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AGRICULTURAL ENGINEERING

TOOL KIT SERIES

UPSC

INDIAN FOREST SERVICE

2026 - 27

Linkage of Concepts with PYQs + Infused with Infographics & Maps

Module - 2

Paper 2 | Section – A + B

PYQs summery

MPPSC STATE FOREST SERVICE 2023



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108 Out of 126 Total Selections in
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AGRICULTURE ENGINEERING

PAPER – 2

EDITION : 2026

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SYLLABUS

Indian Forest Service (IFoS) [Paper 2 | Section A]	***Farm Power and Machinery*** **:** Agricultural mechanization and its scope. Sources of farm power - animate and electro-mechanical. Thermodynamics, construction and working of internal combustion engines. Fuel, ignition, lubrication, cooling and governing system of IC engines. Different types of tractors and power tillers. Power transmission, ground drive, power take off and control systems. Operation and maintenance of farm machinery for primary and secondary tillage. Traction theory. Sowing transplanting and interculture implements and tools. Plant protection equipment – spraying and dusting. Harvesting, threshing and combining equipment. Machinery for earth moving and land development -methods and cost estimation. Ergonomics of man-machine system. Machinery for horticulture and agro-forestry, feeds and forages. Haulage of agricultural and forest produce. ***Agro-energy*** **:** Basic Energy requirements of agricultural operations and agro-processing. Selection, installation, safety and maintenance of electric motors for agricultural applications. Solar (thermal and photovoltoic), wind and bio-gas energy and their utilization in agriculture. Gasification of biomass for running IC engines and for electric power generation. Energy efficient cooking stoves and alternate cooking fuels. Distribution of electricity for agricultural and agro-industrial applications.
Indian Forest Service (IFoS) [Paper 2 | Section B]	***Agricultural Process Engineering*** : Post harvest technology of crops and its scope. Engineering properties of agricultural produces and by-products. Unit operations – clearing grading, size reduction, densification, concentration, drying/dehydration, evaporation, filtration, freezing and packaging of agricultural produces and by-products. Material handling equipment belt and screw conveyors, bucket elevators, their capacity and power requirement. Processing of milk and dairy products - homogenization, cream separation, pasteurization, sterilization, spray and roller drying, butter making, ice cream, cheese and shrikhand manufacture. Waste and by-product utilization - rice husk, rice bran, sugarcane bagasse, plant residues and coir pith ***Instrumentation and computer applications in Agricultural Engineering*** **:** Electronic devices and their characteristics-rectifiers, amplifiers, oscillators, multi-vibrators. Digital circuits - sequential and combinational system. Application of microprocessors in data acquisition and control of agricultural engineering processes-measurement systems for level, flow, strain, force, torque, power, pressure, vacuum and temperature. Computers - introduction, input/output devices, central processing unit, memory devices, operating systems, processors, keyboards and printers. Algorithms, flowchart specification, programme translation and problem analysis in Agricultural Engineering. Multimedia and Audio-Visual aids.

Module - 1

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CHAPTER

1

FARM MECHANIZATION, POWER SOURCES & FARM MANAGEMENT

Mechanization status · Sources of farm power · Selection of machines · Cost economics · Field capacity & efficiency

OFFICIAL SYLLABUS – Chapter 1 Scope

UPSC IFoS — Agricultural Engineering, Paper I, Section A — Topic 1: Soil and Water Conservation

- **Chapter 1 covers:** Status, scope and levels of farm mechanization in India; mechanization index; state-vs-country comparison of farm power availability. Sources of farm power — human, animal (draught), mechanical, electrical, biomass; their merits and demerits. Selection of farm machines based on holding size and category of farmer (small, marginal, medium, large). Farm management economics — fixed cost, variable cost, depreciation methods (straight-line, declining balance, sum-of-years-digits), salvage value, economic life, break-even analysis, custom hiring of tractors, hourly cost of operation, cost estimation of field operations. Machine field capacity (theoretical, effective), field efficiency, percent time loss / time lost, material efficiency.

Full Topic 1 syllabus (this Chapter 1 + sister chapters in Module 1): Sources of farm power — human, animal, mechanical, electrical, wind, solar and biomass. Tractors and power tillers — principles of operation, types, classification, selection, calibration, calculation of capacity and cost. Field capacity — theoretical and effective; field efficiency. Internal combustion engines — principles, classification; fuel and ignition systems; lubrication, cooling and power transmission systems; comparison between IC engines and electric motors as a power source. Tillage implements — mould board plough, disc plough, harrow, cultivator, ridger, sub-soiler, rotavator, etc.; theory of soil cutting and pulverization; traction theory. Sowing and planting equipment; plant protection equipment — sprayers and dusters. Harvesting and threshing equipment — reapers, harvesters, threshers, combine harvesters. Equipment for earth-moving and land development — bulldozers, draglines, scrapers, etc.; ergonomic considerations and design of farm machines for safety and comfort. Renewable energy sources — solar, wind, biomass, biogas, etc.

SECTION A – UPSC IFoS Previous-Year Questions	*7 questions • 2017 – 2025*
2025	✎ Define depreciation and list the different methods employed in calculating depreciation. Also, indicate which method is common for farm machines. [P2/1(b·i) | 4M]
2024	✎ What are the major farm operations performed in an irrigated mechanized wheat production system? Enlist the major farm equipment's used to carry out these operations. [P2/1(a) | 8M]
2023	✎ Briefly write about different sources of farm power used in Indian agriculture. [P2/1(a) | 8M]
2022	✎ Categorize the farmers based upon their holding size. Enlist the different types of machines

	suitable for each category of farmers. [P2/1(a) | 8M]
2021	✎ Discuss the different sources of farm power available in India. What are their merits and demerits? [P2/1(a) | 8M]
2020	✎ Write about the scope of agricultural mechanization for marginal and small land-holding fields in India. [P2/1(a) | 8M]
2017	✎ Define farm mechanization index. Discuss the mechanization status of different farm operations in India. What is the power availability on Indian farms and their constituent sources compared to developed countries. [P2/1(a) | 8M]

SECTION B – State PSC Previous-Year Questions

14 questions • All states · year-descending

✎ Theoretical field capacity - Effective field capacity - Field efficiency Determine the horse power required to pull a four bottom 32 cm plough working to depth of 14 cm. The tractor is operating at a speed of 5.5 kmph. The soil resistance is 0.8 kg/cm². - In a wheat milling experiment, it was found that to grind 4.33 mm sized grains to pass sieve 0.351 mm opening, the power requirement was 8 kw. Calculate the power requirement for milling of wheat using Rittinger's law and Kick's law by the same mill to pass sieve 0.157 mm opening. Feed rate of mill is 200kg/hr.

MH·PSC **Forest Services (Mains) 2024** | **Agri. Engineering** | **Q.8(a)** | 15M

✎ A tractor attached with a cultivator of 3.5 m width is used to cultivate 50 ha of field at a travel speed of 5.0 km/h. Determine the time taken to complete the operation and also theoretical field capacity of the cultivator. Assuming the tractor operator reports a time loss of 0.75 h per 10 h of field operation, what is the effective field capacity?.

OPSC·CSE **CSE (Main) 2024–25** | **Agri. Engineering** | **Paper-II, Q.4** | 15M

✎ How is power measurement essential for optimising the performance of tractors and what role does it play in cost estimation for hiring tractors?.

OPSC·CSE **CSE (Main) 2023–24** | **Agri. Engineering** | **Paper-II, Q.10(a)** | 15M

✎ While estimating the cost of operation of any agricultural machines, what are the sub-heads included in fixed cost?.

HP·PSC **RFO (Mains) 2021** | **Agri. Engineering** | **Q.5(b)** | 10M

✎ What are the benefits of agricultural mechanization? Describe the role of mechanization in meeting the challenges of agriculture in 21st century in India.

UK·PSC **RFO (Mains) 2021** | **Agri. Engineering** | **Q.5(i)** | 10M

✎ Discuss the present status and scope of agricultural mechanization in your state as compared to that of the country.

OPSC·CSE **CSE (Main) 2020–21** | **Agri. Engineering** | **Paper-II, Q.1(a),(i)** | 10M

✎ Determine the hourly cost of operating a tractor costing Rs. 5.0 lakh. The tractor has useful service life of 12 years when operated about 1000 hours every year. The tractor develops 35 bhp consumes 8 liters of fuel/hr. Assume zero salvage value and there is no overhead charge:.

OPSC·CSE **CSE (Main) 2020–21** | **Agri. Engineering** | **Paper-II, Q.1(a),(ii)** | 10M

✎ Compare the present status and trend of different farm power sources in your state in comparison to the country.

OPSC·CSE **CSE (Main) 2020–21** | **Agri. Engineering** | **Paper-II, Q.1(b),(i)** | 10M

- Why is the custom hiring of tractors becoming popular among small and marginal farmers?.
  OPSC·CSE CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.3(a),(ii) | 12M
- What are the hectare per hour theoretical field capacity and percent time loss for 4 and 6 row corn planter set for 600mm rows? The row length is 400m and forward speed of each is 6 km/h. Assume the only time losses are 5 second per row for turning at each end and 60 second for filling the seed and fertilizers cans every second round.
  OPSC·CSE CSE (Main) 2018–19 | Agri. Engineering | Paper-II, Q.1(d) | 20M
- What is the status of farm mechanization in Odisha as compared to that of the country? Compare the availability of animate power, mechanical power and electrical power in. your state with that of India.
  OPSC·CSE CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.1(a) | 20M
- Elaborate the procedure of cost estimation of performing field operations by farm machinery. What is breakeven point (B. E. P.)? Explain it graphically.
  OPSC·CSE CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.1(c) | 20M
- A mini tractor costing Rs. 2,15,000 is purchased by a small farmer with 2 hectares land. If the farmer wants to operate the tractor on custom hire basis and wants to earn Rs. 100 per hour of working, calculate the charge of the tractor-hiring (Rs./hour) with following data: Salvage value : 10% of initial cost, working life : 10 years; working hours/year: 2500, interest rate : 1% / month, taxes, insurance and housing : 1% of initial cost/year, Diesel consumption : 1.5lit/hour @ Rs. 45/lit, Oil consumption : 0.05 lit/hour @ Rs. 100/hour, Repair and maintenance charge : 10% of initial cost. Assume required data if necessary.
  OPSC·CSE CSE (Main) 2015–16 | Agri. Engineering | Paper-II, Q.2(c) | 20M
- Theoretical field capacity - Effective field capacity - Percentage of time lost - Material efficiency - Starting from homogenization of milk and cream separation explain the operation of butter manufacturing unit.
  OPSC·CSE CSE (Main) 2015–16 | Agri. Engineering | Paper-II, Q.5(a) | 20M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	20	19	17	16	TOTAL
IFoS	1	1	1	1	1	1	·	1	·	7
OPSC·CSE	1	1	·	·	4	·	1	2	2	11
OPSC·Forest	·	·	·	·	·	·	·	·	·	0
MH·PSC	·	1	·	·	·	·	·	·	·	1
UK·PSC	·	·	·	·	1	·	·	·	·	1
HP·PSC	·	·	·	·	1	·	·	·	·	1
AP·PSC	·	·	·	·	·	·	·	·	·	0

HOT SUBTOPICS – Most-asked themes in Chapter 1

Frequency bars scaled to top topic (7 questions)

- Farm Management Economics — 7 Qs
- Mechanization Status & Scope — 5 Qs
- Sources of Farm Power — 4 Qs
- Machine Field Capacity & Efficiency — 4 Qs
- Selection & Holding-Size Categorization — 2 Qs

CHAPTER

2

IC ENGINES & ENGINE THEORY

SI/CI · 2-stroke/4-stroke · Otto/Diesel cycle · Engine systems · Performance & efficiency

OFFICIAL SYLLABUS – Chapter 2 Scope

UPSC IFoS — Agricultural Engineering, Paper I, Section A — Topic 1: Soil and Water Conservation

- **Chapter 2 covers:** Internal combustion engines — principles, classification (SI vs CI; 2-stroke vs 4-stroke), comparison with external combustion engines. Air-standard cycles — Otto, Diesel, Dual; P-V & T-S diagrams; thermal/relative efficiency derivations. Engine performance — IHP, BHP, mechanical/volumetric/thermal/relative efficiency, mean effective pressure, specific fuel consumption (SFC, BSFC), detonation, pre-ignition, knocking, octane and cetane numbers, ignition delay. Engine geometry — TDC, BDC, stroke, bore, compression ratio, clearance and swept volumes, tappet clearance, engine displacement. Engine systems — fuel-injection / fuel-supply, cooling (forced-feed, thermo-siphon, thermostat, radiator), lubrication (multigrade oils, oil rings, valve train), ignition (battery, magneto), air cleaner (oil-bath), governor (centrifugal, hunting), carburettor, valve-timing diagram, firing order, flywheel, timing gears.

Full Topic 1 syllabus (this Chapter 2 + sister chapters in Module 1): Sources of farm power — human, animal, mechanical, electrical, wind, solar and biomass. Tractors and power tillers — principles of operation, types, classification, selection, calibration, calculation of capacity and cost. Field capacity — theoretical and effective; field efficiency. Internal combustion engines — principles, classification; fuel and ignition systems; lubrication, cooling and power transmission systems; comparison between IC engines and electric motors as a power source. Tillage implements — mould board plough, disc plough, harrow, cultivator, ridger, sub-soiler, rotavator, etc.; theory of soil cutting and pulverization; traction theory. Sowing and planting equipment; plant protection equipment — sprayers and dusters. Harvesting and threshing equipment — reapers, harvesters, threshers, combine harvesters. Equipment for earth-moving and land development — bulldozers, draglines, scrapers, etc.; ergonomic considerations and design of farm machines for safety and comfort. Renewable energy sources — solar, wind, biomass, biogas, etc.

