I.F.S. EXAM-2016

AGRICULTURAL ENGINEERING

PAPER—I

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 Nos. **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

1. Answer each of the following :

(a) What are the main causes of soil erosion in India? Explain the agronomic practices adopted for controlling the soil erosion. 10

(b) What are the contour and graded bunds? How do they differ in design and functional aspects? 10

(c) Let $P_1, P_2, P_3, \cdots, P_n$ be the depths of rainfall recorded in n rain gauges enclosed by polygon having areas $A_1, A_2, A_3, \cdots, A_n$ within the watershed. Calculate the average depth of rainfall (P) in the watershed of area A. 10

(d) Calculate the cross-section of a contour bund used to store 24-hour excess rainfall of 10 cm. The annual rainfall is about 120 cm with a high intake rate and there is low coverage of crops over the land. The land slope is 4%. Use Cox's formula for VI of contour bund. 10

2. *(a)* With a neat sketch, explain the working of drop inlet spillway. Under what situation is it preferred? 10

(b) What are the main objectives of watershed management programme? What survey is required to be conducted while planning for watershed development? 10

(c) Design the dimensions of a weir used to discharge excess runoff through a contour bund for the conditions given below :

Land slope = 1·5%

Top width of the bund = 45 cm

Height of the bund = 60 cm

Height of crest above GL = 30 cm

Side slope of the bund = 2 : 1

VI = 1 m

Length of the bund = 400 m

Intensity of rainfall for the return period and time of concentration = 12 cm/hr

During the peak rainfall constant infiltration rate = 2·5 cm/hr

No water is stored behind the bund before the peak rainfall occurs

Determine the volume of water stored behind the bund before it starts flowing. 20

3. *(a)* Describe in brief the runoff inducing practices for increasing runoff for water harvesting. 10

(b) Define rational formula for estimating peak runoff rate. Why is it called rational? What are the limitations of rational formula? 10

(c) Design a 150 m long inward sloping (5%) bench terrace for a sandy loam soil with an average slope of 15%. The entire width of the terrace acts as a channel which is provided with a uniform grade of 0·6%. The rainfall intensity for the return period and time of concentration is 20 cm/hr, runoff coefficient = 0·3, riser side slope = 1 : 1, shoulder bund height = 30 cm, bottom width = 75 cm, side slope = 1 : 1, Manning's $n = 0 \cdot 04$, VI = 1·06 m, area of the terrace = 0·09 ha. 20

4. *(a)* Classify remote sensing based on type of data acquisition. Explain in brief the application of remote sensing in agriculture and forestry. 10

(b) What is water-stage recorder? Discuss the current meter as a water flow measuring device. 10

(c) Design a parabolic shaped grassed waterway to carry a flow of 3 cu m/s down a slope of 4%. An excellent stand of dub grass is to be maintained in the waterway. Take Manning's $n = 0 \cdot 04$. 20

SECTION—B

5. Answer each of the following :

(a) Define a weir. Draw the neat sketch of a rectangular weir placed in a channel and label it. 10

(b) Write short notes on the following irrigation efficiencies : 10

(i) Water conveyance efficiency

(ii) Water application efficiency

(iii) Water storage efficiency

(iv) Water distribution efficiency

(c) Define a centrifugal pump. Discuss the probable reasons when the centrifugal pump may fail to operate. 10

(d) An engine-driven centrifugal pump is to be installed in an open well. The yield of the well is sufficient to deliver 16000 litres of water per hour. The static water level is 15 m and the pumping water level is 18 m from ground level. Total losses due to friction in pipe and accessories may be assumed 15% of the total static head. If the pump efficiency is 55% and drive efficiency is 70%, calculate the BHP of the engine required to drive the pump. 10

6. *(a)* Write in brief on the following : 10

(i) Venturi meter

(ii) Parshall flume

(iii) Cipolletti weir

(iv) Tensiometer

(b) Discuss the major components of a drip irrigation system with necessary drawing. 10

