भारतीय वन सेवा परीक्षा, 2011
Indian Forest Services Examination

Serial No. 0415 D–VSF–L–NRB

AGRICULTURAL ENGINEERING

Paper—II

Time Allowed : Three Hours *Maximum Marks : 200*

INSTRUCTIONS

Candidates should attempt Question Nos. 1 and 5 which are compulsory, and any THREE of the remaining questions selecting at least ONE question from each Section.

All questions carry equal marks.

Marks allotted to each part of a question are indicated against each.

Answers must be written in ENGLISH only.

Assume suitable data if considered necessary and indicate the same clearly in your answer.

Unless indicated otherwise, symbols, notations and abbreviations have their usual meanings.

SECTION—A

1. Answer any **FOUR** questions (not exceeding **150** words each) :— 10×4=40

   (a) In spite of a rapid increase in tractor and mechanical power in Indian farms during the last decade, the food productivity scenario has not improved as expected. Give your comments.

   (b) Calculate the theoretical power extracted by a horizontal axis wind rotor of 5 m diameter operating in a wind regime with wind velocity of 15 km/h. Take air density as 1·29 kg/m^3.

   (c) Differentiate between the following pairs in brief :

      (i) Indirect injection (IDI) and direct injection (DI) diesel engines for automotive applications.

      (ii) Traction wheel and towed wheel.

   (d) A field sprayer having a horizontal boom with 20 nozzles spaced 40 cm apart is to be used for a maximum application rate of 650 litres/ha at nozzle pressure of 500 kPa and forward speed of 5 km/h. Determine the required pump capacity in litres/min

(Contd.)

assuming 10 per cent of the flow is bypassed under the above maximum conditions.

(e) Explain with a diagram the transmission of power from engine to the ground drive components in a crawler tractor. Why are these tractors more suitable on undulating terrains as compared to wheel tractors ?

2. (a) A 2-wheel drive tractor was tested on a farm surface and the following data were recorded :

Drawbar pull = 26·2 kN,

distance travelled for 10 revolutions of driving wheels at no load = 55·8 m,

distance travelled for 10 revolutions of driving wheels at load = 46·2 m,

fuel consumed = 126 g, and

time taken = 25·8 seconds

Determine the following :—

(i) drawbar power developed

(ii) per cent wheel slip

(iii) drawbar specific fuel consumption. 15

(b) Explain the working of a power operated thresher used for wheat crop giving the recommended range of cylinder peripheral speed and type of threshing element. Write down the

expressions to evaluate the threshing efficiency and cylinder loss. 15

(c) A single-phase 230 V electric motor running at 1400 rpm develops a torque of 3·1 Nm. Calculate the amount of electric current drawn by the motor, if the phase angle between the voltage and current is 38° and the power efficiency of the motor is 80 per cent. 10

3. (a) Explain the mechanism of anaerobic fermentation of organic solids. Suggest the optimum range of the following operating parameters for increased biogas production :

(i) solid concentration,

(ii) pH of slurry,

(iii) carbon-to-nitrogen ratio,

(iv) digester temperature, and

(v) retention period. 15

(b) With a schematic diagram explain the fuel supply system in a tractor diesel engine. Name the two types of injector nozzles with their applications in diesel engines. 15

(c) A four-cylinder, four-stroke cycle diesel engine operates at 2000 rpm and uses 7·5 litres of fuel per hour. What is the average volume in millilitres of individual injections ? 10

4. (a) A 2-wheel drive tractor engine develops 22·5 kW at 2000 rpm. The drive passes via a gearbox which has a ratio of 5·78 : 1 engaged, a differential reduction of 4 : 1 and a final drive reduction of 5 : 1. Determine the speed, torque and power delivered to a single driving wheel of the tractor if it is moving in a straight line and the overall transmission efficiency is 80 per cent. 15

(b) A self propelled combine with an 8-row corn head for 75 cm row spacing travels at 4 km/h. Loss of time proportional to area equals 8 min/ha and this is primarily due to the unloading of the grain from the combine. If the other losses are neglected, determine on an area basis, (i) the theoretical field capacity, and (ii) the actual field capacity. 10

(c) With a simple schematic diagram explain the working of a tractor drawn cut-and-throw type forage harvester having a cylindrical cutter head. How do you determine the capacity of this machine ? 15

(Contd.)

SECTION—B

5. Write brief notes on any **FOUR** of the following (not exceeding **150** words each) :— 10×4=40

   (a) Linear Variable Differential Transformer (LVDT)

   (b) Deep bed drying

   (c) Hammer mill

   (d) Homogenization of milk

   (e) Rubber roll husker.

6. (a) Draw a block diagram showing the operations performed from receiving to final storage in a modern rice mill. Explain the basic purpose of each operation in brief. 15

   (b) A bin holds 2000 kg of wet grain containing 500 kg of water. This grain is to be dried to a final moisture content of 14 per cent (wet basis).

      (i) What are the initial and final moisture contents of grain on dry basis ?

      (ii) How much water is removed during drying ? 15

   (c) What is a thermistor ? Explain the temperature - resistance function of a thermistor. 10

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7. (a) A Wheatstone bridge circuit uses a strain gauge of 120 Ω resistance with gauge factor of 2·05 in each of its arms where only one of the gauges is active. The active gauge is mounted on a mild steel bar which undergoes a strain of 4×10^{-4}. If the excitation supply voltage is 5 V, determine the bridge output. 15

(b) With a schematic diagram explain the working of a vapor compression refrigeration system commonly used in dairies. 15

(c) What are the desirable qualities of packaging materials for milk and ice cream ? 10

8. (a) A tractor mounted fertilizer applicator is to be used with an electronic sensor and a microprocessor based data acquisition system to apply desired quantity of fertilizer at different locations in a standing crop. Show the schematic design including the various elements of the system and explain its functioning. 15

(b) With a diagram explain the working principle of a Pitot tube to measure the velocity of a gas flowing through a pipe. What is the major drawback with the Pitot tube ? 10

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(c) Draw schematic diagram of a screw conveyer and label the components. A horizontal screw conveyer of length 2 m conveys wheat grain having bulk density of 680 kg/m^3. The screw diameter, shaft diameter and pitch length of the screw are 0·50 m; 0·30 m, and 0·45 m respectively. If the screw is completely filled with the grain and rotates at 60 rpm, determine the capacity of the screw conveyer in kg/h. 15