SECTION A – UPSC IFoS Previous-Year Questions

33 questions • 2016 – 2025

2025	✎ Define indicated thermal efficiency and relative efficiency of an IC engine. Why is relative efficiency preferred as a measure of engine performance?. [P2/1(a) | 8M] ✎ Enlist the reasons for lubricating the different moving parts of IC engine. Also, state what you understand by 'Multigrade' lubricating oil. [P2/1(c) | 8M] ✎ Define the following : (i) Cetane number (ii) Volumetric efficiency of IC engine (iii) Firing order in multicylinder engine (iv) Compression ratio. [P2/1(e) | 8M] ✎ Write short notes on the following : (i) Pressurised radiator cap (ii) Nozzles of agricultural sprayers (iii) Accessories of tractor drawn mouldboard plough (iv) Gasification of biomass (v) Valve timing diagram of a 4-stroke cycle IC engine. [Note: Multi-chapter Q — IC-engine sub-parts only relevant for Ch 2; refer source paper for full Q.]. [P2/2(a) | 15M] ✎ Write down the functions of a Carburettor. Explain with the help of a sketch the principle and working of a simple Float-type Carburettor. [P2/2(b) | 15M]

	✎ Write down the functions of Fuel Injection Pump of a tractor engine. Discuss the importance of fuel viscosity in fuel injection system. [P2/4(b·i) | 8M]
2024	✎ Write short notes on the following : (i) Mechanical efficiency of IC engine (ii) Desirable characteristics of lubricants used in tractor (iii) Power take-off shaft of tractor (iv) Tractive efficiency. [Note: Multi-chapter Q — IC-engine sub-parts only relevant for Ch 2; refer source paper for full Q.]. [P2/1(b) | 8M]
2023	✎ Write short notes on the following : (i) Compression ratio of IC Engine (ii) Timing gears of IC Engine (iii) Harvesting methods for cereal crops (iv) Capacity of biogas plants. [Note: Multi-chapter Q — IC-engine sub-parts only relevant for Ch 2; refer source paper for full Q.]. [P2/1(c) | 8M] ✎ With line diagram of each event, explain the working of a four-stroke compression ignition engine. [P2/2(a) | 10M] ✎ Explain the fuel supply system of a compression ignition engine using a block diagram. [P2/4(a) | 10M]
2022	✎ Write the basic difference between compression ignition (CI) engine and spark ignition (SI) engine. [P2/1(b) | 8M] ✎ Determine the quantity of fuel to be injected per cycle per cylinder for a six-cylinder, 4-stroke diesel engine having brake-specific fuel consumption of 180 grams and developing 121 hp at 2500 r.p.m. [P2/1(e) | 8M] ✎ Write the full forms of the following : (i) SAE (ii) API (iii) DI (iv) IDI (v) CRDI (vi) ASTM (vii) BIS (viii) RON (ix) MON (x) TDC. [P2/3(a) | 10M] ✎ What is the composition and what are the properties of coolant used in cooling system of IC engine? Explain, with the help of labelled neat sketch, the working of forced feed cooling system of tractor engine. [P2/3(b) | 15M] ✎ With the help of P-V diagram, derive the expression for efficiency of ideal Otto cycle. [P2/4(c) | 15M]
2021	✎ Define the following terms : (i) Top Dead Centre (ii) Engine Displacement Volume (iii) Tappet Clearance (iv) Tilt Angle of a Standard Disc Plough (v) Field Performance Index (vi) Salvage Value of a Machine (vii) Total Solids (viii) Volatile Solids (ix) Hydraulic Retention Time (x) Solar Time. [Note: 10-bullet multi-chapter SN — only IC-engine sub-parts relevant for Ch 2; refer source paper for full Q.]. [P2/2(a) | 20M] ✎ Explain the different components of battery ignition system of a four-cylinder engine through neat sketch. [P2/4(a) | 10M]
2020	✎ With a line diagram of each stroke, explain the working of 4-stroke spark-ignition engine. [P2/2(a) | 10M] ✎ What is the purpose of air cleaning system? Write about the working of oil-bath type air cleaning system of a farm tractor. [P2/3(a) | 10M] ✎ 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 83%, calculate the developed brake horsepower of the engine. Write the functions of flywheel, timing gear and differential lock. [P2/4(a) | 10M]
2019	✎ Explain the working and importance of the thermostat valve in the cooling system of an I.C. engine. [P2/1(a) | 8M]

	✎ Explain the working principles of a centrifugal governor with neat sketch diagram. How is the speed maintained constant under varying load conditions in an I.C. engine?. [P2/1(b) | 8M] ✎ A high speed diesel engine running at 2000 rev/min has a single cylinder. During compression stroke, the fuel injection starts 20° before top dead centre and ends at the top dead centre. Calculate the duration (in seconds) of the fuel injection that takes place in the cylinder. [P2/1(e) | 8M] ✎ What do you mean by valve timing diagram of a four-stroke I.C. engine? Describe the occurrence of events in a four-cylinder four-stroke engine in a tabular form, having standard firing order. [P2/2(b) | 15M]
2018	✎ Explain the working of 4-stroke cycle diesel engine with the help of labelled sketch. [P2/1(b) | 8M] ✎ Define the following : (i) Volumetric efficiency (ii) Octane number (iii) IHP (iv) Detonation (v) Ignition delay (vi) Theoretical field capacity (vii) Scouring (viii) Centre of resistance of MB plough (ix) Disc angle (x) Solar constant. [Note: 10-bullet multi-chapter SN — only IC-engine sub-parts relevant for Ch 2; refer source paper for full Q.]. [P2/2(c) | 20M]
2017	✎ Differentiate between the following : (i) CI and SI engine (ii) Octane Number and Cetane Number (iii) Thermal efficiency and Mechanical efficiency (iv) Caster angle and Camber angle in tractor. [P2/1(b) | 8M] ✎ Explain the importance of cooling system in a tractor. Describe the principle and working of a forced circulation system. Why thermostat is used?. [P2/2(a) | 10M] ✎ Explain the working principle of internal combustion engine. How it differs from external combustion engine?. [P2/2(b) | 10M] ✎ A 4-stroke engine has a mean effective pressure of 7 kg/cm² ; area of piston 730 cm² ; 45 cm stroke length; 110 kg-m torque due to brake load; 4·5 kg fuel consumption per hour and working speed 120 rpm. Calculate IHP, BHP, Mechanical efficiency and specific fuel consumption. [P2/2(c) | 10M] ✎ Calculate the compression ratio and clearance volume of an engine whose dimensions are 100 × 120 mm and the length of clearance space at top dead centre being 8 mm. [P2/2(d) | 10M]
2016	✎ Draw a neat figure showing different components of a fuel supply system of a general purpose tractor and describe its working. [P2/2(a) | 10M] ✎ Describe the working of an oil bath type air cleaner. [P2/2(c) | 10M]

SECTION B – State PSC Previous-Year Questions	*39 questions • All states · year-descending*
✎ Define Cetane Number. With the help of neat sketch explain the working of 4-stroke cycle diesel engine. UK·PSC **ACF/RFO/Logging Officer (Mains) 2025 | Agri. Engineering | Q.5(iii) | 10M**	
✎ Describe the operation of 4-stroke internal combustion engine with suitable illustrations. Explain how fuel injection is done in Compression Ignition (CI) engines. In what way electronics are applied in modern fuel injection systems?. OPSC·CSE **CSE (Main) 2024–25 | Agri. Engineering | Paper-II, Q.1 | 15M**	
✎ Explain the working principle of the Otto cycle with the help of the P-V and T-S diagram. OPSC·CSE **CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.2(a) | 15M**	
✎ What are the primary factors influencing the thermal efficiency of internal combustion engines and how do they impact fuel energy conversion into useful work?.	

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OPSC·CSE CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.2(b) | 15M

- Explain the working principle of a 4-stroke diesel engine with the help of suitable figures.
  OPSC·CSE CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.3(a) | 15M
- What are a magneto ignition system's main components and working principles and how does it produce the high-voltage spark needed for internal combustion engines?.
  OPSC·CSE CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.3(b) | 15M
- What are the components of a tractor engine's lubrication system and why is lubrication important for engine function?.
  OPSC·CSE CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.4(a) | 15M
- What are the various types of efficiencies of an IC engine? Differentiate between these. Discuss the working parameters which can help to improve the efficiency of an engine.
  OPSC·Forest Forest Service (Main) 2023–24 | Agri. Engineering | Paper-II, Q.1(a) | 20M
- Differentiate between firing interval and firing order. What should be the firing interval and firing order of a 6 cylinder 4-stroke engine? What do you understand from a valve timing diagram?.
  OPSC·Forest Forest Service (Main) 2023–24 | Agri. Engineering | Paper-II, Q.2(a) | 20M
- Derive the thermal efficiency of Otto cycle.
  OPSC·CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.1(a) | 10M
- Describe the constructional features and working principle of valve train of an Internal Combustion (IC) engine.
  OPSC·CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.2(a) | 12M
- Draw the valve timing diagram of a Spark Ignition (SI) engine.
  OPSC·CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.2(b) | 12M
- A tractor engine rotates at 2100 r. p. m. and develops a torque of 79 Nm and it uses 1.17 kg of fuel in 15 min. Calculate the power developed, fuel consumption and specific fuel consumption of the engine.
  OPSC·CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.3(b) | 5M
- Explain the characteristic features of lubrication system of a tractor engine with a schematic diagram.
  OPSC·CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.14(a) | 13M
- Explain the role of oil rings and connecting rod on the effectiveness of engine lubrication.
  OPSC·CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.14(b) | 7M
- Briefly describe: (i) Volumetric efficiency (ii) Tappet clearance (iii) Hydrogenation (iv) King-pin inclination (v) Harvesting index. (vi) Calculate the theoretical power generated by a wind rotor of 5m diameter with wind velocity of 8.5 km/h. Assume air density 1.25 kg/m³. [Note: Multi-chapter Q — IC-engine sub-parts only relevant for Ch 2; refer source paper for full Q.].
  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.6(a) | 10M
- What are the functions of valves in IC engine? Describe the operation of valves in an IC engine.
  UK·PSC RFO (Mains) 2021 | Agri. Engineering | Q.5(ii) | 10M
- What are the main requirements of an efficient cooling system in an IC engine? Briefly describe the principle and advantages of thermo-siphon cooling system.
  UK·PSC RFO (Mains) 2021 | Agri. Engineering | Q.6(iv) | 10M

- A diesel engine has a compression ratio of 14 and cutoff ratio takes place at 6% of the stroke. Find the air standard efficiency. Take *γ* = 1.4.
  OPSC·CSE CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.1(b),(ii) | 10M
- Differentiate two stroke and four stroke single cylinder engines.
  OPSC·CSE CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.1(c),(i) | 10M
- A 2-cylinder, four stroke C.I. engine with volumetric efficiency 0.88 has stroke to bore ratio 1.12:1, stroke length = 100 mm, clearance volume of each cylinder is 100 cc and mean effective pressure is 6 x 105 Pa. If the piston makes 3000 strokes/min. Calculate: (a) B. H. P. of the engine (b) Air flow rate in m3/min (c) Compression ratio.
  OPSC·CSE CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.1(c),(ii) | 10M
- With the help of neat sketch diagram, describe the fuel supply system of spark ignition engine and compression ignition engine.
  OPSC·Forest Forest Service (Main) 2019–20 | Agri. Engineering | Paper-II, Q.1(a) | 20M
- What do mean by valve timing diagram of a four stroke IC engine? Describe the occurrence of events in a four cylinder four stroke engine in a tabular form having. standard firing order for proper balancing.
  OPSC·Forest Forest Service (Main) 2019–20 | Agri. Engineering | Paper-II, Q.2(b) | 20M
- What do you mean by valve timing diagram of a four stroke IC engine? Describe the occurrence of events in a four cylinder four stroke engine in a tabular form having standard firing order for proper balancing.
  OPSC·CSE CSE (Main) 2018–19 | Agri. Engineering | Paper-II, Q.1(a) | 20M
- What are the basic difference in fuel supply system of petrol engine and diesel engine? Support your answer with neat sketch diagrams.
  OPSC·CSE CSE (Main) 2018–19 | Agri. Engineering | Paper-II, Q.1(b) | 20M
- Describe the working principle of centrifugal governor used in the tractors. Explain governor hunting.
  OPSC·CSE CSE (Main) 2018–19 | Agri. Engineering | Paper-II, Q.2(a) | 20M
- A tractor is equipped with 4-cyclinder 4-stroke engine and it develops 45 hp at 1200rpm. Calculate :.
  OPSC·CSE CSE (Main) 2018–19 | Agri. Engineering | Paper-II, Q.2(b) | 20M
- A high speed diesel engine running at 2000 rev/min has single cyclinder. During compression stroke, about 20° before the top dead centre, the fuel injection starts and ends at the top dead centre. Calculate the duration in seconds, the fuel injection takes place in the cylinder.
  OPSC·CSE CSE (Main) 2018–19 | Agri. Engineering | Paper-II, Q.3(b) | 20M
- What do you mean by Otto cycle and Diesel cycle? Explain with neat diagram giving an expression for thermal efficiency.
  OPSC·CSE CSE (Main) 2017–18 | Agri. Engineering | Paper-II, Q.1(a) | 20M
- State the different components of carburetor and also explain with neat sketch the spark plug in petrol engine.
  OPSC·CSE CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.3(b) | 15M
- Explain the working of I.C. engine used in most of Indian Tractors. Why cooling system is essential in internal combustion engines? Differentiate between air cooled and water cooled systems.
  OPSC·CSE CSE (Main) 2015–16 | Agri. Engineering | Paper-II, Q.2(a) | 20M
- Compare two and four stroke-cycle engines on the basis of efficiency, power, utility and simplicity in

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design.

OPSC·Forest Forest Service (Main) 2015–16 | Agri. Engineering | Paper-II, Q.1(a) | 20M

- Calculate the weight of fuel per kW-h of a diesel engine that has the following specification:.

  OPSC·Forest Forest Service (Main) 2015–16 | Agri. Engineering | Paper-II, Q.1(b) | 20M

- What is the importance of lubrication system in a tractor? Explain briefly any one system of lubrication.

  UK·PSC RFO (Mains) 2015 | Agri. Engineering | Q.5(iii) | 10M

- Differentiate between four stroke cycle diesel engine and petrol engine.

  UK·PSC RFO (Mains) 2015 | Agri. Engineering | Q.6(i) | 10M

- How many times B.H.P. of an engine will increase or decrease if the diameter of the piston is increased by 20% and stroke length is decreased by 20%, all other factors remaining the same? Show complete calculations.

  UK·PSC RFO (Mains) 2015 | Agri. Engineering | Q.6(ii) | 10M

- Why tractor engine has a governor? How a tractor engine differs from a car engine with respect to governor?.

  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.1(G) | 4M

- Differentiate between Octane number and Cetane number.

  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.2(A) | 5M

- Explain the working of a four-stroke diesel engine with the help of neat diagram. Also mention its difference from a two-stroke engine.

