AGRICULTURAL ENGINEERING

Paper II

Time Allowed : Three Hours

Maximum Marks : 200

QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions.

There are **EIGHT** questions in all, out of which **FIVE** are to be attempted.

Question Nos. **1** and **5** are compulsory. Out of the remaining **SIX** questions, **THREE** are to be attempted selecting at least **ONE** question from each of the two **Sections A** and **B**.

Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in the Question-cum-Answer Booklet must be clearly struck off.

All questions carry equal marks. The number of marks carried by a question/part is indicated against it.

Answers must be written in **ENGLISH** only.

Unless otherwise mentioned, symbols and notations have their usual standard meanings.

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

Neat sketches may be drawn, wherever required.

SECTION 'A'

1.(a) Define farm mechanization index. Discuss the mechanization status of different farm operations in India. What is the power availability on Indian farms and their constituent sources compared to developed countries. **8**

1.(b) Differentiate between the following : **8**

   (i) CI and SI engine

   (ii) Octane Number and Cetane Number

   (iii) Thermal efficiency and Mechanical efficiency

   (iv) Caster angle and Camber angle in tractor

1.(c) List the factors to be considered for the design of biogas plant. Briefly discuss the components of a biogas plant with the help of neat sketch. **8**

1.(d) Total draft of a 4-bottom trailed Mould Board plough is 2000 kg when it is moving at a speed of 6 km/h. Calculate

   (i) the unit draft in kg/cm^2 if the depth of cut is 20 cm

   (ii) drawbar horse power required to operate the implement and

   (iii) field capacity. **8**

1.(e) What is secondary tillage system ? Write its objectives. Explain utility of spike tooth and spring tooth harrows. **8**

2.(a) Explain the importance of cooling system in a tractor. Describe the principle and working of a forced circulation system. Why thermostat is used ? **10**

2.(b) Explain the working principle of internal combustion engine. How it differs from external combustion engine ? **10**

2.(c) A 4-stroke engine has a mean effective pressure of 7 kg/cm^2; area of piston 730 cm^2; 45 cm stroke length; 110 kg-m torque due to brake load; 4·5 kg fuel consumption per hour and working speed 120 rpm. Calculate IHP, BHP, Mechanical efficiency and specific fuel consumption. **10**

2.(d) Calculate the compression ratio and clearance volume of an engine whose dimensions are 100 × 120 mm and the length of clearance space at top dead centre being 8 mm. **10**

3.(a) Describe in brief various energy efficient cooking stoves and alternate cooking fuels. **10**

3.(b) Describe the working of wind energy system with the help of line diagram along with main components. **10**

3.(c) Find out height and diameter of the digester of a biogas plant, whose design is to be matched with input feed from dairy of 80 cows and 40 calves. Following assumptions may be made :

Calves produce half gobar (dung) compared to cows
Average gobar (dung) available per cattle per day = 10 kg
Average biogas available per kg gobar (dung) per day = 0·03 m³
Average content of solid in gobar (dung) = 18%
Average bulk density of gobar (dung) = 1100 kg/m³
Optimum ratio of gobar (dung) : water in slurry = 1 : 1   10

3.(d) What is the function of hydraulic nozzle in plant protection equipment ? Enlist different types of hydraulic nozzles and their application.   10

4.(a) Discuss about safety and maintenance measures of electric motors to be used for agricultural operations. What types of motors are normally used in Agricultural sector ?   10

4.(b) An agricultural machine has to be operated by solar energy. What should be the area of solar panel normal to Sun's rays (assuming very sunny day) in India with following parameters ?

Energy requirement : 7·5 kW
Efficiency of solar cell : 75%
Efficiency of battery : 90%
Efficiency of electric motor : 85%

Also calculate the power availability on cloudy day (make necessary assumption if required)   10

4.(c) What is the significance of ergonomics in farm machine design ? Define human efficiency. Describe the methods to assess human energy consumption of a farm worker. What are various angles the agriculture worker has to work ?   10

4.(d) Why decibel scale is used for sound measurement ? What is the sound pressure for a 80 dB(A) sound of a tractor ? If the sound pressure is increased eight times, determine the resulting sound in dB(A). What are tractor seat vibration parameters ? Discuss in detail.   10

SECTION 'B'

5.(a) Discuss the advantages of cold storage in respect of food processing. What is cold food chain ? How it works ?   10

5.(b) What parameters are to be considered while designing a bucket elevator ? Describe briefly.   10

5.(c) With respect to sterilization of food, define thermal death time and decimal reduction time. What can be the effect if the sterilization is not done.   10

5.(d) Write basic principles involved in working of thermocouples. How law of intermediate temperature and metals is used in design of thermocouples ? Also explain the construction and advantages of thermopiles.   10

6.(a) Classify flow meters. Explain the functioning of a hot wire anemometer. Draw a neat sketch.   10

6.(b) Write the working principle of the following :   10

   (i) Piezoelectric transducer

   (ii) Pyrometer

   (iii) Semi conductor resistance sensors

   (iv) Signal conditioning

   (v) Vibration meter

6.(c) Describe different types of torque sensors along with their working principles. How the torque of PTO pulley can be measured ?   10

6.(d) Discuss the criteria and methods of sorting of food materials. Draw sketch of pneumatic method sorting machine.   10

7.(a) What are the benefits of size reduction in food processing ? A crusher requires 10 kW for grinding a material at the rate of 100 kg/h from 2 cm size to 0·5 cm size. How much power would be required if the reduction was to 0·4 cm. Use both Kick's law as well as Rittinger's law to solve the problem.   10

7.(b) Write the physical and thermal properties of food and their importance in food processing. Apple juice needs to be concentrated using an evaporator from an initial moisture content of 85% (w.b.) to a final moisture content of 50% (d.b.). Calculate the amount of moisture required to be removed from 100 kg of apple juice to achieve the same. Draw a mass balance diagram for the same.   10

7.(c) Define water activity. Draw a typical drying curve and explain the mechanism of drying. How moisture content could be quickly removed – explain various measures.   10

7.(d) Explain five important static characteristic parameters of a simplified measuring system. Derive an expression for output of a first order instrument.   10

8.(a) Define precision and accuracy of an instrument with suitable examples.   10

8.(b) Discuss the functions of CPU and memory devices in computers. How microprocessor helps in aquisition of data related to agriculture ?   10

8.(c) Write different technological options available for utilization of rice husk.   10

8.(d) Write the problem associated with storage of rice bran and its possible reasons. Explain with the help of suitable flow diagram the extraction of oil from rice bran.   10