I.F.S. EXAM-2015

C-GEQ-O-BHFB

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.*

*Questions 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 sequential 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 Question-cum-Answer Booklet 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

Q1. Answer each of the following questions : *8×5=40*

(a) A photovoltaic system connected to an inverter and a pump set installed in a borewell pumps water from a depth of 48 m. The solar cells are made from single crystal silicon and the array consists of 24 modules each of size 100 × 50 cm, cell size 10·4 × 10·4 cm. Number of cells equal to 36 and conversion efficiency is of 12·8 percent. The inverter and pump motor set efficiency is 85 and 45 percent respectively. Calculate the water discharge rate at noon when the global radiation incident normally on the cell is 945 W/m^2. *8*

(b) What is the principle of operation of a diesel engine ? *8*

(c) What are the types of supporting towers used for wind energy conversion systems ? Discuss the considerations in their selection. *8*

(d) A gas expands through an ideally insulated nozzle following a reversible polytrophic law $PV^{1.2} = C$. There is no change in potential energy but the pressure drops from 20 bar to 2 bar and specific volume increases from 0·05 m^3 to 0·3 m^3. If the entrance velocity is 80 ms^{-1}, determine the exit velocity. *8*

(e) 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 metering disc with 4 cells on its periphery for dropping of single seed per drill. Calculate the total number of seeds dropped along the row in 10 minutes, if the bullocks pull the drill at 2·5 kmh^{-1}. *8*

Q2. (a) Explain with a neat diagram the functioning of a feed reversing device mounted on power chaff cutter for the safety of operators. *15*

(b) What are the modifications required in a combustion ignition engine for operating it as a dual fuel (diesel + biogas) engine ? *15*

(c) Explain governor regulation and governor hunting in an engine. *10*

Q3. (a) An ideal diesel engine has a diameter of 150 mm and a stroke of 200 mm. The clearance volume is 10 percent of the swept volume. Determine the compression ratio and air standard efficiency of the engine, if the cut-off takes place at 6 percent of the stroke. Assume the adiabatic index as 1·4. *10*

(b) Explain how to determine the torque and axial force on a propeller type wind turbine blade at maximum efficiency. *10*

(c) How will you calibrate a seed drill for checking its correct seed rate ? *10*

(d) A 25 hp tractor is running at 1000 rpm. The total reduction of speed in transmission is 10 : 1. Find the tractive force at each driving wheel, if the diameter of the driving wheel is 1·32 m. *10*

Q4. (a) A two-stroke single cylinder diesel engine having 20 cm bore diameter and 30 cm stroke length has a brake wheel of 1 m. Its indicated mean effective pressure is 2·8 kg cm^{-2}, load on the brake 64 kg, speed 400 rpm and fuel consumed is 4·6 kg h^{-1}. The calorific value of the fuel is 10,500 kcal kg^{-1}. Calculate the mechanical efficiency and brake thermal efficiency. Assume heat value per 1 kW-h as 860 kcal. *10*

(b) Using traction theory, derive the useful pull obtained by a pneumatic tired tractor. *10*

(c) Calculate the day length at a location where the latitude is 28°35′ N and the longitude 77°12′ E on 1.12.1999. *10*

(d) What are the advantages and disadvantages of using disc plough for primary tillage ? *10*

SECTION B

Q5. Answer each of the following questions : *8×5=40*

(a) Calculate the rate of movement and the distance travelled by a flat globule in a centrifugal separator, if the diameter of the fat particle is 6 μ_m, radius of bowl is 12 cm, rpm of bowl is 7000, and capacity of the separator is 3000 $l h^{-1}$. Volume of milk in the bowl is 3 litres. Assume coefficient of viscosity of milk as $2{\cdot}12 \times 10^{-2}$ g $cm^{-1}s^{-1}$ at 21°C. Density of serum and fat globules is 1·037 g cm^{-3} and 0·92 g cm^{-3} respectively. *8*

(b) Explain the components of a wheat mill. *8*

(c) Explain the types of computers used based on size and complexity. *8*

(d) A half wave rectifier having a resistance load of 1 k-ohms rectifies an alternating voltage of 325 V peak value and the diode has a forward resistance of 100 ohms. Calculate its DC power output. *8*

(e) What are the ways to reduce fouling of heat exchangers during milk sterilization ? *8*

Q6. (a) With a neat diagram, explain the safety thermal limit recorder-controller used in high temperature short time system of milk pasteurization. *10*

(b) During the evaluation of an air screen grain cleaner with two screens, the following observations were recorded :

(i) impurities present in feed : 6·5%

(ii) impurities present in clean grain : 0·5%

(iii) the outflow of blower contained 0·2% clean seed

(iv) the overflow of the first screen contained 1% clean seed

(v) the underflow contained 0·5% clean seed

Compute the cleaning efficiency of the cleaner. *10*

(c) Compare the CE, CB and CC configurations of an amplifier. *10*

(d) Explain primary and secondary storage in a computer. How is data stored in a computer ? *10*

Q7. (a) Find out the refrigeration load of an ice-cream freezer in tonnes when the capacity of the freezer is 700 kg/h; drawing temperature – 5°C; initial temperature of the mix 4°C; initial freezing temperature of the mix – 2·5°C; water content of the mix 63%; specific heat of the mix 0·8 kcal/kg°C; specific heat of the mix at 100% overrun 0·6 kcal/kg°C; percentage of water frozen at – 5°C, 47%. Assume 85% of the heat equivalent of the work done by the motor appears as heat in the ice-cream, the freezer requires 5 kW motor to drive the dasher and the radiation loss is 3% of the total heat. The latent heat of fusion of ice is 80 kcal/kg. Consider the heat equivalent of work done in agitation as 1 kW = 860 kcal/h. *10*

(b) How is the dryer performance assessed ? *10*

(c) Determine the quantity of parboiled paddy with 40 percent moisture content on wet basis required to produce 1 tonne of product with 12 percent moisture content on wet basis. Work out the problem on wet basis and check the answer using dry basis. *10*

(d) Explain about platinum resistance thermometer to measure temperature. *10*

Q8. (a) What are the effects of milk homogenization ? *10*

(b) Determine the value of C and n from the Henderson's equation of equilibrium moisture content for thin layer paddy drying. The data observed are : *10*

RH = 30%, t = 50°C and MC = 10·5% I

RH = 55%, t = 50°C and MC = 15·5% II

(c) What are the characteristics of a computer ? *10*

(d) What are the advantages and hazards of plastic packaging for common food products ? *10*