  UK·PSC RFO (Mains) 2012 | Agri. Engineering | Q.8(ii) | 10M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	20	19	18	17	16	15	12	TOTAL
IFoS	6	1	3	5	2	3	4	2	5	2	·	·	33
OPSC·CSE	1	5	6	·	3	·	5	1	1	1	·	·	23
OPSC·Forest	·	2	·	·	·	2	·	·	·	2	·	·	6
MH·PSC	·	·	·	·	·	·	·	·	·	·	·	·	0
UK·PSC	1	·	·	·	2	·	·	·	·	·	3	1	7
HP·PSC	·	·	·	·	1	·	·	·	·	·	·	·	1
AP·PSC	·	·	·	·	·	·	·	·	·	·	·	2	2

HOT SUBTOPICS – Most-asked themes in Chapter 2

Frequency bars scaled to top topic (44 questions)

- Engine Classification & Cycles — 44 Qs
- Engine Performance & Efficiency — 17 Qs
- Fuel & Ignition Systems — 17 Qs
- Auxiliaries — Air Cleaner, Governor, Flywheel — 12 Qs
- Cooling & Lubrication Systems — 11 Qs
- Engine Geometry — 7 Qs
- Combustion & Fuels — 5 Qs

CHAPTER

3

TRACTORS, POWER TILLERS & HYDRAULICS

Tractor classification · Power train · Hydraulic 3PL · Wheels & stability · Power tillers · Brakes & traction aids

OFFICIAL SYLLABUS – Chapter 3 Scope

UPSC IFoS — Agricultural Engineering, Paper I, Section A — Topic 1: Soil and Water Conservation

- **Chapter 3 covers:** Tractor classification & types — general purpose, special purpose, utility, crawler vs wheeled, 2WD vs 4WD, mini/compact tractors. Power transmission train — clutch (single/dual/multi-plate), gear box (sliding mesh, constant mesh, synchromesh), differential (with lock), final drives, PTO shaft. Hydraulic system — hydraulic lift, draft control, draft sensing, position control, three-point linkage (lower link, top link), hitch system. Tractor wheels & geometry — wheelbase, track width, tyre inflation pressure (front vs rear), drive-wheel lugs, front-wheel adjustments (caster, camber, king-pin, toe-in). Tractor stability — overturn during turning, longitudinal/lateral stability, safe turning radius. Power tillers (walking tractors). Brakes & controls — independent brake pedals, differential brake. Traction aids — cage wheel, dual wheel, ballast, tyre chains. (Tractor selection, calibration, capacity & cost calculations are covered in Ch 1; tractive theory — drawbar pull, tractive efficiency, wheel slip, weight transfer — is covered in Ch 4.)

Full Topic 1 syllabus (this Chapter 3 + sister chapters in Module 1): Sources of farm power — human, animal, mechanical, electrical, wind, solar and biomass. Tractors and power tillers — principles of operation, types, classification, selection, calibration, calculation of capacity and cost. Field capacity — theoretical and effective; field efficiency. Internal combustion engines — principles, classification; fuel and ignition systems; lubrication, cooling and power transmission systems; comparison between IC engines and electric motors as a power source. Tillage implements — mould board plough, disc plough, harrow, cultivator, ridger, sub-soiler, rotavator, etc.; theory of soil cutting and pulverization; traction theory. Sowing and planting equipment; plant protection equipment — sprayers and dusters. Harvesting and threshing equipment — reapers, harvesters, threshers, combine harvesters. Equipment for earth-moving and land development — bulldozers, draglines, scrapers, etc.; ergonomic considerations and design of farm machines for safety and comfort. Renewable energy sources — solar, wind, biomass, biogas, etc.

SECTION A – UPSC IFoS Previous-Year Questions	*17 questions • 2016 – 2025*
2025	✎ What type of governor is generally used in tractors manufactured in India? Explain its working principle and operation with the help of a suitable diagram. [P2/3(a) | 15M]
2024	✎ Write the functions of the following : (i) Timing gear of an engine (ii) Flywheel of an engine (iii) Fluted roller type mechanism (iv) Differential unit of a tractor (v) Straw walker of a combine harvester. [Note: Multi-chapter Q — only Ch 3 (tractor) sub-parts apply here; refer source paper for full Q.]. [P2/2(c) | 15M]

2023	✎ Explain the working principle and uses of the following components of tractor power train : (i) Clutch (ii) Gear Box (iii) Differential (iv) Final Drives (v) Power Take-off. [P2/3(b) | 15M]
2021	✎ Describe in brief : (i) Why do rear wheels of general purpose tractors have tyre inflation pressure less than the front wheels? (ii) Why is a differential lock provided in a tractor? (iii) Why do tractors have independent brake pedals? (iv) Why are drive wheel tyres provided with lugs in general purpose tractors?. [P2/1(b) | 8M] ✎ With the help of a suitable block diagram indicate power transmission from engine to drive wheels in a tractor and describe the function of each component of the power train. [P2/3(a) | 15M] ✎ At what speed will a four-wheel tractor overturn during turning if its weight is 2 tonnes, centre of gravity 1 m ahead of rear axle and 75 cm above the ground, wheel base is 2·20 m and wheel spacing 1·6 m? The distance between the centre of rotation and centre of gravity is 4 m. [P2/4(c) | 15M]
2020	✎ 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 [Note: Multi-chapter Q — only Ch 3 (tractor) sub-parts apply here; refer source paper for full Q.]. [P2/1(b) | 8M] ✎ Justify the following : (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? [Note: Multi-chapter Q — only Ch 3 (tractor) sub-parts apply here; refer source paper for full Q.]. [P2/1(c) | 8M] ✎ With a flow chart, explain the working of tractor power train by mentioning the function of each component. [Note: Split sub-part from a multi-part Q — refer source paper for sibling sub-parts assigned to other chapters.]. [P2/2(b·ii) | 10M]
2019	✎ What do you understand by draft sensing in hydraulics of a tractor? Discuss with the help of suitable diagram, the automatic position control systems on tractors. [P2/2(c) | 15M] ✎ What are the different adjustments in the front wheels of tractors? Discuss with the help of suitable diagram. [P2/3(c) | 15M] ✎ A multi-plate clutch is to be designed for a vehicle whose engine develops maximum torque of 13 Nm at 3500 r.p.m. The external diameter of the clutch facings is limited to 100 mm and the inner diameter may be assumed to be 0·2 times the external diameter. The maximum intensity of pressure may be taken as 80 kPa and $\mu = 0{\cdot}3$. Calculate the number of plates. Assume uniform wear. [P2/4(a) | 10M] ✎ What is the purpose of traction aids in wheeled tractors? Discuss the different types of traction aids used in a wheeled tractor. [P2/2(a) | 10M]
2018	✎ How is power transmitted from the engine to the traction wheels and PTO shaft of two-wheel drive tractor? Explain with a schematic diagram. [P2/3(b) | 10M]
2016	✎ Differentiate between the following in brief : (i) Naturally aspirated engine and Turbo-charged engine (ii) Centrifugal pump and Gear pump (iii) Single plate clutch system and Dual plate clutch system (iv) Wheel base and Track width [Note: Multi-chapter Q — only Ch 3 (tractor) sub-parts apply here; refer source paper for full Q.]. [P2/1(a) | 8M] ✎ Draw a neat schematic diagram of a tractor power train and discuss the significance of each member of the power train. [P2/2(b) | 10M]

	✎ Answer the following : (i) Why do general purpose tractors have larger rear wheels and smaller front wheels? (ii) Why is a certain amount of valve clearance provided in valves of IC engines? (iii) Why do tractor rear wheels have lesser inflation pressure than the front wheels? (iv) Why is a breather provided in an engine? (v) Why does the radiator in a tractor cooling system have a pressure cap? [Note: Multi-chapter Q — only Ch 3 (tractor) sub-parts apply here; refer source paper for full Q.]. [P2/2(d) | 10M]

SECTION B – State PSC Previous-Year Questions

11 questions • All states · year-descending

✎ Describe the role of the clutch, gearbox and differential in transmitting power from the engine to the wheels of a tractor.

OPSC·CSE **CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.4(b) | 15M**

✎ With a neat diagram, explain the working of a sliding mesh type gear box. How does anthropometric data help in design of agricultural machinery?.

OPSC·Forest **Forest Service (Main) 2023–24 | Agri. Engineering | Paper-II, Q.2(b) | 20M**

✎ Total draft indicated by the dynamometer = 1200 kgf - Distance moved by the tractor while ploughing = 50 meters - Time taken to move 50 meters by the tractor = 30 seconds Calculate the drawbar horse power developed and the forward speed in km/hr. - What are the functions of differential, final drives and power take off in a tractor.

OPSC·CSE **CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.3(a),(i) | 8M**

✎ What do mean by transmission system of a tractor? What are the functions of transmission system?.

OPSC·Forest **Forest Service (Main) 2019–20 | Agri. Engineering | Paper-II, Q.2(a) | 20M**

✎ The torque developed in kg-m. The volume of fuel required for a single power impulse in any cylinder if the SFC is 0.225 kg/bhp-hr and specific gravity is 0.80. Elaborate the function of differential with the help of suitable sketch. What are the advantages of the differential locks? [Note: Multi-chapter Q — only Ch 3 (tractor) sub-parts apply here; refer source paper for full Q.].

OPSC·CSE **CSE (Main) 2018–19 | Agri. Engineering | Paper-II, Q.2(c) | 20M**

✎ Explain the power transmission system of tractor with neat diagram.

OPSC·CSE **CSE (Main) 2017–18 | Agri. Engineering | Paper-II, Q.2(a) | 20M**

✎ A tractor of 3,000kg weight is moving with a speed of 25 kmph on a road. To avoid side over turning and safely turning of the tractor, determine minimum radius of safe turning of the tractor with track width of 1.8m and the centre of gravity of the tractor lies 0.8m above ground surface.

OPSC·CSE **CSE (Main) 2015–16 | Agri. Engineering | Paper-II, Q.1(c) | 20M**

✎ What is the importance of power. transmission system in a tractor? Describe working of power transmission train of a tractor with a labelled diagram. Describe various points of power outlets of a tractor and percentage of power availability at these points.

OPSC·CSE **CSE (Main) 2015–16 | Agri. Engineering | Paper-II, Q.3(a) | 20M**

✎ Why does a tractor need clutch? What are essential features of a good clutch?.

AP·PSC **RFO (Mains) 2012 | Agri. Engineering | Q.2(B) | 5M**

✎ What do you understand by a farm tractor? Explain different types of tractors being used for various purposes on Indian farms. What is power tiller?.

UK·PSC **RFO (Mains) 2012 | Agri. Engineering | Q.5(i) | 10M**

With the help of a diagram and labelled parts, explain the need and working principle of differential system of a tractor.

UK·PSC RFO (Mains) 2012 | Agri. Engineering | Q.7(ii) | 10M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	21	20	19	18	16	12	TOTAL
IFoS	1	1	1	3	3	4	1	3	·	17
OPSC·CSE	·	1	·	1	·	1	1	2	·	6
OPSC·Forest	·	1	·	·	1	·	·	·	·	2
MH·PSC	·	·	·	·	·	·	·	·	·	0
UK·PSC	·	·	·	·	·	·	·	·	2	2
HP·PSC	·	·	·	·	·	·	·	·	·	0
AP·PSC	·	·	·	·	·	·	·	·	1	1

HOT SUBTOPICS – Most-asked themes in Chapter 3

Frequency bars scaled to top topic (17 questions)

- Power Transmission Train — 17 Qs
- Wheels, Geometry & Stability — 4 Qs
- Tractor Classification & Types — 2 Qs
- Hydraulic System & 3-Point Linkage — 2 Qs
- Power Tillers (Walking Tractors) — 1 Qs
- Brakes, Controls & Traction Aids — 1 Qs

CHAPTER

4

TILLAGE IMPLEMENTS & TRACTION THEORY

Plough/harrow/cultivator/rotavator · MB & disc geometry · Implement attachment · Traction theory · Soil cutting

OFFICIAL SYLLABUS – Chapter 4 Scope

UPSC IFoS — Agricultural Engineering, Paper I, Section A — Topic 1: Soil and Water Conservation

- **Chapter 4 covers:** Tillage classification (primary/secondary/conservation/zero) and objectives. Plough types — MB plough (with coulter, jointer, share, frog, mouldboard, land side, vertical/horizontal suction), disc plough, indigenous/soil-turning ploughs, centre of resistance & centre of pull. Disc plough/harrow geometry — disc angle, tilt angle, gang angle, concavity, single vs double action, offset vs tandem, factors affecting penetration. Other implements — cultivator (rigid/flexible tine), rotavator/rotary tiller, subsoiler, spike-tooth & spring-tooth harrow, ridger, puddler. Implement attachment — trailed, mounted, semi-mounted classification. Traction theory — drawbar pull/power, tractive efficiency, coefficient of traction, unit/specific draft, rolling resistance, wheel slip vs wheel skid, rim pull, weight transfer in tractor pulling implement. Theory of soil cutting and pulverization. Field-capacity and draft calculations in plough/cultivator context.

Full Topic 1 syllabus (this Chapter 4 + sister chapters in Module 1): Sources of farm power — human, animal, mechanical, electrical, wind, solar and biomass. Tractors and power tillers — principles of operation, types, classification, selection, calibration, calculation of capacity and cost. Field capacity — theoretical and effective; field efficiency. Internal combustion engines — principles, classification; fuel and ignition systems; lubrication, cooling and power transmission systems; comparison between IC engines and electric motors as a power source. Tillage implements — mould board plough, disc plough, harrow, cultivator, ridger, sub-soiler, rotavator, etc.; theory of soil cutting and pulverization; traction theory. Sowing and planting equipment; plant protection equipment — sprayers and dusters. Harvesting and threshing equipment — reapers, harvesters, threshers, combine harvesters. Equipment for earth-moving and land development — bulldozers, draglines, scrapers, etc.; ergonomic considerations and design of farm machines for safety and comfort. Renewable energy sources — solar, wind, biomass, biogas, etc.

