2007

AGRICULTURAL ENGINEERING - I (Optional) 100080

Standard : Degree **Total Marks : 200**

Nature : Conventional **Duration : 3 Hours**

Note :

(i) *Answers must be written in* ***English.***

(ii) *Question* ***No. 1*** *is* ***Compulsory.*** *Of the remaining questions, attempt* ***any four*** *selecting one question from* ***each section.***

(iii) *Figures to the* ***RIGHT*** *indicate marks of the respective question.*

(iv) *Use of log table, Non-Programmable calculator is permitted, but any other Table/Code/Reference book are not permitted.*

(v) *Make suitable assumptions, wherever be necessary and state the same.*

(vi) *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.*

(vii) *Credit will be given for orderly, concise and effective writing.*

(viii) *Candidate 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.*

(ix) *For each slab of 10 and 15 marks, the examinee is expected to write answers in 125 and 200 words respectively.*

1. Answer **any four** of the following questions :

(a) What is the importance and need of processing of biological materials. Briefly explain principles and operation of specific gravity separator, spiral separator and disc separator. **10**

(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 : **10**
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.

Marks

(c) (i) Explain the parts and working principle of a Gator Rocking sprayer with a sketch. **5**

(ii) A tractor operating at 4 Kmph, pulls a three bottom plough. The furrow of each bottom is 30 cm wide and 15 cm deep. The soil resistance is 0.5 kg/sqm. Calculate the draft. Calculate the area ploughed in 10 hrs if 5 percent time is lost in turning. **5**

(d) (i) Discuss briefly about renewable energy sources. Explain how solar energy is the best alternative source of energy. **5**

(ii) Explain the working principle of a solar water heater with a neat sketch. **5**

(e) (i) Calculate the time required for sowing 4 hectares of land by a 5 furrow seed drill having furrow openers at 10 cm apart. The drill is working to a depth of 12.5 cm. Soil resistance is 0.42 kg/sq.cm. **4**

(ii) Differentiate between a Seed drill and planter. **2**

(iii) Explain the procedure for calibrating a Seed drill in the laboratory **4**

SECTION - A

2. Answer the following sub-questions :

(a) Briefly explain Direct and Indirect methods of measurement of moisture content of farm crops. What is the difference between static and dynamic method of measurement of Equilibrium moisture content. **10**

(b) Briefly describe with diagram construction, operation, advantages and disadvantages of Re-circulating batch type (RPEC) dryer and Louisiana State University (LSU) dryer. **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 drag coefficient, terminal velocity, ideal elastic behaviour, ideal viscous behaviour and viscoelastic behaviour of biological materials. **10**

3. Answer the following sub-questions :

(a) Calculate the Equilibrium moisture content of seeds at relative humidity of 10% and temperature of 50°c using Henderson's equation. Given that constants c is 6.5×10^{-6} and n is 1.8. **10**

Marks

(b) Briefly describe with diagram construction and operation of Rotary and Solar dryer. **10**

(c) Write the importance of thermal properties (such as specific heat, thermal conductivity and thermal diffusivity) and electrical properties (like electrical conductance and dielectric properties) of biological materials in the design of handling and processing equipments. **10**

(d) Briefly explain the criteria for design of material handling devices like belt conveyor and bucket elevator used for biological materials. **10**

SECTION - B

4. 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-°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 infiltration load is assumed as 980 kcal in 24 hours. The cold storage measures 6 x 6 x 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 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 tone of refrigeration = 3000 kcal/hr). **10**

(c) Briefly describe stanchion diary barn and loose housing barn, milking parlour, pen barn and community barn. **10**

(d) Briefly explain the principles and operations of size reduction machinery like attrition mill, hammer mill and ball mill. **10**

5. 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 need and importance of food packaging functions, general requirements and type of packaging materials. **10**

Marks

(c) Briefly describe criteria for design and construction of poultry houses (wire floored and deep litter type). **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 (1) Rittinger's law and (2) Kick's law. Feed rate of mill is 200 Kg/hr. **10**

SECTION - C

6. Answer the following sub-questions :

(a) (i) Explain the working principle of a 2-stroke petrol engine with a neat sketch. **5**

(ii) A 4-stroke four cylinder tractor consumes 6 litres of diesel per hour, while its engine is operating at 1200 rpm. The size of the engine is 10 x 12 cm and develop a mean effective pressure of 7 kg/sq.cm. If the mechanical efficiency of the engine is 75 percent, calculate the brake horse power and thermal efficiency of the engine. **5**

(b) (i) Explain battery ignition system of an I.C. engine with a neat sketch. **5**

(ii) Explain the parts and functions of a tractor differential with a neat sketch. **5**

(iii) (1) Why water is used as cooling agent in an I.C. engine ? **2**

(2) Write a note on types and qualities of lubricants. **3**

(c) (i) Explain the parts and working principle of a vertical conveyor reaper **5**

