2011

AGRICULTURAL ENGINEERING (Optional)
(Paper – I)

570070

Standard : Degree | **Total Marks : 200**

Nature : Conventional (Essay) type | **Duration : Three Hours**

Note :

1) *Answers must be written in* ***English.***
2) *Question No. 1 is* ***compulsory****. Of the remaining questions, attempt* ***any four*** *selecting one question from* ***each*** *Section.*
3) *Figures to the* ***RIGHT*** *indicate marks of the respective question.*
4) *Use of log table, Non-Programmable calculator is permitted, but any other Table/Code /Reference book are not permitted.*
5) *Make* ***suitable*** *assumptions,* ***wherever*** *be necessary and state the same*
6) *Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.*
7) *Credit will be given for orderly, concise and effective writing.*
8) *Candidates should not write roll number, any name (including their own) signature, address or any indication of their identity anywhere inside the answer book otherwise he/she will be penalised.*

SEAL

Marks

1. (**Compulsory**, short-answer type and based on almost the entire syllabus of the paper) Answer **any four** of the following (**10** marks **each**) :

   (a) Briefly describe unit operations such as cleaning, sorting, grading, drying, dehydration, storage, milling and packaging used in processing of biological materials. 10

Marks

(b) A cylindrical silo of 2.5 m diameter and 20 m in height, is filled with wheat. Calculate the load on the bottom of silo. The silo is made of steel with smooth walls. The characteristics of stored wheat are as follows :

Minimum bulk density : 720 kg/m^3, Maximum bulk density : 830 kg/m^3, Minimum angle of internal friction : 25°, Maximum angle of internal friction : 30°, Minimum angle of friction on smooth sheeting : 18°, Angle of repose : 25°. Make reasonable assumptions if required. **10**

(c) (i) Explain the working principle of a knapsack sprayer with a neat sketch and label its parts. **5**

(ii) The cost of a bullock drawn mould board plough is Rs. 600/-. The hiring charges of a pair of bullock with the ploughman is Rs. 200/-. per day of 8 hours. Find out the cost of ploughing per hectare if the field capacity of the plough is 40 hours per hectare. Make necessary assumptions if any. **5**

(d) (i) Write down the names of different types of renewable energy sources. Briefly describe the importance of solar energy in Indian agriculture. **5**

(ii) Draw a sketch of a solar water heating system and label its parts. Describe its working principles briefly. **5**

(e) (i) Calculate the actual field capacity of a 3 furrow seed drill having row to row spacing of 20 cm. The speed of operation of the drill is 2.5 km/h and field efficiency is 70 percent. **5**

(ii) Draw a sketch of an air assisted sprayer and label its parts. Describe its working principle. **5**

Marks

SECTION – A

2. (Short-answer type questions). Answer the following sub-questions :

   (a) Briefly describe constant rate period and falling rate period in drying of farm crops. Define Equilibrium Moisture Content and Psychrometry. Briefly explain application of psychrometric chart in drying process. 10

   (b) Describe briefly with diagram construction, operation and advantages and disadvantages of Baffle dryer used for drying of farm crops. 10

   (c) Write the importance of physical characteristics (such as shaper, size, spatial dimensions, roundness, volume, density, specific gravity, surface area and porosity) and mechanical properties (like hardness of grain, compressive strength, impact and shear resistance) of biological materials in the design of handling and processing equipments. 10

   (d) Briefly describe the importance of aero and hydrodynamic characteristics and rheological properties in handling of biological materials. 10

3. (Short-answer type questions). Answer the following sub-questions :

   (a) Determine the values of constants c and n from the Henderson's equation of Equilibrium Moisture Content for the following data obtained from thin layer paddy drying experiment.

   Relative Humidity = 30%, temperature = 50 °C, Equilibrium Moisture Content = 10.5 percent

   Relative Humidity = 55%, temperature = 50 °C, Equilibrium Moisture Content = 15.5 percent. 10

Marks

(b) Briefly explain dryer factors, air factors, grain factors and heating system factors which are taken into consideration in design of heated air grain dryers. 10

(c) What are the uses of mechanical properties (like hardness of grain, compressive strength, impact and shear resistance) and physical characteristics (such as shaper, size, spatial dimensions, roundness, volume, density, specific gravity, surface area and porosity) of biological materials in the design of processing and handling equipments ? 10

(d) What are important points which should be taken into account before selection of a conveying system for biological materials ? Briefly explain with diagram working principle of bucket elevator. 10

SECTION – B

4. (Short-answer type questions). Answer the following sub-questions :

(a) Describe briefly the importance and principles of homogenization. Also explain the construction and working of homogenizer. 10

(b) Eight tones of apple having specific heat of 0.8 kcal/Kg-$^{\circ}$C is to be cooled from 25 to 14°C in 24 hours. The heat of respiration per 24 hours is 745 kcal/t. Three men will work for 4 hours and lighting load is estimated to be 100 watt. Air inflitration load is assumed as 980 kcal in 24 hours. The cold storage measures 6 × 6 × 3 m on the inside and is constructed of bricks laid in cement mortar. Wall thickness is 40 cm and there is 10 cm thick cork insulation on the inside of the four walls. The cement plaster is 1 cm thick. The heat transfer coefficient for the ceiling is 20% more than that for the walls. The outside

