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**UPSC IFS**  
**Previous Year Paper**  
**(Agricultural Engineering**  
**Paper - II) 2020**



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.
  - (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
  - (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?
  - (d) What is gasification? Explain the working of up-draft type gasifier with a neat diagram.
  - (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.
2.
  - (a) With a line diagram of each stroke, explain the working of 4-stroke spark-ignition engine.
  - (b)
    - (i) Write about the objectives of primary and secondary tillage.
    - (ii) With a flow chart, explain the working of tractor power train by mentioning the function of each component.
  - (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.
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.
  - (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  $10 \text{ m/s}^2$ )
  - (c) What is the necessity of seed drill calibration? Explain the sequential steps followed in seed drill calibration.

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4. (a) A 4-cylinder 4-stroke CI engine with 100 mm × 120 mm size has a mean effective pressure of 6 kg/cm<sup>2</sup>. 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.
- (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?
- (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.
- (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.
- (e) Write the types of instrumentation systems being used in food processing. Explain the elements of an analog data acquisition system.

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  $80 \text{ kg/m}^3$  whereas that of densified straw as  $400 \text{ kg/m}^3$ . The transportation cost may be considered as ₹ 2000 per truck from city A to city B. Consider the volume of one truck as  $10 \text{ m}^3$ . 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  $7850 \text{ kg m}^{-3}$ , 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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