SECTION A – UPSC IFoS Previous-Year Questions	*20 questions • 2016 – 2025*
2025	✎ A disc harrow with a draft of 18 N is required to be pulled at a speed of 4 km/h in a firm untilled field by a tractor having maximum PTO power rating of 40 kW. Calculate the actual PTO power needed to pull the harrow, if the tractive and transmission coefficient for a 2-wheel drive tractor for the untilled firm soil is 0·75. [Note: Split sub-part from a multi-part Q — refer source paper for sibling sub-parts assigned to other chapters.]. [P2/1(b·ii) | 4M] ✎ (i) What types of disc harrow fall under the category of 'Double Action' disc harrow? Explain their working with a line sketch. [5 M] (ii) A tractor weighing 28·5 kN with a front wheel reaction of 9·0

	kN, is in static position on a horizontal surface. The wheelbase is 2·08 m. Calculate the horizontal distance from the rear axle centreline to the centre of gravity. Also, calculate the rear wheel reaction and explain with reason if it is a 2-wheel drive or a 4-wheel drive tractor. [10 M]. [P2/3(b) | 15M] ✎ Classify implements on the basis of how they are attached to a wheel-type Agricultural Tractor and discuss each. [P2/4(c) | 10M]
2024	✎ Write about the effect of the following : (i) Overlapping of discs on field capacity of disc plough (ii) Liquid pressure in a sprayer on nozzle characteristics (iii) Level of oil in an oil-bath type air cleaner (iv) Drive wheel tyre pressure on tractive performance [Note: Multi-chapter Q — only Ch 4 (tillage / traction) sub-parts apply here; refer source paper for full Q.]. [P2/1(d) | 8M] ✎ The line of pull of a 1·2 m width cultivator is inclined at 20° with horizontal and acting on the vertical plane along the direction of motion. If the pull required by the prime mover at 3 km/h forward speed is 10 kN, determine the drawbar power. [P2/2(a) | 10M] ✎ Write about different adjustments of standard disc plough and mould board plough for effective field operation. [P2/3(a) | 10M] ✎ Write the difference between the following : (i) Conventional tillage and Conservation tillage [Note: Fragment sub-bullet — parent Q has additional bullets distributed across other chapters per source design; refer original paper for context.]. [P2/1(c·i) | 2M]
2023	✎ A track-type tractor with two tracks each of 300 mm width and 1500 mm length weighs 30 kN. While pulling an implement at a forward speed of 3·6 km/h, the tractor experiences a rolling resistance of 3 kN. Calculate : (i) Gross traction coefficient. (ii) Drawbar power in kW. Consider soil cohesion as 8 kPa and angle of internal friction as 30°. [P2/4(c) | 15M]
2022	✎ What are the different factors affecting the penetration of disc harrow? Define gang angle and its adjustment. [P2/1(c) | 8M] ✎ Distinguish between the following : (i) Wheel slip and Wheel skid (ii) Vertical suction and Horizontal suction of MB plough (iii) Coulter and Jointer in a plough (iv) Trailed type and Mounted type implement (v) Disc angle and Tilt angle of a disc plough. [P2/2(a) | 10M] ✎ Write about the care and maintenance during operation and storage of the following : (i) Disc plough and disc harrow (ii) Sprayer and duster (iii) Rotavator [Note: Multi-chapter Q — only Ch 4 (tillage / traction) sub-parts apply here; refer source paper for full Q.]. [P2/**4(b)** | **15M]**
2020	✎ Write about the objectives of primary and secondary tillage. [Note: Split sub-part from a multi-part Q — refer source paper for sibling sub-parts assigned to other chapters.]. **[P2/2(b·i)** | **5M]** ✎ 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 kilometres 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/s²). [P2/3(b) | 15M] ✎ Write short notes on the following : (i) Tractive efficiency (Traction Theory) [Note: Fragment sub-bullet — parent Q has additional bullets distributed across other chapters per source design; refer original paper for context.]. [P2/4(c·i) | 3M]
2018	✎ Define tillage. What do you understand by primary tillage and secondary tillage? Classify implements on the basis of how they are attached to the tractor. [P2/1(a) | 8M] ✎ What is traction? Explain with proper equations/expressions how the traction can be improved under (i) sandy soil, and (ii) clayey soil conditions. [P2/1(d) | 8M]

2017	✎ Total draft of a 4-bottom trailed Mould Board plough is 2000 kg when it is moving at a speed of 6 km/h. Calculate : (i) the unit draft in kg/cm² if the depth of cut is 20 cm (ii) drawbar horse power required to operate the implement and (iii) field capacity. [P2/1(d) | 8M] ✎ What is secondary tillage system? Write its objectives. Explain utility of spike tooth and spring tooth harrows. [P2/1(e) | 8M]
2016	✎ Differentiate between the following in brief : (i) Indigenous and Soil turning ploughs (ii) Offset and Tandem disc harrow (iii) Seed drill and Planter (iv) Centre of resistance and Centre of pull. [P2/1(b) | 8M] ✎ Numerical : (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. (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. (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. (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. [Note: Multi-chapter Q — only Ch 4 (tillage / traction) sub-parts apply here; refer source paper for full Q.]. [P2/1(d) | 8M]

SECTION B – State PSC Previous-Year Questions

34 questions • All states · year-descending

✎ What are the functions of M.B. plough? Write in brief about its components and accessories.
UK·PSC **ACF/RFO/Logging Officer (Mains) 2025 | Agri. Engineering | Q.5(i) |** 10M

✎ Discuss in brief about traction theory and weight transfer in agricultural tractors. Explain how traction can be increased in.
UK·PSC **ACF/RFO/Logging Officer (Mains) 2025 | Agri. Engineering | Q.5(iv) |** 10M

✎ Define tillage. State its objectives. Classify implements on the basis how they are attached to the tractors.
MH·PSC **Forest Services (Mains) 2024 | Agri. Engineering | Q.5(a) |** 8M

✎ Discuss the kinematic principles of tractor-implement combination and illustrate the various forces acting on a tractor pulling an implement. Derive the weight transfer within the tractor in rest condition and when the implement is attached and pulled.
OPSC·CSE **CSE (Main) 2024–25 | Agri. Engineering | Paper-II, Q.2 |** 15M

✎ Explain the interrelationship between wheel slip at a drawbar pull, tractive coefficient and tractive efficiency. When a tractor was tested at no-load and load, the distance covered by the rear wheel was 55.8 m and 46.2 m respectively. Calculate the wheel slip in this case.
OPSC·CSE **CSE (Main) 2024–25 | Agri. Engineering | Paper-II, Q.3 |** 15M

✎ A tractor attached with a cultivator of 3.5 m width is used to cultivate 50 ha of field at a travel speed of 5.0 km/h. Determine the time taken to complete the operation and also theoretical field capacity of the cultivator. Assuming the tractor operator reports a time loss of 0.75 h per 10 h of field operation, what is the effective field capacity?.
OPSC·CSE **CSE (Main) 2024–25 | Agri. Engineering | Paper-II, Q.4 |** 15M

✎ A 4-bottom 30 cm mouldboard plough is drawn by a tractor at a speed of 5 km/h. The soil resistance is 0.7 kg/cm2. The working depth is 15 cm. Find ***(a)*** the centre of resistance from the wing of the first

bottom for this 4-bottom 30 cm mouldboard plough and ***(b)*** the horsepower needed to pull the plough.

OPSC·CSE CSE (Main) 2024–25 | Agri. Engineering | Paper-II, Q.14 | 20M

- What is the slippage of a traction wheel that underwent testing in a soil bin featuring a 600 mm diameter? The provided data includes an angular speed of 10 RPM, an input torque to the wheel of 60 Nm, a drawbar pull of 150 N, a normal load on the wheel axle of 500 N and a wheel forward speed of 0.25 m/s.

  OPSC·CSE CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.6(a) | 15M

- How does the location of a tractor's Center of Gravity (CG) influence the performance of tillage implements?.

  OPSC·CSE CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.9(a) | 15M

- Describe the critical design features of primary tillage equipment that contribute to their efficiency.

  OPSC·CSE CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.9(b) | 15M

- What are the various types of tillage followed giving example of machinery used for each of these types? Differentiate between the types of furrow openers used on these listed machines.

  OPSC·Forest Forest Service (Main) 2023–24 | Agri. Engineering | Paper-II, Q.1(b) | 20M

- Graphically illustrate the tractor drawbar performance in terms of drawbar pull and fuel consumption.

  OPSC·CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.3(a) | 10M

- Derive an expression for the weight transfer in a tractor pulling an attached implement.

  OPSC·CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.13(a) | 10M

- A disc harrow having disc diameter 560mm covers a width of 125mm and is operating at a speed of 4.5km.h-1. The average soil resistance is 0.63kg.cm-2. Determine the actual field capacity and horsepower required to pull the plough, if the field efficiency is 75 per cent.

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.5(a) | 10M

- Explain the working of indigenous plough used in your state with details of line sketch, parts, ploughing procedure/pattern, furrow cross section, methods of layout of land, soil deformation, adjustments, field capacity and power requirement.

  OPSC·CSE CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.2(a) | 20M

- Find out the horse power developed by a pair of bullocks in pulling plough at the forward speed of 3km/hr the plough makes a furrow 20 cm wide and 11 cm deep. The dynamometer indicates an average draft of 85 kgf. What will be the. unit draft?.

  OPSC·CSE CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.2(b),(ii) | 12M

- While testing a two bottom tractor drawn M. B. plough the following observations are noted:.

  OPSC·CSE CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.2(c),(ii) | 12M

- Name the different implements used as Primary tillage and Secondary tillage. How a disc plough differs with mould board plough in principle? What are the advantages and disadvantages of disc plough?.

  OPSC·Forest Forest Service (Main) 2019–20 | Agri. Engineering | Paper-II, Q.1(b) | 20M

- What are the various forces acting upon the mould board plough used for tillage operation? Elaborate graphically.

  OPSC·CSE CSE (Main) 2018–19 | Agri. Engineering | Paper-II, Q.3(a) | 20M

- Weight transfer on rear axle - Coefficient of traction - Tractive efficiency - A 35 HP tractor costing Rs. 5 lakh

is expected to have a useful life of 10 years. Calculate the depreciated value after 5 years, by 3 different methods, assuming the salvage value as 10% of initial cost.

OPSC·CSE CSE (Main) 2017–18 | Agri. Engineering | Paper-II, Q.1(d) | 20M

- How the primary and secondary tillage equipments differ in field working? To what an extent they supplement each other?.

  OPSC·CSE CSE (Main) 2017–18 | Agri. Engineering | Paper-II, Q.2(c) | 20M

- Weight transfer on rear axle - Coefficient of traction - Tractive efficiency. - What are the different types of transmission systems used in a tractor engine? Explain any one of them.

  OPSC·CSE CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.2(a) | 15M

- The total draft of a 3-bottom 30cm MB plough, when ploughing 20cm deep at 5km/h was 12 kN. Calculate:.

  OPSC·CSE CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.2(d) | 15M

- Specific draft in N/cm2. - What is the actual power requirement? - If the field efficiency is 80%, what would be the rate of work in ha/h. - Write the name of any 5 tractors, their manufacturers in India along with their specifications.

  OPSC·CSE CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.3(a) | 15M

- Explain the forces acting upon a tillage tool. Explain the working and importance of the tractor drawn tillage tool. Which is very efficient and can prepare seed bed in single run. State the salient features and advantages of Zero till Drill.

  OPSC·CSE CSE (Main) 2015–16 | Agri. Engineering | Paper-II, Q.1(b) | 20M

- Find out tractive force of a tractor and weight transfer to the real wheel with the following data: Tractor weight : 2,500 kg. wheel base : 2.2 m, C. G from real axle : 0.8 m, Vertical distance of C. G. from ground : 0.8 m, pull of 1,500 kg at an angle of 30° to the horizontal, the angle of cohesion is 20°, area of contact of rear wheel : 2,000 cm2, soil resistance: 0.1 kg/cm2.

  OPSC·CSE CSE (Main) 2015–16 | Agri. Engineering | Paper-II, Q.1(d) | 20M

- A tractor is pulling 4 × 40 cm mould board plough in a barren land with depth of ploughing 15 cm and speed of operation as 6 km/hr. Assume soil resistance as 0.4 kg/ cm2, shape of furrow is rectangular and field efficiency is 85%, calculate: power requirement to pull the plough, time require to plough 8 ha land. Please comments on status of draft, power requirement and field capacity if the plough is to be operated in a grassy land.

  OPSC·CSE CSE (Main) 2015–16 | Agri. Engineering | Paper-II, Q.3(b) | 20M

- Primary and Secondary tillage tools - Trailed, Semi-mounted and Mounted implements - Fixed type M. B. plough and Turn wrest plough - Disc plough and M.B. plough - Spring loaded cultivator and Rigid tined cultivator - Describe various unit operations in Agricultural Processing.

  OPSC·Forest Forest Service (Main) 2015–16 | Agri. Engineering | Paper-II, Q.5(a) | 20M

- Draw neat figures showing arrangement of discs in a single action, tandem and offset disc harrows. Describe how the depth of penetration is controlled in these harrows?.

  UK·PSC RFO (Mains) 2015 | Agri. Engineering | Q.6(iii) | 10M

- How a disc plough differs with mould board plough in principle?.

  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.1(I) | 4M

- What is the difference between disc angle and tilt angle?.

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AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.2(C) | 5M

- Explain the functions of various parts of a mould board plough with the help of a neat labelled diagram. Also, indicate various forces acting on it and mention their significance.

  UK·PSC RFO (Mains) 2012 | Agri. Engineering | Q.5(ii) | 10M

- What are various types of mould boards in a mould board plough? Explain their suitability for different soil conditions.

  UK·PSC RFO (Mains) 2012 | Agri. Engineering | Q.7(iv) | 10M

- A 40 cm mould board plough bottom makes 15 cm deep furrow in a field. Compute unit draft and horse power required for a two-bottom mould board plough working at 5 km per hour speed and 1200 kg. draft.

  UK·PSC RFO (Mains) 2012 | Agri. Engineering | Q.8(i) | 10M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	20	19	18	17	16	15	12	TOTAL
IFoS	3	4	1	3	·	3	·	2	2	2	·	·	20
OPSC·CSE	4	3	2	·	3	·	1	2	3	3	·	·	21
OPSC·Forest	·	1	·	·	·	1	·	·	·	1	·	·	3
MH·PSC	·	1	·	·	·	·	·	·	·	·	·	·	1
UK·PSC	2	·	·	·	·	·	·	·	·	·	1	3	6
HP·PSC	·	·	·	·	1	·	·	·	·	·	·	·	1
AP·PSC	·	·	·	·	·	·	·	·	·	·	·	2	2

HOT SUBTOPICS – Most-asked themes in Chapter 4

Frequency bars scaled to top topic (18 questions)

- Traction Theory — 18 Qs
- Tillage Classification & Objectives — 16 Qs
- MB Plough — Geometry & Components — 15 Qs
- Disc Plough & Harrow — 14 Qs
- Other Tillage Implements — 10 Qs
- Soil Cutting & Field-Draft Numericals — 9 Qs
- Implement Attachment Classification — 4 Qs

CHAPTER

5

SOWING & PLANT PROTECTION EQUIPMENT

Seed drills · Planters & transplanters · Furrow openers & metering · Sprayers · Dusters · Nozzles & atomization

OFFICIAL SYLLABUS – Chapter 5 Scope

UPSC IFoS — Agricultural Engineering, Paper I, Section A — Topic 1: Soil and Water Conservation

- **Chapter 5 covers:** Sowing equipment — seed drill, fertilizer drill, seed-cum-fertilizer drill, planter (corn/row/horizontal-plate/vertical-plate), transplanter, broadcasters. Seed-drill components & metering — furrow openers (shoe, hoe, disc, shovel), fluted-roller, cell metering, inclined plate, cup feed, seed/fertilizer metering rate, seed-drill calibration, seed spacing. Sowing methods — broadcasting, drilling, hill dropping, check-row planting, precision planting, transplanting. Plant-protection equipment — sprayers (hydraulic / air-assisted / mist blower / knapsack / compression / rocker / power / boom), dusters; manually-operated vs power-operated. Sprayer components & operation — pumps, hydraulic & air-shear nozzles (solid cone, hollow cone, flat fan, flood jet), spray pattern, atomization, droplet size (VMD/NMD), application rate, spray volume. Sprayer numericals — nozzle flow rate, working pressure, pump power, droplet characteristics.

