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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 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 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) Describe farm mechanization problems and scope with respect to mountain farming. 8
- 1.(b) Calculate tension T_1 and T_2 of a V-belt transmitting 7.5 kW power with 16 m/s speed. Take arc of contact 125° and value of $k = 0.4$. 8
- 1.(c) Discuss about wind energy conversion system (WECS) with line diagram. 8
- 1.(d) Calculate the consumption of gas in cubic metre per bhp-hour and air standard efficiency if the clearance volume of the engine is 22% of the swept volume. The relative efficiency on IHP basis is 65% and mechanical efficiency is 75% with calorific value of the gas 3550 kcal/cu metre. 8
- 1.(e) What is the principle of generation of voltage? Describe working of four point starter with the help of diagram. 8
- 2.(a) Describe the working principle of a combine with line diagram. 10
- 2.(b) The line of pull on an implement is 15° above the horizontal and is in vertical plane which is at an angle of 10° with the direction of travel. Compute the draft and side draft for a pull of 12 kN. Also compute drawbar power required at 4.5 km/h. 10

- 2.(c) What are the different types of seed metering mechanisms? Explain the working of most suitable metering mechanism of seed drills used in India. 10
- 2.(d) Following data are given for a family biogas plant suitable for the output of 12 cows, the retention time is 32 days, temperature 26°C, dry matter consumed per day is 6 kg, biogas yield is 0.38 m³ per kg. The efficiency of the burner is 75%, methane proportion is 0.8, heat of combustion of methane is 35 MJ/m³, density of fluid mass (ρ_m) = 30 kg/m³. Calculate volume of biogas digester and power available from the digester. 10
- 3.(a) Discuss various methods for obtaining energy from biomass and which one is the most suitable economically. 10
- 3.(b) The total power input to the impeller-cutter head on a PTO driven flail chopper is 20 kW and the theoretical length of cut is 12 mm. The division of power is as follows: cutting - 40%, accelerating chopped material - 20%, friction of chopped material in housing - 25% and blowing air - 15%. If the tractor engine speed is increased 10%, what would be (i) the new total power input to the impeller-cutter head? (ii) the new theoretical cutting length? 10
- 3.(c) A tractor operating with sowing equipments at a speed of 3.5 km/h develops a drawbar pull of 1250 kg. Calculate (i) Speed in metre per second (ii) work done kg-m/min (iii) Drawbar horse power (iv) Horse power hour of drawbar work per eight hours a day (v) the change in speed required to increase the drawbar horse power to 22. 10
- 3.(d) How does solid injection differ from air injection? Discuss different methods of solid injection. 10
- 4.(a) Explain the different types of potato harvesting machines available in India and which type is most suitable for our condition? 10
- 4.(b) A mower has drive wheels of 220 mm radius and speed of crank is 600 rpm. The mower is attached with tractor which is moving at constant speed of 2.4 km/h. Calculate the increase or decrease in speed of the mower to maintain same speed of crank if the speed ratio between the crank wheel and land wheel is changed to 25 : 2. 10
- 4.(c) Describe the working principle of self propelled reaper-cum-binder. 10
- 4.(d) A horizontal axis wind rotor of 4.5 m diameter is used to lift water in the farm. Calculate the theoretical power generated by wind rotor and wind power, if average wind velocity is 20.5 km/h and air density is 1.28 kg/m³. Assume data if necessary. 10

SECTION 'B'

- 5.(a) Describe how actual p-V diagram of engine differs from the ideal air standard diesel cycle. 8
- 5.(b) What is the binary number system and how does it compare to the decimal number system write with example? 8

- 5.(c) Design a LSU dryer of 5 tonnes holding capacity with paddy at 16% moisture content (w.b). Use the following data : Cross section of the dryer = $1.4 \times 1.4 \text{ m}^2$; Air velocity in the air ports = 5 m/sec; Pitch of the air ports = 50 cm; Row to row spacing = 25 cm; Grain residence time = 30 minutes. 8
- 5.(d) Explain the computer applications in process equipment design. 8
- 5.(e) Discuss working of refrigeration system with help of the diagram. 8
- 6.(a) What is the human computer interface ? 8
- 6.(b) Describe the constructional features of bucket elevator with diagram showing forces acting on the grain. 10
- 6.(c) What is difference between baffle type drier and LSU type drier ? 10
- 6.(d) Design a steel conveyor with the grain moving in the open top to operate at a 30° incline and elevate grain to a height of 6 m at a rate of 45 m^3 per hour if flight speed is 32 m per minute. Assume other necessary data if required. 12
- 7.(a) What is structured programming and also explain its application. 10
- 7.(b) Write design of cyclone separator with schematic diagram showing relative recommended dimensions. 10
- 7.(c) Explain actual vapour compression cycle with the help of T- ϕ diagram. 10
- 7.(d) Describe piezoelectric transducers use with their advantages. 10
8. Differentiate between the following :
- 8.(a) Fourth-generation and fifth-generation computers 8
- 8.(b) HTST Pasteurizer and Batch type Pasteurizer 8
- 8.(c) Single phase and poly-phase motor 8
- 8.(d) Hammer mill and attrition mill 8
- 8.(e) Gravity separator and pneumatic separator 8