(ii) Give comparison between disc plough and disc harrow. **4**

(iii) What are the functions of a tractor drawn cultivator ? Explain the parts and functions of the tractor drawn cultivator. **6**

7. Answer the following sub-questions :

(a) (i) What is meant by firing order of an I.C. engine ? Through a table indicate the firing order 1-3-4-2 of an I.C. engine. **3**

(ii) Define the following terms with reference to an I.C. engine. **3**

(1) Specific fuel consumption

(2) Thermal efficiency

(3) Mechanical efficiency

(iii) A four cylinder gas engine having a cylinder diameter of 25 cm and stroke length of 50 cm is operating at 150 rpm. The engine fires once per two revolution and shows an indicated mean effective pressure of 7.5 kg/sq.cm. If the Mechanical efficiency of the engine is 85 percent. **4**

Marks

Calculate :

(1) Stroke bore ratio

(2) BMEP

(3) IHP

(4) BHP

(b) (i) Explain the parts and working principles of hydraulic system of a tractor. 5

(ii) What is clutch ? Why clutch is necessary in a tractor ? Explain a single plate clutch of a tractor. 5

(iii) Write a note on daily maintenance of agricultural tractor. 5

(c) (i) Discuss briefly about New Tillage System in Agriculture 5

(ii) List the recommendations made to increase agricultural production in the country. 5

(iii) A five tyne cultivators having tynes, spaced 8 cm apart and working to a depth of 5 cm is operating at a speed of 3 km per hour. There is a time loss of 10 percent while turning. Calculate the time to cultivate 4 hectares of land. If the soils resistance is 0.6 kg/sq.cm and width of each furrow is 5 cm, calculate the maximum draft and H.P. required. 5

SECTION - D

8. Answer the following sub-questions :

(a) (i) How do you give the size and specification of V-belt ?

(ii) List the advantage of V-belt drive over flat belt driver. 3

(iii) A pulley of 50 cm diameter running at a speed of 1500 rpm is driving a pulley at 500 rpm. Determine : 3 5

(1) Diameter of the driven pulley

(2) Length of open belt when the pulleys are 2 meters apart

(3) Length of closed belt when the pulley are 2 meters apart

(iv) Write short notes on :

(1) Speed cone 4

(2) Bevel gear

(b) (i) Give a complete analysis of the soil forces acting upon a tractor drawn mould board plough bottom. 2½

(ii) Discuss briefly about different types of seed metering mechanisms in a seed drill. 2½

Marks

(iii) What seed spacing is required when planting corn in rows 102 cm apart if the desired population is 6000 plants per hectare. An average emergence of 85% is expected. 5

(c) (i) What is the principle of wind energy conversion ? Derive expression for power developed from wind mill. 4

(ii) Write a note on vertical axis type wind mill. 3

(iii) Explain the different stages involved in Biogas production 3

(iv) Explain the working principle of a floating dome (KVIC) type biogas plant with sketch. 5

9. Answer the following sub-questions :

(a) (i) Discuss briefly about different types of power transmitting methods used in Agricultural machineries. 6

(ii) Find the width of belt to transmit 15 HP to a pulley 35 cm in diameter. The speed of the pulley is 1600 rpm. Coefficient of friction between belt and pulley is 0.22 and angle of contact is 210° C. Maximum tension in belt not to exceed 8 kg per cm width. 5

(iii) Write a note on different types of chain drive. 4

(b) (i) Explain the parts and functions of a multi-crop thresher. 3

(ii) Discuss briefly about different types of threshing drums used in mechanical threshers. 3

(iii) Define the terms : 4

(1) Threshing efficiency

(2) Cleaning efficiency

(3) Blower loss

(4) Sieves loss

(5) Cylinder loss

(c) (i) A farmer is using 12 liters of kerosene per month for lighting and 105 kg of fire wood for meeting his cooking demand. Calculate whether it is possible to replace the fuel demand by biogas if he maintains 3 Cows, 1 Buffalo and 3 Calves in his farm. 4

Marks

(ii) A photovoltaic system (PV system) for supplying drinking water is installed in a village. The water is pumped from a bore-well from a depth of 48 meters. The solar cells are made of single crystal silicon and the array consists of 24 modules with 36 cells. Dimension of cell is 10.4 x 10.4 cm^2. Inverter efficiency is 85 percent and pump motor efficiency is 45 percent. Calculate the water discharge rate when solar radiation incident normally on the cell is 945 w/m^2. Conversion efficiency of solar cell is 12.8 percent. **5**

(iii) How would you select the best source of power for the following farm operations ? **4**

(1) Pumping water

(2) Cane crushing

(3) Chaff cutting

What are the limitations of wind power as a source of lifting water for irrigation purpose ?

(iv) How C/N ratio is controlled to get optimum biogas production ? **2**

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