Full Topic 1 syllabus (this Chapter 5 + sister chapters in Module 1): Sources of farm power — human, animal, mechanical, electrical, wind, solar and biomass. Tractors and power tillers — principles of operation, types, classification, selection, calibration, calculation of capacity and cost. Field capacity — theoretical and effective; field efficiency. Internal combustion engines — principles, classification; fuel and ignition systems; lubrication, cooling and power transmission systems; comparison between IC engines and electric motors as a power source. Tillage implements — mould board plough, disc plough, harrow, cultivator, ridger, sub-soiler, rotavator, etc.; theory of soil cutting and pulverization; traction theory. Sowing and planting equipment; plant protection equipment — sprayers and dusters. Harvesting and threshing equipment — reapers, harvesters, threshers, combine harvesters. Equipment for earth-moving and land development — bulldozers, draglines, scrapers, etc.; ergonomic considerations and design of farm machines for safety and comfort. Renewable energy sources — solar, wind, biomass, biogas, etc.

SECTION A – UPSC IFoS Previous-Year Questions	*12 questions • 2016 – 2025*
2025	✎ What is Atomization? Discuss the main fluid properties that affect droplet size in agricultural spraying. [Note: Split sub-part from a multi-part Q — refer source paper for sibling sub-parts assigned to other chapters.]. [P2/4(b·ii) | 7M]
2024	✎ Write the difference between the following : (i) Sowing and Transplanting operation [Note: Fragment sub-bullet — parent Q has additional bullets distributed across other chapters per source design; refer original paper for context.]. [P2/1(c·ii) | 2M]
2023	✎ Explain the construction and working of a tractor-drawn seed drill. [P2/2(b) | 15M]

2022	✎ Calculate the diameter and the peripheral distance between the two consecutive cells to get 20 cm seed spacing by a seed planter having speed ratio between ground wheel and rotor as 4 : 3. Assume wheel diameter as 70 cm, rotor speed for 93 percent fill as 27 m/min, and travel speed as 3·2 km/h. [P2/2(b) | 15M]
2021	✎ What are the different types of sprayers used on agricultural farms? Explain the functioning of manually operated knapsack sprayer with suitable diagram. [P2/3(b) | 15M]
2020	✎ What is the necessity of seed drill calibration? Explain the sequential steps followed in seed drill calibration. [P2/3(c) | 15M]
2019	✎ Draw a neat sketch showing the basic components of a tractor mounted hydraulic sprayer having mechanical agitation. Explain the different factors that affect the amount of spray liquid applied per hectare by a field sprayer. [P2/3(a) | 10M]
2018	✎ What is the function of furrow opener in a seed drill? Write down the different types of furrow openers, their construction and the soil conditions in which they are suitable. [P2/2(a) | 10M] ✎ A tractor operated hydraulic sprayer has 13 nozzles at 40 cm spacing. The application rate and speed of travel are 800 lit/ha and 5 km/h, respectively. Determine the nozzle flow rate in lit/min. Also determine the working pressure and power requirement of the pump if the nozzle diameter is 0·5 mm. Consider the coefficient of discharge and mechanical efficiency of the pump as 0·35 and 0·6, respectively. [P2/3(c) | 20M]
2017	✎ What is the function of hydraulic nozzle in plant protection equipment? Enlist different types of hydraulic nozzles and their application. [P2/3(d) | 10M]
2016	✎ 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?. [P2/3(a) | 10M] ✎ 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. [P2/3(b) | 10M]

SECTION B – State PSC Previous-Year Questions

22 questions • All states · year-descending

✎ What is necessity of seed drill calibration? Explain the sequential steps followed in seed drill calibration.
MH·PSC **Forest Services (Mains) 2024** | **Agri. Engineering** | **Q.6(a)** | 15M

✎ Explain the working of most commonly used metering mechanism in a seed drill for wheat crop. What is the principle difference between seed drilling and planting?.
OPSC·Forest **Forest Service (Main) 2023–24** | **Agri. Engineering** | **Paper-II, Q.3(a)** | 20M

✎ A planter has a vertical rotor metering device with no seed ejector. The unit is operated without a seed tube and the seeds are released from the periphery of the rotor at the lowest point and falling freely by gravity to the furrow bottom 90 mm below. The peripheral speed of the rotor is 20 m/min and that of the ground wheel is 5 km/h. How far the seed moves horizontally forward or backward| between the point of discharge at the rotor and the point of impact on the furrow? The direction of rotation of the rotor is opposite to that of the ground wheels.
OPSC·CSE **CSE (Main) 2022–23** | **Agri. Engineering** | **Paper-II, Q.4(a)** | 10M

✎ Describe the construction of a tractor operated boom sprayer.

OPSC·CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.15(a) | 10M

- A farmer is aiming to apply an insecticide on his crop at the rate of 1.1 kg per hectare using a power sprayer. The spray solution needs to be prepared by mixing 0.9 kg of insecticide in 90 litres of water. The rated delivery from each nozzle of power sprayer was set to 0·5 litres/min at a pressure of 2.7 kg/cm2. If the nozzles are spaced 60 cm apart, find the forward speed of travel of sprayer for a pressure setting of 2.1 kg/cm2.

  OPSC·CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.15(b) | 10M

- Briefly describe : (i) Horizontal suction and Vertical suction (ii) Hill dropping and Check-row planting (iii) VMD and NMD (iv) Octane number and Cetane number. [Note: Multi-chapter Q — only Ch 5 (sowing / plant protection) sub-parts apply here; refer source paper for full Q.].

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.5(d) | 10M

- Differentiate between a seed drill and a planter. Describe the operation of a planter.

  UK·PSC RFO (Mains) 2021 | Agri. Engineering | Q.5(iii) | 10M

- A plunger barrel type pump of a tractor PTO operated sprayer is required to deliver fluid @ 91.6 lpm at a speed of 1500 rpm against a fluid pressure of 15 MPa. Calculate pump efficiency if shaft power needed to operate the pump is 27.5 kW. Also determine torque requirement of the pump.

  OPSC·CSE CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.1(d),(ii) | 12M

- What are the different types of seed metering mechanism? Explain the working of fluted roller type and internal double run type metering mechanism.

  OPSC·Forest Forest Service (Main) 2019–20 | Agri. Engineering | Paper-II, Q.3(a) | 20M

- What is the difference between a sprayer and a duster? How a knapsack type duster differs from rotary duster?.

  OPSC·Forest Forest Service (Main) 2019–20 | Agri. Engineering | Paper-II, Q.3(b) | 20M

- Maximum yield of maize is obtained with a population of 40000 plants per hectare. The rows are 100cm apart and an average emergence is 90% expected. What would be the seed spacing?.

  OPSC·CSE CSE (Main) 2018–19 | Agri. Engineering | Paper-II, Q.3(c) | 20M

- A3 × 22 cm bullock drawn seed drill is being used for sowing wheat crop. The speed of drilling machine is 3 km/h. Seed rate setting is 90 kg/ha.

  OPSC·CSE CSE (Main) 2017–18 | Agri. Engineering | Paper-II, Q.4(a) | 20M

- What are the advantages and salient features of zero till seed drill and pneumatic seed drill over the conventional seed drill. What are the advantages of precision seed drill / precision planter?.

  OPSC·CSE CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.1(b) | 20M

- An air blast sprayer is to be operated at 3 km/h and the desired application rate is 18 liter per tree. The tree spacing is 9m × 9m. each nozzle delivers 5 liters/min at the operating pressure of 4.0 × 105 N/m2. If one half row is sprayed from each side of the machine, how many nozzles will be needed?.

  OPSC·CSE CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.3(d) | 15M

- Explain, in brief, various sowing and planting machines. Also, discuss the calibration of Pneumatic seed drill.

  OPSC·CSE CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.4(a) | 15M

- A 8-row automatic transplanter operates at a forward speed of 0.25m/s. If the seedling spacing along the row is 0.25m and row to row distance is 0.75m, calculate the feed rate of seedling into the planter.

OPSC·CSE CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.4(b) | 15M

- Classify different types of seed metering mechanisms used in sowing machines. Find the suction capacity of a power sprayer if diameter is 30 mm, speed is 1000 rpm, length of stroke is 25 mm, number of plunger is 3. If the pump efficiency of the power sprayer is 90%, calculate the shaft power at the pressure of 40kg/cm2.

  OPSC·CSE CSE (Main) 2015–16 | Agri. Engineering | Paper-II, Q.2(b) | 20M

- What are the different types of sprayers? Describe the working of Knapsack type sprayer with the help of a neat sketch.

  OPSC·Forest Forest Service (Main) 2015–16 | Agri. Engineering | Paper-II, Q.2(b) | 20M

- What are the advantages and salient features Pneumatic Seed Drill and Zero Till Seed Cum Fertilizer Drill over the conventional seed drill?.

  OPSC·Forest Forest Service (Main) 2015–16 | Agri. Engineering | Paper-II, Q.4(a) | 20M

- The following results were obtained while calibrating a seed drill. Calculate the seed rate per hectare, if size of seed drill 10 x 20 cm, No. of furrows 10, spacing between furrows 20 cm, diameter of ground wheel = 1.2 metre. No. of revolutions = 100, seed collected = 3.5 kg.

  UK·PSC RFO (Mains) 2015 | Agri. Engineering | Q.5(ii) | 10M

- What is seed drill and what are the functions of a seed drill?.

  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.4(C) | 10M

- What is a seed drill? Mention the functions of various parts of seed drill. Explain the stepwise procedure for calibration of a seed drill.

  UK·PSC RFO (Mains) 2012 | Agri. Engineering | Q.6(iv) | 10M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	20	19	18	17	16	15	12	TOTAL
IFoS	1	1	1	1	1	1	1	2	1	2	·	·	12
OPSC·CSE	·	·	3	·	1	·	1	1	4	1	·	·	11
OPSC·Forest	·	1	·	·	·	2	·	·	·	2	·	·	5
MH·PSC	·	1	·	·	·	·	·	·	·	·	·	·	1
UK·PSC	·	·	·	·	1	·	·	·	·	·	1	1	3
HP·PSC	·	·	·	·	1	·	·	·	·	·	·	·	1
AP·PSC	·	·	·	·	·	·	·	·	·	·	·	1	1

HOT SUBTOPICS – Most-asked themes in Chapter 5

Frequency bars scaled to top topic (17 questions)

- Sowing Equipment — Seed Drills & Planters — 17 Qs
- Plant Protection — Sprayers (Types) — 11 Qs
- Seed-Drill Components & Metering — 10 Qs
- Sowing Methods — 5 Qs
- Atomization & Droplet Characteristics — 4 Qs
- Sprayer Components & Nozzles — 2 Qs

CHAPTER

6

HARVESTING, THRESHING & COMBINE EQUIPMENT

Reaper · Mower · Cutter bar · Thresher · Threshing cylinders · Combine harvester · Grain losses

OFFICIAL SYLLABUS – Chapter 6 Scope

UPSC IFoS — Agricultural Engineering, Paper I, Section A — Topic 1: Soil and Water Conservation

- **Chapter 6 covers:** Reapers (manual, self-propelled, tractor-mounted/drawn). Mowers — reciprocating & rotary types, cutter-bar mechanism, alignment & registration. Threshers — paddy / multi-crop / wheat / mechanical thresher; threshing cylinder/drum types (spike tooth, rasp bar, hammer mill, wire loop), concave clearance, screens, cleaning unit. Axial-flow vs throughput vs tangential-flow threshers. Combine harvester — header, reel, auger, threshing & separation, straw walker, cleaning shoe, grain tank; functions, types and sources of grain loss (header, cylinder, walker, sieve, shattering). Balers (pickup, hay), windrowers; harvest index. Capacity / throughput numericals for threshers and combines.

Full Topic 1 syllabus (this Chapter 6 + sister chapters in Module 1): Sources of farm power — human, animal, mechanical, electrical, wind, solar and biomass. Tractors and power tillers — principles of operation, types, classification, selection, calibration, calculation of capacity and cost. Field capacity — theoretical and effective; field efficiency. Internal combustion engines — principles, classification; fuel and ignition systems; lubrication, cooling and power transmission systems; comparison between IC engines and electric motors as a power source. Tillage implements — mould board plough, disc plough, harrow, cultivator, ridger, sub-soiler, rotavator, etc.; theory of soil cutting and pulverization; traction theory. Sowing and planting equipment; plant protection equipment — sprayers and dusters. Harvesting and threshing equipment — reapers, harvesters, threshers, combine harvesters. Equipment for earth-moving and land development — bulldozers, draglines, scrapers, etc.; ergonomic considerations and design of farm machines for safety and comfort. Renewable energy sources — solar, wind, biomass, biogas, etc.

SECTION A – UPSC IFoS Previous-Year Questions	*5 questions • 2018 – 2024*
2024	✎ Write about the principle of threshing for different types of threshing cylinders. [Note: Split sub-part from a multi-part Q — refer source paper for sibling sub-parts assigned to other chapters.]. [P2/4(c·i) | 7M]
2022	✎ Enlist the different components of conventional reciprocating mower. Explain the effect of improper registration and alignment of cutter bar on its performance. [P2/4(a) | 10M]
2019	✎ What are the different types of threshing cylinders/drums employed on mechanical threshers for different crops? Explain them briefly with the help of sketches. [P2/1(c) | 8M] ✎ What are the functions of Combine harvester? Discuss the different types and sources of grain

	losses. [P2/4(c) | 15M]
2018	✎ What is the function of a mower? Write down the different parts of a conventional reciprocating mower. What do you understand by Alignment and Registration of mower?. [P2/2(b) | 10M]

SECTION B – State PSC Previous-Year Questions

7 questions • All states · year-descending

✎ How does a combine harvester simplify the process of harvesting grain crops and what are the key steps involved in its operation, from cutting the crop to storing the harvested grain?

OPSC·CSE **CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.6(b) | 15M**

✎ Explain the term "Registration", and *Alignment" as applied to the cutter bar of a Mower and state how these adjustments are done?

OPSC·CSE **CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.2(b),(i) | 8M**

✎ Differentiate among "Reaper", "Mower" and "Reaper Binder".

OPSC·CSE **CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.2(c),(i) | 8M**

✎ What are the main functions of a combine? What are the possible reasons for getting un-threshed materials from the combine?

OPSC·CSE **CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.4(a),(ii) | 12M**

✎ Combine harvester or - Self propelled reaper and thresher or - Tractor drawn front mounted reaper and thresher? State your comments with supporting reasons. Discuss the working of power thresher, its classification and important terminology. - Which type biogas plant is most suitable for alluvial soil region. Discuss the various factors affecting the biogas generation. Design a suitable biogas plant for 10 dairy animals with following data : Dung availability-10kg/day/animal, density of slurry : 500kg/m3, bio-gas production from dung : 0.1m3/kg dung.

OPSC·CSE **CSE (Main) 2015–16 | Agri. Engineering | Paper-II, Q.4(a) | 20M**

✎ Compare different harvesting methods/ machines indicating brief description, advantages and disadvantages.