(c) Tomato with 60 cm effective root zone depth is grown in a soil with field capacity and permanent wilting point of 22% and 8% respectively. Irrigation is applied after 40% depletion of the available moisture. Apparent specific gravity of soil = 1·6. Calculate the depth of irrigation required. If a pump delivers 10 l/s discharge, how much time will it take for the irrigation of 2 ha? Assume no loss of water. 20

7. *(a)* Define agricultural drainage. What are the sources and ill effects of drainage? 10

(b) Runoff water from a watershed enters into a drainage area for 8 hours at the rate of 3 m^3/s. The total rainfall during 24-hour period is 12 cm and the total infiltration during the period is 4 cm. If the total drainage area is 200 ha and the crop can tolerate a ponding of 10 cm, calculate the drainage coefficient of the land. 20

(c) Discuss the following in brief : 10

(i) Mole drain

(ii) Interceptor drain

(iii) Bio-drainage

(iv) Channel lining

8. *(a)* What is polyhouse? Describe the working of fan and pad cooling system with a neat sketch. 12

(b) Classify silos. Describe constructional features and use of pit silos. 12

(c) A rectangular farm of 10 ha (500 m × 200 m) is to be fenced by barbed wires with concrete poles. Estimate the cost of fencing with six rows of barbed wires. Assume suitable values for spacing of posts and appropriate prices for posts and wires. 16

★ ★ ★

C-MNS-S-AGE

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. (a) Differentiate between the following in brief : *2×4=8*

(i) Naturally aspirated engine and Turbo-charged engine *2*

(ii) Centrifugal pump and Gear pump *2*

(iii) Single plate clutch system and Dual plate clutch system *2*

(iv) Wheel base and Track width *2*

(b) Differentiate between the following in brief : 2×4=8

(i) Indigenous and Soil turning ploughs 2

(ii) Offset and Tandem disc harrow 2

(iii) Seed drill and Planter 2

(iv) Centre of resistance and Centre of pull 2

(c) Differentiate between the following in brief : 2×4=8

(i) Gas engine and Dual fuel engine 2

(ii) CNG and Bio-CNG 2

(iii) Anaerobic process and Aerobic process 2

(iv) Active solar heating and Passive solar heating 2

(d) (i) A three-bottom, 40 cm mouldboard plough is working at a depth of 16 cm. Calculate the actual field capacity when the speed of operation is 4·5 km/h and field performance index is 0·75. 2

(ii) Calculate the area covered (ha) in 8 hours for an animal drawn seed drill which has three furrow openers 180 mm apart. The speed of operation is 2 km/h. 2

(iii) A 4 m width of cut combine is travelling at 50 m/min speed. In one minute time, 50 kg of grain was collected in the grain tank and 60 kg of material was discharged at the rear of the machine. Calculate the capacity of the combine on throughput basis. 2

(iv) Calculate the vertical soil reaction on an implement weighing 350 kg, when a pull of 6·5 kN is exerted on it at an angle of 15° with the ground surface. 2

(e) Discuss the major differences between the following : 2×4=8

(i) Biogas and Producer gas 2

(ii) Biodiesel and Bio-ethanol 2

(iii) Single phase electric motor and Three phase electric motor 2

(iv) Downdraft gassifier and Updraft gassifier 2

Q2. (a) Draw a neat figure showing different components of a fuel supply system of a general purpose tractor and describe its working. *10*

(b) Draw a neat schematic diagram of a tractor power train and discuss the significance of each member of the power train. *10*

(c) Describe the working of an oil bath type air cleaner. *10*

(d) (i) Why do general purpose tractors have larger rear wheels and smaller front wheels ? *2*

(ii) Why is a certain amount of valve clearance provided in valves of IC engines ? *2*

(iii) Why do tractor rear wheels have lesser inflation pressure than the front wheels ? *2*

