वियोज्य *DETACHABLE*

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 no. **1** & **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 chronological 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 answer book 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) Draw the valve timing diagram of a four stroke tractor engine and explain. 8

1.(b) How many times the power of a four stroke engine increases or decreases if the diameter of the piston is increased by 20 per cent and stroke length is reduced by 20 per cent, and all factors remaining the same. 8

1.(c) Explain about solar cell and how electric current is produced in the cell. 8

1.(d) A hydraulic circuit uses 25 litres of fluid per minute. The fluid is supplied by a pump having a fixed displacement of 12·5 cm^3 per revolution driven at 3000 rpm. The pump has a volumetric efficiency of 85 per cent and torque efficiency of 88 per cent. If the system pressure is set at 18 MPa by the relief valve, calculate (i) the power required to drive the pump (ii) heat generated owing to excess flow passing over the relief valve. 8

1.(e) Calculate (i) the volume of a biogas digester suitable for the output of five cows and (ii) the power available from the digester. Retention time is 20 days, temperature 30°C, dry matter available 2 kg/day per cow, biogas yield 0·24 m^3 per kg. Burner efficiency is 60 per cent, methane proportion is 0·8. The heat of combustion of methane may be assumed to be 28 MJ/m^3 at standard temperature and pressure. The density of dry matter in the fluid may be taken as 50 kg/m^3. 8

2.(a) Calculate the angle made by beam radiation with the normal to a flat plate collector on December 1 at 9·00 am (local apparent time). The collector located at 28°35′N and 77°12′E is tilted at an angle of 36 deg with the horizontal and is pointing due south. 10

2.(b) With a neat sketch, explain Deenabandhu biogas plant. 10

2.(c) A farmer erected a propeller type wind turbine. The diameter of the turbine is 120 m and rotating at 40 rpm at maximum efficiency. On the farm, wind velocity of 15 m/s is available at one standard atmospheric pressure and 15°C. Calculate (i) the total power density in the wind stream (ii) the maximum obtainable power density (iii) the total power and (iv) the torque and axial thrust. For air assume gas constant as 0·287 kJ/kgK. The efficiency of wind turbine is 35 per cent. 10

2.(d) What is pyrolysis and how gasifiers are biomass classified ? 10

3.(a) What are the functions of a carburettor and explain its different components. 10

3.(b) In a diesel cycle, the compression of air starts at atmospheric pressure and 37°C temperature. The compression ratio is 16 : 1. The cylinder has 10 cm bore diameter and 12 cm stroke length. Calculate the air standard efficiency and net work done per cycle, if the addition of heat at constant pressure ends at 5 per cent of stroke volume. Also find the increase or decrease in air standard efficiency, if the fuel cut off ends at 20 per cent of the stroke length. Assume $C_V = 0{\cdot}718$ kJ/kgK and characteristic gas constant as 287 J/kgK . 15

3.(c) Why a tractor is provided with a differential unit and how does it work ? 8

3.(d) With a neat schematic diagram, classify the disc harrows based on their gang arrangement. 7

4.(a) Explain the splash and force feed systems of lubrication in engines. 10

4.(b) A bullock drawn single row planter has a wheel of 50 cm diameter. The wheel shaft carries a 7 teeth sprocket which drives a 12 teeth sprocket on a counter shaft. Another 7 teeth sprocket on the counter shaft drives a 12 teeth sprocket on a shaft carrying a roller with 4 cells on its periphery for dropping of single seed per hill. Calculate (i) total number of droppings along one row in 10 minutes if the travelling speed is 2·5 km/h (ii) determine the horse power required to pull the planter, when the cross-section of the furrow was 7·5 × 7·5 cm and soil resistance was 7 kg_f/cm^2. . 10

4.(c) Explain the principle of working of a battery ignition system with the help of a circuit. 10

4.(d) A motor car has a wheel base of 2·743 m and pivot centre of 1·065 m. The front and rear wheel track is 1·217 m. Calculate the correct angle of outside lock and turning radius of the outer front and inner rear wheels when the angle of inside lock is 40 deg. 10