OPSC·Forest **Forest Service (Main) 2015–16 | Agri. Engineering | Paper-II, Q.2(a) | 20M**

✎ What do you understand by registration of Alignment of mower?

AP·PSC **RFO (Mains) 2012 | Agri. Engineering | Q.3(F) | 8M**

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	24	22	21	19	18	16	12	TOTAL
IFoS	1	1	·	2	1	·	·	5
OPSC·CSE	1	·	3	·	·	1	·	5
OPSC·Forest	·	·	·	·	·	1	·	1
MH·PSC	·	·	·	·	·	·	·	0
UK·PSC	·	·	·	·	·	·	·	0
HP·PSC	·	·	·	·	·	·	·	0

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AP·PSC	·	·	·	·	·	·	**1**	**1**

HOT SUBTOPICS – Most-asked themes in Chapter 6

Frequency bars scaled to top topic (6 questions)

- Reapers & Mowers — **6** *Qs*
- Combine Harvester — **3** *Qs*
- Threshers — **1** *Qs*

CHAPTER

7

EARTH-MOVING EQUIPMENT & ERGONOMICS

Bulldozer · Dragline · Grader · Excavator · Post-hole digger · Ergonomics · Anthropometry · Noise & vibration

OFFICIAL SYLLABUS – Chapter 7 Scope

UPSC IFoS — Agricultural Engineering, Paper I, Section A — Topic 1: Soil and Water Conservation

- **Chapter 7 covers:** Earth-moving & land-development machines — bulldozer, dragline, motor grader, scraper, excavator, backhoe, loader, post-hole digger, pavement breaker, compactor/roller. Ergonomic considerations in farm-machine design — human factors, anthropometry, man-machine system, operator comfort, safety design (ROPS, FOPS), tractor seat & cabin design, reach and grip parameters. Operator physiology & work assessment — physiological cost, heart rate, energy expenditure, human efficiency, work-rest cycles. Noise, vibration & thermal environment — sound pressure, decibel scale, tractor noise, tractor seat vibration (whole-body), tractor cabin design.

Full Topic 1 syllabus (this Chapter 7 + sister chapters in Module 1): Sources of farm power — human, animal, mechanical, electrical, wind, solar and biomass. Tractors and power tillers — principles of operation, types, classification, selection, calibration, calculation of capacity and cost. Field capacity — theoretical and effective; field efficiency. Internal combustion engines — principles, classification; fuel and ignition systems; lubrication, cooling and power transmission systems; comparison between IC engines and electric motors as a power source. Tillage implements — mould board plough, disc plough, harrow, cultivator, ridger, sub-soiler, rotavator, etc.; theory of soil cutting and pulverization; traction theory. Sowing and planting equipment; plant protection equipment — sprayers and dusters. Harvesting and threshing equipment — reapers, harvesters, threshers, combine harvesters. Equipment for earth-moving and land development — bulldozers, draglines, scrapers, etc.; ergonomic considerations and design of farm machines for safety and comfort. Renewable energy sources — solar, wind, biomass, biogas, etc.

SECTION A – UPSC IFoS Previous-Year Questions	*5 questions • 2017 – 2024*
2024	✎ (i) Name different machines used for earth moving and land development operations. [5 M] (ii) Explain the working of a tractor operated post-hole digger for horticultural and forestry plantation. [10 M]. [P2/3(b) | 15M]
2020	✎ (i) Write about the importance of ergonomics in farm machinery design. Enlist anthropometric parameters used in design of farm implements. [8 M] (ii) Define wheel base and wheel track. Explain the terms used in the empirical equation F = Ac + W tan ϕ, related to tire performance. [7 M] [Note: Multi-chapter Q — only Ch 7 (earth-moving / ergonomics) sub-parts apply here; refer source paper for full Q.]. [P2/4(b) | 15M]
2018	✎ Define Ergonomics and Anthropometry. Describe in brief about the human factors considered in design of modern tractors. [P2/1(c) | 8M]
2017	✎ What is the significance of ergonomics in farm machine design? Define human efficiency.

	Describe the methods to assess human energy consumption of a farm worker. What are various angles the agriculture worker has to work?. [P2/4(c) | 10M]
✎	Why decibel scale is used for sound measurement? What is the sound pressure for a 80 dB(A) sound of a tractor? If the sound pressure is increased eight times, determine the resulting sound in dB(A). What are tractor seat vibration parameters? Discuss in detail. [P2/4(d) | 10M]

SECTION B – State PSC Previous-Year Questions

7 questions • All states · year-descending

✎ How does considering human factors influence the design process of tractor dashboard instrument panels to enhance usability? Explain.
OPSC·CSE **CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.5(b) | 15M**

✎ Discuss the significance of ergonomics in the man-machine system related to tractor operation.
OPSC·CSE **CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.11(a) | 15M**

✎ Explain human factors in tractor design.
OPSC·CSE **CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.3(b),(ii) | 10M**

✎ Describe, in brief, the ergonomics of man-machine system.
OPSC·CSE **CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.4(a),(i) | 8M**

✎ Earth moving and development machinery.
OPSC·CSE **CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.4(c),(i) | 5M**

✎ Describe the importance and role of human factors in tractor design.
OPSC·CSE **CSE (Main) 2017–18 | Agri. Engineering | Paper-II, Q.2(b) | 20M**

✎ Explain the role of earth moving machines in land development works, particularly the use of laser land leveler in rice fields.
OPSC·CSE **CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.4(c) | 15M**

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	24	21	20	18	17	TOTAL
IFoS	1	·	1	1	2	5
OPSC·CSE	2	3	·	1	1	7
OPSC·Forest	·	·	·	·	·	0
MH·PSC	·	·	·	·	·	0
UK·PSC	·	·	·	·	·	0
HP·PSC	·	·	·	·	·	0
AP·PSC	·	·	·	·	·	0

HOT SUBTOPICS – Most-asked themes in Chapter 7

Frequency bars scaled to top topic (8 questions)

- Ergonomics & Human Factors — 8 Qs
- Earth-Moving & Land Development Machines — 4 Qs
- Operator Physiology & Work Assessment — 1 Qs
- Noise, Vibration & Cabin Design — 1 Qs

CHAPTER

8

SOLAR, WIND & ELECTRIC MOTORS

Solar fundamentals · PV systems · Solar thermal · Wind energy · Electric motors as farm power

OFFICIAL SYLLABUS – Chapter 8 Scope

UPSC IFoS — Agricultural Engineering, Paper I, Section A — Topic 1: Soil and Water Conservation

- **Chapter 8 covers:** Solar energy fundamentals — solar constant, solar radiation (global, diffuse, beam), instruments for solar measurement (pyranometer, pyrheliometer). Solar thermal — flat-plate collector, concentrating collector, solar cooker (box / dish / community), solar dryer, solar still, solar pond. Solar photovoltaic — PV cell working principle, silicon cell efficiency, PV module/array, PV system components (controller, battery, inverter), household & agricultural applications, solar pump. Wind energy — windmill classification (HAWT, VAWT), rotor blade types, wind-electric generating system components, cut-in/cut-out speeds, wind power calculation. Electric motors as farm power source — induction motor (single phase, three phase), BLDC motor, AC vs DC motors, motor selection criteria, motor maintenance.

Full Topic 1 syllabus (this Chapter 8 + sister chapters in Module 1): Sources of farm power — human, animal, mechanical, electrical, wind, solar and biomass. Tractors and power tillers — principles of operation, types, classification, selection, calibration, calculation of capacity and cost. Field capacity — theoretical and effective; field efficiency. Internal combustion engines — principles, classification; fuel and ignition systems; lubrication, cooling and power transmission systems; comparison between IC engines and electric motors as a power source. Tillage implements — mould board plough, disc plough, harrow, cultivator, ridger, sub-soiler, rotavator, etc.; theory of soil cutting and pulverization; traction theory. Sowing and planting equipment; plant protection equipment — sprayers and dusters. Harvesting and threshing equipment — reapers, harvesters, threshers, combine harvesters. Equipment for earth-moving and land development — bulldozers, draglines, scrapers, etc.; ergonomic considerations and design of farm machines for safety and comfort. Renewable energy sources — solar, wind, biomass, biogas, etc.

SECTION A – UPSC IFoS Previous-Year Questions	*18 questions • 2017 – 2025*
2025	✎ What is Solar Constant? Write about the instruments that are used to measure solar energy. [P2/1(d) | 8M] ✎ Discuss the different types of solar energy collectors and their applications. [P2/2(c) | 10M] ✎ Write down the classification of Induction Motors. List the factors that should be considered for selecting the right type of motor. [P2/3(c) | 10M]
2024	✎ Write short notes on the following : (i) BLDC motor (ii) Different renewable cooking fuels (iii) Working principle of a wind turbine [Note: Multi-chapter Q — only Ch 8 (solar / wind / motor) sub-parts apply here; refer source paper for full Q.]. [P2/2(b) | 15M] ✎ Write the operating principle of a photovoltaic cell. Mention the efficiency of different types of

	silicon PV cells. [P2/4(b) | 10M]
2023	✎ Briefly write about different devices and components of a solar photo-voltaic system. Write about the applications of solar dryer. [P2/2(c) | 15M]
2022	✎ What do you understand by global radiation and diffuse radiation?. [P2/1(d) | 8M] ✎ What do you understand by solar thermal energy collectors? Discuss the various design parameters affecting the performance of solar flat-plate collector. [P2/2(c) | 15M] ✎ How do you classify the windmill? Discuss the different types of rotor blades used in the windmill. [P2/3(c) | 15M]
2021	✎ Name the different components required in a Solar PV system for household application and describe the function of each component. [P2/2(b) | 10M]
2020	✎ 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. [P2/1(e) | 8M] ✎ Explain the functions of different components of a solar photovoltaic system used for power generation. Write a short note on solar flat plate collector. [P2/2(c) | 15M]
2019	✎ Explain with the help of labelled diagram, the construction details of single reflector box solar cooker. What are the limitations of solar cookers?. [P2/1(d) | 8M] ✎ What are different types of rotors of windmill? Describe the different components of wind-electric generating system with the help of suitable diagram. [P2/3(b) | 15M]
2018	✎ Explain the principle of operation of concentrating type solar collector with a suitable diagram. What are the advantages and disadvantages of such collectors over flat plate solar collectors?. [P2/4(a) | 15M] ✎ The cut-in wind speed of a horizontal axis wind generator having 8 m diameter blade span is 5·0 m/s. The wind turbine generates 4·0 kW electrical power at 6·5 m/s wind speed. Determine the overall efficiency of the wind turbine generator considering the density of air as 1·2 kg/m³. [P2/4(c) | 10M]
2017	✎ Describe the working of wind energy system with the help of line diagram along with main components. [P2/3(b) | 10M] ✎ An agricultural machine has to be operated by solar energy. What should be the area of solar panel normal to Sun's rays (assuming very sunny day) in India with following parameters?. [P2/4(b) | 10M]

SECTION B – State PSC Previous-Year Questions

14 questions • All states · year-descending

✎ How is the solar energy harnessed for useful applications? Explain in detail.

UK·PSC **ACF/RFO/Logging Officer (Mains) 2025 | Agri. Engineering | Q.6(ii) | 10M**

✎ How do you classify the windmill? Explain in detail about construction and operating principle of savonius rotor blades used in the windmill.

MH·PSC **Forest Services (Mains) 2024 | Agri. Engineering | Q.6(b) | 15M**

- Describe the features of a photovoltaic generator. What are the methods of tracking the Sun for the generator? Explain the thermo- hydraulic tracking principle.

  OPSC·CSE CSE (Main) 2024–25 | Agri. Engineering | Paper-II, Q.6 | 15M

- Consider a wind turbine with a 5 m diameter rotor. The speed of the rotor at 10 m/s wind velocity is 130 r/min and its power coefficient at this point is 0.35. Calculate the tip speed ratio and torque coefficient of the turbine. What will be the torque available at the rotor shaft? Assume the density of air to be 1.24 kg/m3.

  OPSC·CSE CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.7(b) | 15M

- What are the different factors to be considered for suitable site selection for a wind mill installation? Explain working of a horizontal axis wind power plant with neat diagram.

  OPSC·Forest Forest Service (Main) 2023–24 | Agri. Engineering | Paper-II, Q.4(b) | 20M

- Write an essay on the status and scope of wind power generation in India and propose a strategy for harnessing the potential of wind energy for the country.

  OPSC·CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.18(a) | 10M

- Explain the characteristics of three different types of wind mill.

  OPSC·CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.18(b) | 10M

- Briefly describe the thermal applications of solar energy in agriculture and allied activities.

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.6(c) | 10M

- What factors should be considered for selection of right type of electric motor for agricultural operations? What are the causes of overheating of electric motors and how it can be rectified?.

  UK·PSC RFO (Mains) 2021 | Agri. Engineering | Q.6(i) | 10M

- What is solar constant? With a neat sketch describe solar Photovoltaic system and working of solar power generators.

  UK·PSC RFO (Mains) 2021 | Agri. Engineering | Q.6(ii) | 10M

- Elaborate the basic difference between solar flat plate collector and solar concentrator. Under what condition these two are recommended for various uses.

  OPSC·CSE CSE (Main) 2018–19 | Agri. Engineering | Paper-II, Q.4(c) | 20M

- Compare and contrast in between horizontal type wind mill and vertical axis type of wind mill.

  UK·PSC RFO (Mains) 2015 | Agri. Engineering | Q.7(ii) | 10M

- Why a statter is needed for a AC motor?.

  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.1(A) | 4M

- Describe the functions of different parts of a horizontal-axis wind mill for water lifting and explain its working.

