

**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 2-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  $\Omega$  at 0 °C, 7.00  $\Omega$  at 100 °C and 14.00  $\Omega$  at 400 °C. Find  $\alpha$  and  $\delta$  constants of the measuring instrument, and the true temperature when resistance is 10.00  $\Omega$ . 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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