SECTION 'B'

5.(a) What are the principles of size reduction ? Derive an equation for energy and power requirement in size reduction. 8

5.(b) What do you understand by standardization of milk ? Explain Pearson's square method for 500 kg of milk having fat content of 6·5 per cent to be standardized to 3·1 per cent fat using skim milk containing fat of 0·05 per cent. 8

5.(c) Discuss triode as an amplifier. 8

5.(d) Explain ROM, PROM and EPROM of memory units of computer. 8

5.(e) A single effect evaporator concentrates orange juice at atmospheric pressure of 10130 kPa from 10 to 50 per cent total soluble solids (w.b.). Saturated steam at 205 kPa is used as indirect heating system. Calculate the vapour and product flow rates and steam consumption for a feed rate of 7 kg/s. Assume only latent heat of condensation is available for heating and feed rate that enters at its boiling point at 100°C. The enthalpies of saturated steam, condensate and vapour produced are 2707, 503 and 2676 kJ/kg respectively. The heat capacity value for both feed and output liquid is 4·187 kJ/kgK and latent heat of vaporization at 100°C is 2257 kJ/kg. Assume datum temperature as 100°C. 8

6.(a) Derive an equation for filtration. Discuss filter cake compressibility. 10

6.(b) Describe belt conveyor and factors that affect belt conveyor design.

A 5 m long screw conveyor with 30 cm screw diameter 15 cm shaft diameter and 28 cm screw pitch rotates at 300 rpm. Calculate the delivery capacity of this screw conveyor in m^3/h. Its actual capacity is 50 per cent of the theoretical capacity. Calculate the actual power required for transporting wheat of bulk density 770 kg/m^3. Assume the material factor to be 0·40 and power transmission efficiency as 50 per cent. 10

6.(c) Explain the method of measuring torque of rotating shafts using strain gauges. 10

6.(d) A certain vegetable of 85 per cent moisture content (w.b.) at 25°C is dried to 85 per cent solid. The specific heat of vegetable and water is 3·7 and 4·186 kJ/kg°C respectively. The latent heat of vaporization at 100, 50 and 0°C are 2260, 2380 and 2840 kJ/kg. Find the heat required per kg of vegetable in the following cases :

Case I : If dehydration is carried out at 100°C at atmospheric pressure and

Case II : If freeze drying is to be carried out and product temperature is initially reduced to 0°C. 10

7.(a) Explain how rice bran oil is extracted by solvent extraction method. 10

7.(b) A food with an initial moisture content of 15 per cent w.b. is dried in a continuous dryer to attain a final moisture content of 7 per cent w.b. This drying is accomplished by blowing fresh warm air after it was mixed with same part of the exhaust air (recycled stream) from the dryer. The absolute humidity of fresh, recycled and mixed air streams are 0·01, 0·1 and 0·03 kg/kg of dry air respectively. For a feed rate of 100 kg/h, calculate the required flow rates of fresh and recycled air stream in terms of kg of dry air per hour and the amount of dried product obtained per hour. 10

7.(c) Explain with a flow chart how butter is prepared from milk. 10

7.(d) List different types of active electrical transducers. Explain the purpose for which piezoelectric transducers are used. Mention their advantages. 10

8.(a) In sieve analysis of corn grits with respect to any particular screen opening of the mass fractions of desired particle size in feed, overflow, underflow streams are 0·47, 0·85 and 0·2 respectively. The feed rate of the material on the screen is 10 kg/h. Find mass flow rate for the overflow stream and overall effectiveness of the stream. 10

8.(b) Shelf life of food stored at 30°C is 7 days. Assuming that Q_{10} value of deteriorative reactions occuring in the food is 1·8, estimate the shelf life when it is stored at 10°C. 10

8.(c) Why sugarcane bagasse is best suited for paper making ? 10

8.(d) It is found that the energy required to reduce particles from a mean diameter of 10 mm to 3 mm is 10 kJ/kg. Using Rittinger's law, calculate the energy required to reduce the same material from a diameter of 1 mm to 0·3 mm. 10