  UK·PSC RFO (Mains) 2012 | Agri. Engineering | Q.5(iii) | 10M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light

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												= low frequency
SOURCE \ YEAR	25	24	23	22	21	20	19	18	17	15	12	TOTAL
IFoS	3	2	1	3	1	2	2	2	2	·	·	18
OPSC·CSE	1	1	2	·	·	·	1	·	·	·	·	5
OPSC·Forest	·	1	·	·	·	·	·	·	·	·	·	1
MH·PSC	·	1	·	·	·	·	·	·	·	·	·	1
UK·PSC	1	·	·	·	2	·	·	·	·	1	1	5
HP·PSC	·	·	·	·	1	·	·	·	·	·	·	1
AP·PSC	·	·	·	·	·	·	·	·	·	·	1	1

HOT SUBTOPICS – Most-asked themes in Chapter 8

Frequency bars scaled to top topic (9 questions)

- Wind Energy — 9 *Qs*
- Solar Energy Fundamentals — 7 *Qs*
- Solar Thermal Systems — 6 *Qs*
- Solar Photovoltaic (PV) — 6 *Qs*
- Electric Motors as Farm Power — 4 *Qs*

CHAPTER

9

BIOGAS, BIOMASS & GASIFIER

Biogas plants · Anaerobic digestion · Gasifier types · Biomass conversion · Cooking stoves · Biofuels

OFFICIAL SYLLABUS – Chapter 9 Scope

UPSC IFoS — Agricultural Engineering, Paper I, Section A — Topic 1: Soil and Water Conservation

- **Chapter 9 covers:** Biogas plants — KVIC (floating drum), Deenbandhu, fixed dome; types of digester by construction & gas storage; design factors, components & site selection. Anaerobic digestion — phases (hydrolysis, acidogenesis, acetogenesis, methanogenesis), advantages, factors (manure-water ratio, ambient temperature, total solids, pH, ammoniacal nitrogen, slurry density), aerobic vs anaerobic comparison. Biogas calculations — digester volume, gas yield from cattle dung/cow manure, daily biogas production, methane content, calorific value, burner efficiency, power available, retention time. Biogas applications — direct cooking, gas engine, dual-fuel diesel engine, Bio-CNG, biogas vs producer gas vs natural gas. Biomass conversion — thermo-chemical, bio-chemical & mechanical methods, briquetting, charring, pyrolysis, biomass gasifier-based power generation. Gasifier — fixed-bed types (updraft, downdraft, cross-draft, fluidized bed), zones with temperature profiles, producer gas composition, tar & particulate matter. Other biofuels — biodiesel, bio-ethanol; alternate cooking fuels & energy-efficient cooking stoves.

Full Topic 1 syllabus (this Chapter 9 + sister chapters in Module 1): Sources of farm power — human, animal, mechanical, electrical, wind, solar and biomass. Tractors and power tillers — principles of operation, types, classification, selection, calibration, calculation of capacity and cost. Field capacity — theoretical and effective; field efficiency. Internal combustion engines — principles, classification; fuel and ignition systems; lubrication, cooling and power transmission systems; comparison between IC engines and electric motors as a power source. Tillage implements — mould board plough, disc plough, harrow, cultivator, ridger, sub-soiler, rotavator, etc.; theory of soil cutting and pulverization; traction theory. Sowing and planting equipment; plant protection equipment — sprayers and dusters. Harvesting and threshing equipment — reapers, harvesters, threshers, combine harvesters. Equipment for earth-moving and land development — bulldozers, draglines, scrapers, etc.; ergonomic considerations and design of farm machines for safety and comfort. Renewable energy sources — solar, wind, biomass, biogas, etc.

SECTION A – UPSC IFoS Previous-Year Questions	*23 questions • 2016 – 2025*
2025	✎ Classify the digester of a biogas plant on the basis of construction as well as on the basis of gas storage. Also, discuss the utilization of biogas for different applications. [P2/4(a) | 15M]
2024	✎ Enlist different types of fixed-bed biomass gasifiers and discuss different zones with temperature profiles. [P2/1(e) | 8M] ✎ Write the effect of the following on biogas production from a cow manure-based biogas plant : (i) Manure-water ratio (ii) Ambient temperature (iii) Total solid content in manure (iv) pH of slurry (v) Ammoniacal nitrogen in slurry. [P2/4(a) | 15M]

2023	✎ (i) What are the different methods of biomass conversion for energy generation? Enlist different processes of energy conversion under each method. [10 M] (ii) Name the different components of biomass gasifier-based electric power generation system. [5 M]. [P2/3(a) | 15M] ✎ Using a neat diagram, explain the construction and working of KVIC-type biogas plant. [P2/4(b) | 15M]
2021	✎ Distinguish between the following in brief : (i) Biogas and Producer Gas (ii) Compressed Natural Gas and Compressed Biogas (iii) AC Motor and DC Motor (iv) Solar Cell and Dry Cell [Note: Multi-chapter Q — only Ch 9 (biogas / biomass / gasifier) sub-parts apply here; refer source paper for full Q.]. [P2/1(d) | 8M] ✎ List the factors affecting the following : (i) Biogas production from cattle manure (ii) Producer gas production from agricultural crop residues (iii) Draft requirement of a tractor drawn mouldboard plough (iv) Grain losses in a power thresher [Note: Multi-chapter Q — only Ch 9 (biogas / biomass / gasifier) sub-parts apply here; refer source paper for full Q.]. [P2/1(e) | 8M] ✎ A cattle manure-based biogas plant has diameter and height of digester as 2 m and 5 m respectively. The plant is charged daily with 100 kg fresh manure mixing it in equal proportion with water. If the input slurry has density of 1·05 g/cc, calculate the volume of digester of the plant and also the daily biogas production from the plant if [...]. [P2/3(c) | 10M] ✎ Draw a neat figure showing the different components of a Deenbandhu Biogas plant and describe its working. [P2/4(b) | 15M]
2020	✎ What is gasification? Explain the working of up-draft type gasifier with a neat diagram. [P2/1(d) | 8M]
2019	✎ With the help of suitable diagram, show the different components of floating dome type biogas plant. Compare the advantages and disadvantages of floating dome and fixed dome type digesters in a biogas plant. [P2/4(b) | 15M]
2018	✎ Explain the working principle of a downdraft type gasifier with a suitable diagram. [P2/1(e) | 8M] ✎ What are the different phases of anaerobic digestion for bio-gas production? What are the advantages of anaerobic digestion?. [P2/3(a) | 10M]
2017	✎ List the factors to be considered for the design of biogas plant. Briefly discuss the components of a biogas plant with the help of neat sketch. [P2/1(c) | 8M] ✎ Describe in brief various energy efficient cooking stoves and alternate cooking fuels. [P2/3(a) | 10M] ✎ Find out height and diameter of the digester of a biogas plant, whose design is to be matched with input feed from dairy of 80 cows and 40 calves. Following assumptions may be made : [...]. [P2/3(c) | 10M] ✎ Calves produce half gobar (dung) compared to cows. Average gobar (dung) available per cattle per day = 10 kg. Average biogas available per kg gobar (dung) per day = 0·03 m^3. Average content of solid in gobar (dung) = 18%. Average bulk density of gobar (dung) = 1100 kg/m^3. Optimum ratio of gobar (dung) : water in slurry = 1 : 1. Discuss about [...]. [P2/4(a) | 10M]
2016	✎ Differentiate between the following in brief : (i) Gas engine and Dual fuel engine (ii) CNG and Bio-CNG (iii) Anaerobic process and Aerobic process (iv) Active solar heating and Passive solar

	heating [Note: Multi-chapter Q — only Ch 9 (biogas / biomass / gasifier) sub-parts apply here; refer source paper for full Q.]. [P2/1(c) | 8M] ✎ Discuss the major differences between the following : (i) Biogas and Producer gas (ii) Biodiesel and Bio-ethanol (iii) Single phase electric motor and Three phase electric motor (iv) Downdraft gassifier and Updraft gassifier. [P2/1(e) | 8M] ✎ What are the modifications required to run a constant speed diesel engine on dual fuel (biogas + diesel) mode and why? [Note: Multi-chapter Q — only Ch 9 (biogas / biomass / gasifier) sub-parts apply here; refer source paper for full Q.]. [P2/3(c) | 10M] ✎ Calculate the volume of a biogas digester and power available from it assuming the following : [...]. [P2/4(a) | 15M] ✎ 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/m³. Biogas yield per unit dry mass = 0·2 m³/kg. Heat of combustion of methane = 28 MJ/m³ at STP. Write short notes on [...]. [P2/4(b) | 15M] ✎ Write the major differences between the following : (i) Tar and Particulate matter (ii) Briquetting and Charring (iii) Wind mill and Water mill (iv) Mechanical efficiency and Thermal efficiency (v) Total solids and Volatile solids. [P2/4(c) | 10M]

SECTION B – State PSC Previous-Year Questions	*22 questions • All states · year-descending*
✎ What are the main components of a biogas plant? On what basis biogas plants can be classified?. UK·PSC **ACF/RFO/Logging Officer (Mains) 2025 | Agri. Engineering | Q.6(iii) | 10M**	
✎ Compare floating gas holder and fixed-dome types of biogas units. UK·PSC **ACF/RFO/Logging Officer (Mains) 2025 | Agri. Engineering | Q.6(iv) | 10M**	
✎ Give the classification of gasifiers as per the direction of the gas flow. Explain the working principle of updraft type gasifier with neat sketch. MH·PSC **Forest Services (Mains) 2024 | Agri. Engineering | Q.5(b) | 8M**	
✎ Discuss the applications of gasifiers for the conversion of biomass and agricultural residues. What are the essential parameters affecting gasification? Describe the construction and working operation of an updraft gasifier highlighting the formation of different zones within the biomass. OPSC·CSE **CSE (Main) 2024–25 | Agri. Engineering | Paper-II, Q.15 | 20M**	
✎ How do biogas plants address environmental and energy challenges in rural areas and what are the key benefits they offer in terms of waste management, renewable energy generation and economic development?. OPSC·CSE **CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.7(a) | 15M**	
✎ Explain the working principle of updraft and downdraft gasifiers and draw the diagram for updraft and downdraft gasifiers. OPSC·CSE **CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.8(a) | 15M**	
✎ How does producer gas technology align with sustainable agricultural practices and what advancements or	

innovations are being made in this field?.

OPSC-CSE CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.8(b) | 15M

- Explore the concept of energy-efficient cooking stoves and their significance in the context of sustainable agriculture.

  OPSC-CSE CSE (Main) 2023–24 | Agri. Engineering | Paper-II, Q.12(b) | 15M

- Tangential flow threshing and axial flow threshing - Impact cutting and shear cutting of grasses - Write about different reactions occurring in a gasifier reactor? Describe in detail the power generation from biomass gasification.

  OPSC-Forest Forest Service (Main) 2023–24 | Agri. Engineering | Paper-II, Q.4(a) | 20M

- Explain the characteristic features of a 'Deenbandhu' biogas plant suitable for a farmer.

  OPSC-CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.10(a) | 10M

- What are the potential uses of biogas in a farm?.

  OPSC-CSE CSE (Main) 2022–23 | Agri. Engineering | Paper-II, Q.10(b) | 5M

- Biomass and Biogas - Floating drum biogas plant and Fixed dome biogas plant - Beam radiation and Diffuse radiation - Solar thermal and Solar photovoltaic - With a flow diagram explain the steps followed in canning of fruits and vegetables.

  HP-PSC RFO (Mains) 2021 | Agri. Engineering | Q.7(a) | 10M

- Producer gas and bio gas for running I. C, engines.

  OPSC-CSE CSE (Main) 2020–21 | Agri. Engineering | Paper-II, Q.4(c),(iv) | 5M

- What are the various constituents present in the producer gas? Explain the different types of gasifier with the help of suitable diagram.

  OPSC-CSE CSE (Main) 2018–19 | Agri. Engineering | Paper-II, Q.4(b) | 20M

- Explain how the producer gas and biogas is used for running I. C. engines and for electric power generation.

  OPSC-CSE CSE (Main) 2017–18 | Agri. Engineering | Paper-II, Q.1(b) | 20M

- Describe the energy efficient cooking stoves and alternate cooking fuels.

  OPSC-CSE CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.2(c) | 15M

- How bio gas and producer gas is used for running I. C. engines?.

  OPSC-CSE CSE (Main) 2016–17 | Agri. Engineering | Paper-II, Q.4(d) | 15M

- State the chemical reactions that occurs in gasifier. Explain the working of downdraft gasifier.

  UK-PSC RFO (Mains) 2015 | Agri. Engineering | Q.6(iv) | 10M

- State merits and demerits of anaerobic digestion of biogas waste. Describe the constructional feature of fixed Dome Janta type Biogas plant.

  UK-PSC RFO (Mains) 2015 | Agri. Engineering | Q.7(i) | 10M

- what is gasifire? Whar are the gases obtained during gasification in gasifire?.

AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.1(L) | 4M

✎ Discuss various factors which affect the generation of biogas production.

AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.4(E) | 10M

✎ Explain bio-digestion process in a biogas plant. Also, mention the functions of various parts of Khadi and Village Industries Commission (KVIC) model of biogas plant and compare it with Janata model.

UK·PSC RFO (Mains) 2012 | Agri. Engineering | Q.6(i) | 10M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	21	20	19	18	17	16	15	12	TOTAL
IFoS	1	2	2	4	1	1	2	4	6	·	·	23
OPSC·CSE	1	4	2	1	·	1	1	2	·	·	·	12
OPSC·Forest	·	1	·	·	·	·	·	·	·	·	·	1
MH·PSC	·	1	·	·	·	·	·	·	·	·	·	1
UK·PSC	2	·	·	·	·	·	·	·	·	2	1	5
HP·PSC	·	·	·	1	·	·	·	·	·	·	·	1
AP·PSC	·	·	·	·	·	·	·	·	·	·	2	2

HOT SUBTOPICS – Most-asked themes in Chapter 9

Frequency bars scaled to top topic (22 questions)

- Biomass & Gasifier — 22 Qs
- Biogas Plants — Types & Design — 14 Qs
- Anaerobic Digestion & Process Factors — 8 Qs
- Biogas Calculations & Applications — 7 Qs
- Other Biofuels & Cooking Stoves — 3 Qs

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CHAPTER

1

POST-HARVEST TECHNOLOGY & ENGINEERING PROPERTIES

Post-harvest scope & losses · Engineering & thermal properties · Moisture content & EMC · Paddy parboiling

OFFICIAL SYLLABUS – Chapter 1 Scope

UPSC IFoS — Agricultural Engineering, Paper II, Section B — Topic 3: Agricultural Process Engineering

- **Chapter 1 covers: Post-harvest technology of crops and its scope; engineering properties of agricultural produce and by-products; moisture relations (wet/dry basis, EMC); paddy parboiling.**

Full Topic 3 syllabus: Post harvest technology of crops and its scope. Engineering properties of agricultural produces and by-products. Unit operations — cleaning, grading, size reduction, densification, concentration, drying/dehydration, evaporation, filtration, freezing and packaging of agricultural produces and by-products. Material handling equipment — belt and screw conveyors, bucket elevators, their capacity and power requirement. Processing of milk and dairy products — homogenization, cream separation, pasteurization, sterilization, spray and roller drying, butter making, ice cream, cheese and shrikhand manufacture. Waste and by-product utilization — rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.

