AGRICULTURAL ENGINEERING

PAPER—II

Time : 3 Hours

Full Marks : 250

The figures in the right-hand margin indicate marks.

*Candidates should attempt **any 10 (ten)** questions of* **GROUP—A** *with word limit of 250 words and should attempt **any 5 (five)** questions from* **GROUP—B** *with word limit of 300 words.*

GROUP—A

Answer *any* **ten** of the following questions in which Q. No. 1 is compulsory :

1. (a) Derive the thermal efficiency of Otto cycle.   10

    (b) State the reasons for the deviation of actual air standard cycles from the ideal ones.   5

2. (a) Describe the constructional features and working principle of valve train of an Internal Combustion (IC) engine.   7½

    (b) Draw the valve timing diagram of a Spark Ignition (SI) engine.   7½

3. (a) Graphically illustrate the tractor drawbar performance in terms of drawbar pull and fuel consumption.   10

    (b) A tractor engine rotates at 2100 r. p. m. and develops a torque of 79 Nm and it uses 1·17 kg of fuel in 15 min. Calculate the power developed, fuel consumption and specific fuel consumption of the engine.   5

4. (a) A planter has a vertical rotor metering device with no seed ejector. The unit is operated without a seed tube and the seeds are released from the periphery of the rotor at the lowest point and falling freely by gravity to the furrow bottom 90 mm below. The peripheral speed of the rotor is 20 m/min and that of the ground wheel is 5 km/h.

How far the seed moves horizontally forward or backward between the point of discharge at the rotor and the point of impact on the furrow? The direction of rotation of the rotor is opposite to that of the ground wheels. 10

(b) In the above said problem, calculate the angle of strike of the seed on the furrow from the vertical axis through the centre of the rotor. 5

5. (a) Illustrate the process of grain drying psychometrically. 5

(b) Explain the significance of Equilibrium Moisture Content (EMC) of grain. How does temperature affect the EMC-ERH relationship? 5

(c) Describe the characteristic features of Louisiana State University (LSU) dryer. 5

6. (a) Explain the major effects of biotic and abiotic factors on stored grain in a silo. 10

(b) Explain the phenomenon of moisture migration in stored grain bulk. 5

7. (a) Highlight the salient features of Plate Heat Exchangers used in dairy industry. 10

(b) Differentiate 'D' value from 'z' value in thermal processing of foods. 5

8. (a) Describe the characteristic features of a bucket elevator. 10

(b) Calculate the power required for a bucket elevator to convey 0·5 tonnes of paddy per min to a height of 11 m. Consider an allowance of 20% for frictional and transmission losses in the power train. 5

9. (a) Explain the construction and working principle of solar tunnel dryers. 10

(b) A solar tunnel dryer is to be installed for drying applications of coconut and turmeric in a farm. What are the accessories necessary (i) to make the process automatic and (ii) to continue drying in the same facility during adverse weather conditions? 5

10. (a) Explain the characteristic features of a 'Deenbandhu' biogas plant suitable for a farmer. 10

(b) What are the potential uses of biogas in a farm? 5

11. (a) Define the following instrument parameters :   5

    (i) Accuracy

    (ii) Precision

    (iii) Drift

    (b) State the principle of flow measurement using a venturi tube.   5

    (c) Compare the characteristics of Resistance Temperature Detectors (RTDs), Transistors and Thermocouples for temperature measurement.   5

12. (a) Describe the principle of operation of a single phase full wave bridge rectifier.   10

    (b) What is the significance of ripple factor in the design of bridge rectifier?   5

GROUP—B

Answer *any* **five** of the following questions in which Q. No. 13 is compulsory :

13. (a) Derive an expression for the weight transfer in a tractor pulling an attached implement.   10

    (b) A 2-wheel drive 35 HP tractor has a wheel diameter of 1·5 m. The engine runs at 1200 r. p. m. The reduction of speed from transmission to the wheel is 50 : 1. Find the travelling speed of the tractor in km/h and the tractive effort at each driving wheel.   10

14. (a) Explain the characteristic features of lubrication system of a tractor engine with a schematic diagram.   13

    (b) Explain the role of oil rings and connecting rod on the effectiveness of engine lubrication.   7

15. (a) Describe the construction of a tractor operated boom sprayer.   10

    (b) A farmer is aiming to apply an insecticide on his crop at the rate of 1·1 kg per hectare using a power sprayer. The spray solution needs to be prepared by mixing 0·9 kg of insecticide in 90 litres of water. The rated delivery from each nozzle of power sprayer was set to 0·5 litres/min at a pressure of 2·7 kg/cm^2. If the nozzles are spaced 60 cm apart, find the forward speed of travel of sprayer for a pressure setting of 2·1 kg/cm^2.   10

16. *(a)* Describe the constructional features and operational principle of rising film long tube evaporator. 10

(b) How much water should be evaporated from 1 kg of sugar solution at 30 °C to concentrate it up to a level of 50%? Calculate the specific energy required, if the efficiency of the evaporator is 85%. Use the following data :

Specific heat of sugar solution = 3·95 kJ/kg °C

Boiling point of sugar solution = 105 °C

Latent heat of vaporization of water = 2502·3 kJ/kg 10

17. *(a)* Explain the construction and working principle of hammer mill for size reduction operations. 10

(b) Grinding green gram with a hammer mill required 8·3 kWh of energy per tonne of material for reducing its size from 6·25 mm to 0·75 mm. Assuming that Bond's law holds good for the material, estimate the amount of energy required for reducing the size down to 0·1 mm. 10

18. *(a)* Write an essay on the status and scope of wind power generation in India and propose a strategy for harnessing the potential of wind energy for the country. 10

(b) Explain the characteristics of three different types of wind mill. 10

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