 45% solids ( $C_p = 2.85 \text{ kJ/kg } ^\circ\text{C}$ ) in a continuous type evaporator which allows transfer of heat at a rate of 30 kW. The feed enters the evaporator at  $60^\circ\text{C}$  and vacuum maintained inside

the evaporator allows the juice to boil at 55 °C. Find the kilogram of juice that can be concentrated per hour. Enthalpy of water vapour at 55 °C is 2604 kJ/kg. 15

7. (a) With the necessary process flow chart, explain the manufacturing process of ice cream. Also list the importance of overrun in its manufacturing. Give two fundamental methods for calculating percentage overrun. 10
- (b) Draw the thermal destruction curve, showing z-value. Briefly explain the determination of thermal process time for sterilization of canned forest foods for exports. 10
- (c) Determine the quantity of parboiled paddy with 40% moisture on wet basis required to produce one tonne of product with 12% moisture content on wet basis. Work out the problem on wet basis and check the answer using dry basis. Assume suitable data, if required. 10
- (d) The temperature of a furnace (heating) is measured by means of a platinum resistance thermometer. The resistance of the thermometer is 4.50 Ω at 0 °C, 7.00 Ω at 100 °C and 14.00 Ω at 400 °C. Find  $\alpha$  and  $\delta$  constants of the measuring instrument, and the true temperature when resistance is 10.00 Ω. Use formula  $R_t = R_0(1 + \alpha t)$  for range

0 °C–100 °C and the connection  $\Delta_t = \delta_t(t - 100 \text{ °C})$  for range above 100 °C to obtain true temperature. 10

8. (a) Power sensing by means of thermocouple is, perhaps, the best method of measuring power at microwave frequencies. With the help of a circuit diagram of a thermocouple power-sensitive element, explain in brief the working of a thermocouple power meter for measurement of power. 15
- (b) What types of materials are available for packaging food and forest materials for distribution through wholesaler and retailer to the consumer? Explain the role of quality packaging to contain, protect and sell these materials. 10
- (c) What are the considerations on which an instrumentation circuit system is selected for measurement of strain? With a suitable diagram, briefly explain the instrumentation scheme of using a Bridge circuit along with an operational amplifier for measurement of strain. 10
- (d) Comment briefly on Indexed Sequential Access Method (ISAM) of storing and retrieving of data. 5

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