

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.*

*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) State the adoptability and functions of the following structures : 8
- (i) Drop spillway
 - (ii) Chute spillway
 - (iii) Levees
 - (iv) Retards
- (b) Discuss various methods of in-situ moisture conservation applicable for crop production under dryland areas. 8
- (c) Define drainage density and derive the relationship between drainage density and ruggedness number. 8
- (d) Differentiate between the following : 8
- (i) Geostationary satellite and Polar sun-synchronous satellite
 - (ii) Active remote sensing and Passive remote sensing
- (e) Define various satellite orbital characteristics. 8
- Q2.** (a) Briefly describe various methods of reducing surface wind velocities in wind erosion control. 10
- (b) Calculate the volume of water available in the pond under the following conditions : 15
- (i) When the pond is filled to 100% of its total depth.
 - (ii) When the pond is filled to 50% of its total depth.
- The dimensions of the pond are as follows :
- Shape – Trapezoidal, Depth 3.0 m, Side slope 2 : 1 (H : V),
- Bottom surface 21 m × 45 m.
- (c) Determine the depth of runoff and peak rate of runoff for 25 years recurrence interval for antecedent moisture condition II from a 150 ha watershed. The curve number to apply for three 50 ha sub watersheds for antecedent moisture condition II are respectively 85, 65 and 75. Six hours, 25 years frequency rainfall for the given location is 120 mm. The time of concentration and time to peak of runoff are 30 min and 60 min respectively. 15

- Q3.** (a) Describe importance of stream ordering in watershed study. 10
- (b) The normal annual rainfall at Stations A, B, C, and D in the basin are 80·97, 67·59, 76·28 and 92·01 cm, respectively. In the year 1985, the Station D was inoperative and the Stations A, B and C recorded annual precipitation of 91·11, 72·33 and 79·89 cm, respectively. Estimate the rainfall at Station D in that year. 10
- (c) Discuss the methods of separation of base flow from a runoff hydrograph. 20
- Q4.** (a) Explain spectral reflectance curve with the help of neat sketch for soil, water and vegetation. 15
- (b) What are the methods of digital image processing ? Discuss any one in detail. 10
- (c) Discuss the interaction of Electromagnetic Radiation (EMR) with the atmosphere and the Earth's surface. 15

SECTION B

- Q5.** (a) Discuss the specialised structures used with underground pipeline system to control the water and protect the pipeline from damage. 8
- (b) Discuss the coordinate method of measuring discharge from pipes discharging horizontally. 8
- (c) Describe the importance and significance of selection of a suitable site for a nuclear power plant. 8
- (d) What do you mean by Greenhouse Effect ? How does it affect the climate ? How can you build a low cost greenhouse ? 8
- (e) Discuss the important hydraulic phenomenon involved in border irrigation method. 8
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- Q6.** (a) A tank has a water spread area of 40 hectares with an average depth of 3 m of water. Calculate the area of paddy crop of 120 days duration that can be irrigated if the duty is expressed as 15
- (i) 960 hectare per m^3/sec
- (ii) 110 hectare cm and
- (iii) 90 hectare/million m^3 of water
- (b) Discuss about the pipe drain and pipless drains (mole) used in subsurface drainage system. 10
- (c) Discuss the different types of sprinkler irrigation systems based on portability. 15
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- Q7.** (a) (i) A stream of 130 litres/second was diverted from a canal and 100 litres/sec were delivered to the field. An area of 1.8 hectares was irrigated in 8 hours. The runoff loss in the field was 432 m^3 . Available moisture holding capacity of the soil is 20 cm per meter depth of soil. Determine the water conveyance, water application and water storage efficiency. Irrigation was started at a moisture level of 50 percent of the available moisture. 12
- (ii) Differentiate between the following : 8
- (I) Semi confined aquifer and Perched water table
- (II) Transmissibility and Storage coefficient
- (III) Piezometric surface and Pumping water level
- (IV) Single acting pump and Double acting pump

- (b) Differentiate between the following : 10
- (i) Saline-alkali soil and Non-saline alkali soil
 - (ii) Saturation capacity and Field capacity
 - (iii) Permanent wilting point and Ultimate wilting point
 - (iv) Soil texture and Soil structure
- (c) Discuss the basic requirements for any well screen. 10
- Q8.** (a) Discuss safe disposal of all human sewage and domestic wastes in farmstead planning, illustrating suitable layout. How is it different from homestead planning ? 20
- (b) What is sanitary drainage system ? What are the different types of drainage systems ? What is the difference between sewage and drainage ? How can drainage systems be improved ? 10
- (c) What are the considerations to frame water supply system in rural areas ? Illustrate with examples. 10

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 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.

All questions carry equal marks. The number of marks carried by a question/part is indicated against it.

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.

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.

Answers must be written in ENGLISH only.