Marks

temperature is 30°C and the inside is maintained at 5°C. The thermal conductivity of bricks and cork and cement plaster is 0.45, 0.025 and 0.25 kcal/hr/m - °C respectively. Heat of respiration for men is 170 kcal/hr. It may be assumed that there is no heat transfer through the floor. Calculate the plant capacity needed in tones of refrigeration (Assume 1 tones of refrigeration = 3000 kcal/hr). 10

(c) Briefly describe farm stead and farm house design, farm fencing and cost estimation of barbed wire fencing. 10

(d) Briefly explain the principles of operations of size reduction machinery like gyratory crushers and roller crushers. 10

5. (Short-answer type questions). Answer the following sub-questions

(a) Describe with flow diagram the High Temperature Short Time (HTST) pasteurizer. What is the difference between pasteurization and sterilization ? 10

(b) Briefly explain principles of fruit and vegetable preservations like canning, drying, slicing, blanching and sterilization. 10

(c) Briefly describe criteria for design and construction of loose housing dairy barn and deep litter poultry houses. 10

(d) In a wheat milling experiment it was found that to grind 4.33 mm sized grains to IS sieve 35 (0.351 mm opening) the power requirement was 8 kW. Calculate the power requirement for milling of wheat by the same mill to IS sieve 15 (0.157 mm opening) using 10

(1) Rittinger's law and

(2) Kick's law. Feed rate of mill is 200 kg/hr.

Marks

SECTION - C

6. (a) (i) Explain the working principle of a 4-stroke petrol engine with a neat sketch. 5

(ii) Estimate the fuel consumption of an engine developing 15 BHP and having indicated thermal efficiency of 28% and mechanical efficiency of 75%. Calorific value of fuel may be taken as 10,000 kcal per kg. 5

(b) (i) Briefly describe the working principle of a forced circulation cooling system with a sketch. 5

(ii) Explain briefly the working principle of a planetary gear system with a neat sketch. 5

(iii) Write the periodic maintenance of agricultural tractors at 1000 hours of use. 5

(c) (i) Write down the farm mechanization status of Maharashtra state. 5

(ii) Draw a sketch of a tractor operated inclined plate planter and label its parts. Explain its working principle. 5

(iii) Explain the working principle of a self propelled vertical conveyor reaper and name its parts. 5

7. (a) (i) Draw the P-V diagram of air standard diesel cycle and derive an expression for the thermal efficiency in terms of compression ratio (r) and adiabatic index (γ). 5

(ii) A tractor has four cylinders four stroke engine with cylinder bore 90 mm and stroke 130 mm, compression ratio 15 : 1 belt horse power 32 and engine speed 2000 rpm. Calculate : 5

(i) piston displacement (ii) displace volume

(iii) piston speed (iv) stroke-bore ratio.

Marks

(b) (i) Briefly describe the working principle of a force feed lubrication system of an engine with a sketch. 5

(ii) Explain briefly the working principle of clutch system of a tractor with a sketch. 5

(iii) What is weight transfer of a tractor ? Draw a free body diagram illustrating the forces acting during weight transfer. 5

(c) (i) Write the names of tractor drawn primary tillage equipments. Draw the diagram of a tractor drawn mould board plough and label its parts. 5

(ii) Explain the working principle of an axial flow crop thresher and name its parts. 5

(iii) Write down the expression for the efficiencies and losses of a crop combine harvester. 5

SECTION – D

8. (a) (i) The maximum allowable tension in a V-belt of grove angle of 45 is 1500 N. The angle of lap is 170° and the coefficient of friction between the belt and material of the pulley is 0.27. If the belt is running at 2m/s. Determine :

(a) net driving tension and

(b) power transmitted by the pulley.

Neglect the effect of centrifugal tension. 10

(ii) Write down the parameters to be considered in the design of a tractor operated rotary tiller. 5

(b) Describe the design considerations of a seed cum fertilizer drill. 10

(c) Describe the working principle of fixed dome (Janata) type biogas plant with a neat sketch and label its parts. 15

Marks

9. (a) Write down the ergonomical considerations in the design of a thresher. **15**

(b) If the total draft for the different operations of ploughing at 4.5 km/hr is divided as 50%, 30% and 20% for cutting, pulverizing and rolling resistance respectively, determine the probable percent decrease in the unit draft if the ploughing depth with 40 cm mould board plough bottom is increased from 18 to 25 cm. Assume that the total cutting force is proportional to the cross-sectional area of the furrow slice and that the total force required for pulverizing is proportional to the volume of soil handled, rolling resistance remaining constant. **10**

c) Draw the schematic diagram of an updraft gasifier and describe its working principle in detail. **15**

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