(iv) Why is a breather provided in an engine ? *2*

(v) Why does the radiator in a tractor cooling system have a pressure cap ? *2*

Q3. (a) List the different types of seed and fertilizer metering mechanisms used in modern seed-cum-fertilizer drills commonly used in India. How does the rate of application vary using these mechanisms ? *10*

(b) List the different types of nozzles used for the application of agro-chemicals in manually operated sprayers used in India. How does their spray pattern differ ? Write about their specific use in plant protection. *10*

(c) What are the modifications required to run a constant speed diesel engine on dual fuel (biogas + diesel) mode and why ? *10*

(d) Write short notes on the following : *5×2=10*

(i) Terracer blade *5*

(ii) Traction aids for wheel tractors *5*

Q4. (a) Calculate the volume of a biogas digester and power available from it assuming the following : *15*

Number of animals = 8

Retention time = 20 days

Temperature of digestion = 35°C

Dry matter consumed per animal per day = 2 kg

Burner efficiency = 70%

Methane content in biogas = 70%

Density of dry matter in slurry = 50 kg/m^3

Biogas yield per unit dry mass = 0·2 m^3/kg

Heat of combustion of methane = 28 MJ/m^3 at STP

(b) Write short notes on the following : *5×3=15*

(i) Solar lantern *5*

(ii) Solar cooker *5*

(iii) Gas engines *5*

(c) Write the major differences between the following : *2×5=10*

(i) Tar and Particulate matter *2*

(ii) Briquetting and Charring *2*

(iii) Wind mill and Water mill *2*

(iv) Mechanical efficiency and Thermal efficiency *2*

(v) Total solids and Volatile solids *2*

SECTION B

Q5. (a) Differentiate between the following : *2×4=8*

(i) Analog and Digital signals *2*

(ii) Readability and Span *2*

(iii) True value and Accuracy *2*

(iv) Force and Torque *2*

(b) Describe in brief the method of measurement calibration of the following : *4×2=8*

(i) Draft requirement of an animal drawn plough *4*

(ii) Draft requirement of a tractor drawn trailed disc harrow *4*

(c) How are the following measurements done ? *4×2=8*

(i) Brake Horse Power of an engine using hydraulic brake dynamometer *4*

(ii) Calibration of a hydraulic tension dynamometer *4*

(d) Differentiate between the following : *2×4=8*

(i) Osmosis and Dehydration *2*

(ii) Equilibrium moisture content and Moisture content *2*

(iii) Angle of repose and Angle of internal friction *2*

(iv) Specific heat and Thermal conductivity *2*

(e) Write about the basic drying principle(s) involved in the following : *2×4=8*

(i) Mechanical drying *2*

(ii) Chemical drying *2*

(iii) Vacuum drying *2*

(iv) Freeze drying *2*

Q6. (a) What are the major differences between a Hammer mill and a Roller mill ? *10*

(b) Describe the working of a cyclone separator. How is its separation factor related to the weight of a particle ? *10*

(c) Describe the basic methods of force measurement. *10*

(d) Which are the by-products generated during milling of paddy ? Describe how the by-products can be profitably used. *10*

Q7. (a) What are the common types of equipment used in grain handling ? Discuss in brief the factors considered in their selection. *10*

(b) Name the different types of strain measuring equipment and describe in brief the techniques adopted using strain gauges. *10*

(c) Differentiate between the working principle and application of Spray and Roller driers in Milk Powder manufacture. *10*

(d) Describe how sugarcane bagasse can be utilized, not going as waste. *10*

Q8. (a) How are Microprocessors used in data acquisition and control of Agricultural Engineering processes ? *10*

(b) Describe in brief the application of Multimedia and Audio-Visual aids in propagation of forestation. *10*

(c) Explain in brief the role of C.P.U. and memory devices in modern computers. *10*

(d) Differentiate between the working principle of sequential and combination systems of Digital circuits. *10*