SECTION—A

1. (a) Write about the scope of agricultural mechanization for marginal and small land-holding fields in India. 8
 - (b) Differentiate between the following in brief :
 - (i) 2-Stroke and 4-Stroke engine
 - (ii) Draft control and Position control hydraulic system
 - (iii) Spraying and Dusting
 - (iv) Seed drill and Transplanter 8
 - (c) Justify the following in brief :
 - (i) Why is the size of rear wheels of tractor larger than the front wheels?
 - (ii) Why is producer gas not used directly for domestic purpose?
 - (iii) Why is the compression ratio of CI engines higher than SI engines?
 - (iv) Why is thermostat valve used in cooling system? 8
 - (d) What is gasification? Explain the working of up-draft type gasifier with a neat diagram. 8
 - (e) What factors are required to be considered for selection of electric motor used in agricultural operations? Write about the regular maintenance needed by an electric motor. 8
2. (a) With a line diagram of each stroke, explain the working of 4-stroke spark-ignition engine. 10
 - (b) (i) Write about the objectives of primary and secondary tillage. 5
 - (ii) With a flow chart, explain the working of tractor power train by mentioning the function of each component. 10
 - (c) Explain the functions of different components of a solar photovoltaic system used for power generation. Write a short note on solar flat plate collector. 15
3. (a) What is the purpose of air cleaning system? Write about the working of oil-bath type air cleaning system of a farm tractor. 10
 - (b) A 3-bottom 35 cm mould board plough is working at a depth of 20 cm. It requires a draft force of 18 kN working at a speed of 3 kilometers per hour. If the field efficiency is 70%, calculate the actual field capacity of the plough. Also calculate the unit draft and drawbar horsepower. (Consider the acceleration due to gravity as 10 m/s^2) 15
 - (c) What is the necessity of seed drill calibration? Explain the sequential steps followed in seed drill calibration. 15

4. (a) A 4-cylinder 4-stroke CI engine with 100 mm × 120 mm size has a mean effective pressure of 6 kg/cm². It works at a speed of 300 r.p.m. If the mechanical efficiency is 85%, calculate the developed brake horsepower of the engine.
Write the functions of flywheel, timing gear and differential lock. 10
- (b) (i) Write about the importance of ergonomics in farm machinery design. Enlist anthropometric parameters used in design of farm implements. 8
(ii) Define wheel base and wheel track. Explain the terms used in the empirical equation $F = Ac + W \tan \phi$, related to tire performance. 7
- (c) Write short notes on the following :
(i) Tractive efficiency
(ii) Registration and alignment of cutter bar
(iii) Anaerobic digestion
(iv) Wind power and its estimation
(v) Threshing efficiency 3×5=15

SECTION—B

5. (a) Define the following properties of agricultural produces :
(i) Bulk density
(ii) Porosity
(iii) Angle of repose
(iv) Coefficient of friction
Also write the importance of each property in crop processing. 8
- (b) Define equilibrium moisture content of grain. Write Henderson's equation for grain isotherm, explaining all its terms. If 10 kg fruit pulp is dried using a drum dryer from 60% (wet basis) to 10% (dry basis) moisture content, how much dried pulp can be obtained? 8
- (c) Define capacity and economy of an evaporator. A single-effect evaporator is used to concentrate fruit juice from 20% to 50% solid. The feed rate of the juice is 1000 kg per hour. Draw a mass balance diagram of the process and find out the concentrated juice coming out from the evaporator and the amount of vapour being evaporated from the juice. 8
- (d) What is pasteurization of milk? Enlist the methods of pasteurization of milk. Write the advantages of high temperature short time (HTST) pasteurization of milk. 8
- (e) Write the types of instrumentation systems being used in food processing. Explain the elements of an analog data acquisition system. 8

6. (a) The biomass generated from various crops have usually low bulk density and thus pose huge problem in transportation and storage. State how this problem can be solved. List the technologies available for this. Describe any one technology in detail. Calculate the percent saving per kg in transportation cost of chopped wheat straw if it is transported by a truck from city A to city B in two different forms, i.e., loose form and densified form. The bulk density of loose straw may be assumed as 80 kg/m^3 whereas that of densified straw as 400 kg/m^3 . The transportation cost may be considered as ₹ 2000 per truck from city A to city B. Consider the volume of one truck as 10 m^3 . 15
- (b) Air screen cleaner and specific gravity separators are used in crop processing. Write the basic principle of operation of these equipments. List the components of both the equipments along with the role of each component. Write the importance of cleaning in crop processing. 10
- (c) Draw drying curves of a particulate solid. What do you mean by multipass drying? Describe the constructional features and functioning of an LSU type grain dryer. 15
7. (a) Explain the working of centrifugal cream separator. Calculate the power requirement to start up a centrifugal cream separator if the density of the bowl is 7850 kg m^{-3} , revolutions per second 100, outer radius and inner radius of the disk are 0.25 m and 0.225 m, respectively. The length where the mass is concentrated is 0.35 m and time to reach the running speed is 300 s. 15
- (b) Define filtration. Briefly discuss along with sketch (showing the flow of the feed and the permeate) the cake filter, clarifying filter and the cross-flow filter. If in a slurry there is high solid content, which type of filter will you recommend? Write with proper reasoning.
Define screening in food processing. Show mass balance over a screen and find out the ratio of oversize to feed in terms of mass fractions of feed, oversize and undersize. Make suitable assumptions. 15
- (c) How many kg each of cream having 30% fat and milk having 5% fat will be required to make 1000 kg of mixture having 10% fat? 10
8. (a) Describe the working principle of strain gauge torque meters.
Write the methods of measurement of liquid level in a glass tube. What are the advantages and disadvantages of resistive method? 15
- (b) Describe the two basic methods for measurement of low pressure in a food processing equipment.
Draw a diagram of the thermocouple vacuum gauge and explain the heater element. 15
- (c) Write the functions of a food packaging material. What is modified atmosphere packaging? Briefly describe how a modified atmosphere packaging works.
Differentiate between modified atmosphere storage and controlled atmosphere storage. 10

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