SECTION A – UPSC IFoS Previous-Year Questions	*14 questions • 2016 – 2024*
2024	✎ Explain the improved paddy parboiling method developed by CFTRI and mention its advantages. [P2/5(a) | 8 M] ✎ Define Equilibrium Moisture Content (EMC) and its usefulness. Mention Henderson's equation for determining EMC. [P2/8(c) | 10 M]
2022	✎ Explain the design considerations of concrete grain bin. Briefly write the steps and stages of design. [P2/7(b) | 15 M] ✎ Define relative humidity (RH) and humidity ratio with the help of equations. [P2/5(c) | 8 M]
2021	✎ Write the different types of post-harvest losses which occur at different stages of unit operations in food grains. Explain any one of them. [P2/5(a) | 8 M] ✎ Write the advantages of Rice Parboiling. [P2/5(b) | 8 M] ✎ With the help of process flowchart describe the cottage scale food processing industry for production of fruit jams and juices. [P2/6(a) | 15 M] ✎ Briefly describe the following : (i) Burr mill (ii) Turmeric processing [P2/6(c) | 10 M]

2020	✎ 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. [P2/5(a) | 8 M] ✎ 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? [P2/5(b) | 8 M]
2018	✎ What is meant by sphericity of a particle? Write the expression for determining sphericity of a body. How does a jaw crusher work? [P2/5(c) | 8 M] ✎ What is meant by dry and wet basis calculations for moisture content in solids? How much water must be removed from parboiled paddy with 45% moisture content (wet basis) to produce 500 kg of dry parboiled paddy with 15% moisture content (wet basis)? [P2/7(b) | 15 M]
2017	✎ With respect to sterilization of food, define thermal death time and decimal reduction time. What can be the effect if the sterilization is not done. [P2/5(c) | 10 M]
2016	✎ Differentiate between the following : (i) Osmosis and Dehydration (ii) Equilibrium moisture content and Moisture content (iii) Angle of repose and Angle of internal friction (iv) Specific heat and Thermal conductivity. [P2/5(d) | 8 M]

SECTION B : State PSC Previous-Year Questions

35 questions • All states · year-descending

✎ Explain moisture content and its measurement. Also give moisture content representation.

UK·PSC **ACF RFO Logging officer (Mains) 2025 | Agri. Engineering | Q.7 (ii), (a) | 5M**

✎ Enlist various methods of paddy parboiling.

UK·PSC **ACF RFO Logging officer (Mains) 2025 | Agri. Engineering | Q.7 (ii), (b) | 5M**

✎ What do you understand by engineering properties of agricultural materials? Enlist all properties and also give its importance.

UK·PSC **ACF RFO Logging officer (Mains) 2025 | Agri. Engineering | Q.7 (iv) | 10M**

✎ What do you mean by drying? Write the formulae used for expressing moisture content on wet basis and dry basis. Two ton of wheat with 22 per cent moisture content on wet basis are to be dried to 13 per cent moisture content on dry basis. Calculate: Weight of bone dry matter; Amount of water evaporated; Final weight of grain after drying.

MH·PSC **Forest Services (Mains) 2024 | Agri. Engineering | Q.5 (c) | 8M**

✎ Define the following properties of agricultural produce: Bulk density; Porosity; Angle of repose; Roundness.

MH·PSC **Forest Services (Mains) 2024 | Agri. Engineering | Q.5 (g), (i) | 8M**

✎ Determine the sphericity of an apple using spatial dimensions or three mutually perpendicular axis of fruits as A = 85 mm, B = 58 mm and C = 41 mm.

MH·PSC **Forest Services (Mains) 2024 | Agri. Engineering | Q.5 (g), (ii) | 8M**

✎ Enumerate the advantages of bulk storage of grain compared to bag storage. What is meant by CAP storage? State its importance in grain handling in India. List the biotic and abiotic factors affecting stored grain in warehouses.

OPSC·CSE **CSE (Main) 2024-25 | Agri. Engineering | Paper-II, Q.9 | 15M**

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- Give a brief outline of improved postharvest practices that can be adopted in handling fresh fruits and vegetables. Explain the significance of precooling of horticultural commodities. What is the fundamental physiological principle of Controlled Atmosphere (CA) storage in prolonging the shelf life of fruits and vegetables?

  OPSC·CSE CSE (Main) 2024-25 | Agri. Engineering | Paper-II, Q.17 | 20M

- How does post-harvest technology contribute to optimizing the handling, storage and processing of agricultural produce?

  OPSC·CSE CSE (Main) 2023-24 | Agri. Engineering | Paper-II, Q.13 (a) | 20M

- What are the key challenges and opportunities in post-harvest handling of crops and how do they impact the agricultural supply chain and farmers' livelihoods?

  OPSC·CSE CSE (Main) 2023-24 | Agri. Engineering | Paper-II, Q.13 (b) | 20M

- Two tons of paddy with 22% moisture content on a wet basis is to be dried to 13% moisture content on a dry basis. Calculate the weight of bone dry products and water evaporated.

  OPSC·CSE CSE (Main) 2023-24 | Agri. Engineering | Paper-II, Q.14 (a) | 20M

- Describe the key steps in determining moisture content in agricultural products and its importance in post-harvest technology.

  OPSC·CSE CSE (Main) 2023-24 | Agri. Engineering | Paper-II, Q.14 (b) | 20M

- Discuss the physical properties of fruits and vegetables and their relevance in sorting, washing and preservation technology.

  OPSC·CSE CSE (Main) 2023-24 | Agri. Engineering | Paper-II, Q.16 (b) | 20M

- Differentiate between: Static and Dynamic friction; Sphericity and roundness.

  OPSC·Forest Forest (Main) 2023-24 | Agri. Engineering | Paper-II, Q.5 (c) | 20M

- Explain about different physical preservation methods followed in food industry.

  OPSC·Forest Forest (Main) 2023-24 | Agri. Engineering | Paper-II, Q.6 (b) | 20M

- Explain the significance of Equilibrium Moisture Content (EMC) of grain. How does temperature affect the EMC-ERH relationship?

  OPSC·CSE CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.5 (b) | 5M

- Explain the major effects of biotic and abiotic factors on stored grain in a silo.

  OPSC·CSE CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.6 (a) | 10M

- Explain the phenomenon of moisture migration in stored grain bulk.

  OPSC·CSE CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.6 (b) | 5M

- With a flow diagram explain the steps followed in canning of fruits and vegetables.

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (a) | 10M

- Differentiate between: Thermal conductivity and Thermal diffusivity

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (c) | 10M

- Briefly explain: Waxing / coating

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (d) | 10M

- Slicing, blanching and mixing

OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.5 (d), (ii) | 5M

- Storage and preservation technology

  OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.5 (d), (iii) | 5M

- Properties of dairy and food products

  OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.5 (d), (iv) | 5M

- Explain the engineering properties of agricultural produces and by-products, affecting its handling and processing.

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.5 (d) | 20M

- Find the amount of moisture to be removed in drying 1 tonne of grain, initially at 24% moisture (wet basis) to 12% moisture (wet basis). Also, calculate the weight of dried grain.

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.6 (c) | 20M

- Write brief notes on: Equilibrium moisture content

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.8 (c) | 20M

- Write brief notes on: Blanching

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.8 (c) | 20M

- 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 percent (wet basis). What are the initial and final moisture contents of grain on dry basis? How much water is removed during drying?

  UK·PSC RFO (Mains) 2015 | Agri. Engineering | Q.8 (iii) | 10M

- Explain stepwise after harvesting how the peas are processed for canning. A feed of 110 tons per hour containing 15% sugar is evaporated to produce 60% sugar solution in an evaporator. Calculate the amount of solution produced and the amount of water removed.

  OPSC·CSE CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.8 (a) | 20M

- Explain the various engineering properties of agricultural produces and by-products, affecting its handling and processing.

  OPSC·Forest Forest (Main) 2015-16 | Agri. Engineering | Paper-II, Q.5 (c) | 20M

- What are the advantages of parboiling the paddy?

  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.2 (G) | 5M

- What are the factors which causes spoilage of food during storage? How is spoilage of food prevented during storage?

  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.2 (H) | 5M

- What are problems associated with post harvest technology in the rice industry. Discuss them.

  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.5 (A) | 20M

- Discuss influence of moisture content, relative humidity, temperature and storage fungi on stored seed.

  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.5 (C) | 20M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	20	18	17	16	15	12	TOTAL
IFoS	·	2	·	2	4	2	2	1	1	·	·	14

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OPSC·CSE	·	2	5	3	·	3	·	·	4	1	·	18
OPSC·Forest	·	·	2	·	·	·	·	·	·	1	·	3
AP·PSC	·	·	·	·	·	·	·	·	·	·	4	4
HP·PSC	·	·	·	·	3	·	·	·	·	·	·	3
MH·PSC	·	3	·	·	·	·	·	·	·	·	·	3
UK·PSC	3	·	·	·	·	·	·	·	·	1	·	4

HOT SUBTOPICS — Most-asked themes in Chapter 1

- **Moisture content & EMC (wet/dry basis, Henderson)** (14 questions)
- **Engineering & physical properties (bulk density, porosity, sphericity, angle of repose)** (10 questions)
- **Thermal properties & food preservation** (10 questions)
- **Post-harvest technology & losses** (6 questions)
- **Paddy parboiling** (5 questions)

CHAPTER

2

UNIT OPERATIONS — SIZE & SEPARATION

Size reduction & crushing laws · Cleaning, grading, sorting · Separators · Milling · Filtration

OFFICIAL SYLLABUS – Chapter 2 Scope

UPSC IFoS — Agricultural Engineering, Paper II, Section B — Topic 3: Agricultural Process Engineering

- **Chapter 2 covers: Unit operations of size reduction (crushing laws, jaw/hammer/roller mills) and separation (cleaning, grading, sorting, air-screen & specific-gravity separators, cyclone); crop milling; filtration.**

Full Topic 3 syllabus: Post harvest technology of crops and its scope. Engineering properties of agricultural produces and by-products. Unit operations — cleaning, grading, size reduction, densification, concentration, drying/dehydration, evaporation, filtration, freezing and packaging of agricultural produces and by-products. Material handling equipment — belt and screw conveyors, bucket elevators, their capacity and power requirement. Processing of milk and dairy products — homogenization, cream separation, pasteurization, sterilization, spray and roller drying, butter making, ice cream, cheese and shrikhand manufacture. Waste and by-product utilization — rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.

SECTION A – UPSC IFoS Previous-Year Questions	*16 questions • 2016 – 2025*
2025	✎ Define Fineness Modulus. Using fineness modulus, determine the average particle size with the following data : [P2/5(c) | 8 M] ✎ With the help of a line diagram, discuss Vertical Cone Rice Whitener. Also, discuss its advantages and disadvantages. [P2/6(a) | 15 M] ✎ What are the objectives of the Tempering-Degerming (TD) method in corn dry milling? Describe the basic operations involved in the TD method. [P2/8(a) | 15 M] ✎ Describe the various steps in modern wheat flour milling. [P2/8(b) | 15 M]
2024	✎ Derive the effectiveness of screen in a grader through material balance. [P2/7(a) | 15 M] ✎ In wheat milling, it was found that to grind 4·33 mm sized grains to pass sieve of 0·351 mm opening, the power requirement was 8 kW. Calculate the power requirement for milling of the wheat using Rittinger's law and Kick's law by the same mill to pass sieve of 0·157 mm opening. The feed rate of milling is 200 kg/h. [P2/7(b) | 10 M] ✎ Explain the components of a wheat mill. [P2/5(e) | 8 M]
2023	✎ What are the design considerations for air screen grain cleaner? [P2/5(a) | 8 M]
2021	✎ (i) Explain the processing and ginning of cotton. [5 M] (ii) Briefly explain about mechanical oil expeller for production of edible oils. [5 M] [P2/7(c) | 10 M]

2020	✎ 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. [P2/6(b) | 10 M] ✎ 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. [P2/7(b) | 15 M]
2019	✎ State Bond's Law of Crushing. What is Work Index? State the principle of operation of a jaw crusher. [P2/5(a) | 8 M]
2017	✎ Discuss the criteria and methods of sorting of food materials. Draw sketch of pneumatic method sorting machine. [P2/6(d) | 10 M] ✎ What are the benefits of size reduction in food processing? A crusher requires 10 kW for grinding a material at the rate of 100 kg/h from 2 cm size to 0·5 cm size. How much power would be required if the reduction was to 0·4 cm. Use both Kick's law as well as Rittinger's law to solve the problem. [P2/7(a) | 10 M]
2016	✎ What are the major differences between a Hammer mill and a Roller mill? [P2/6(a) | 10 M] ✎ Describe the working of a cyclone separator. How is its separation factor related to the weight of a particle? [P2/6(b) | 10 M]

SECTION B : State PSC Previous-Year Questions	*36 questions • All states · year-descending*
✎ Write the salient points of nano-filtration. UK·PSC **ACF RFO Logging officer (Mains) 2025 | Agri. Engineering | Q.7 (i), (b) | 5M**	
✎ Discuss the size reduction procedures of agricultural produces. Also give the name of machines. UK·PSC **ACF RFO Logging officer (Mains) 2025 | Agri. Engineering | Q.8 (iv) | 10M**	
✎ In a wheat milling experiment, it was found that to grind 4.33 mm sized grains to pass sieve 0.351 mm opening, the power requirement was 8 kw. Calculate the power requirement for milling of wheat using Rittinger's law and Kick's law by the same mill to pass sieve 0.157 mm opening. Feed rate of mill is 200 kg/hr. MH·PSC **Forest Services (Mains) 2024 | Agri. Engineering | Q.8 (a) | 15M**	
✎ Outline the process involved in the milling of pulses using a flowchart. What are the equipments required in setting up of such a mill? OPSC·CSE **CSE (Main) 2024-25 | Agri. Engineering | Paper-II, Q.10 | 15M**	
✎ What are the key unit operations involved in processing cereals and how do they contribute to producing safe, nutritious and marketable cereal products? OPSC·CSE **CSE (Main) 2023-24 | Agri. Engineering | Paper-II, Q.15 (a) | 20M**	
✎ Sugar crystals were ground from an average Sauter diameter of 500 µm to a powder with an average Sauter diameter of 100 µm. The net energy consumption was 0.5 kWh per ton. What would be the net	

energy consumption for grinding the crystals to 50 µm powder? According to Rittinger's law; According to Kick's law.

OPSC·CSE CSE (Main) 2023-24 | Agri. Engineering | Paper-II, Q.15 (b) | 20M

- How are the principles of solvent extraction applied in the extraction of oils from oilseeds and what are the diverse applications of solvent-extracted oils in various industries?

  OPSC·CSE CSE (Main) 2023-24 | Agri. Engineering | Paper-II, Q.16 (a) | 20M

- Explain the construction and working principle of hammer mill for size reduction operations.

  OPSC·CSE CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.17 (a) | 10M

- Grinding green gram with a hammer mill required 8.3 kWh of energy per tonne of material for reducing its size from 6.25 mm to 0.75 mm. Assuming that Bond's law holds good for the material, estimate the amount of energy required for reducing the size down to 0.1 mm.

  OPSC·CSE CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.17 (b) | 10M

- Differentiate between: Grading and Sorting

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (c) | 10M

- Differentiate between: Spiral separator and Specific gravity separator

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (c) | 10M

- Briefly explain: Degree of grinding

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (d) | 10M

- What do you understand by Fineness Modulus and Uniformity Index? Describe the method for determining the Fineness Modulus of a feed in the laboratory.

  UK·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (i) | 10M

- What is grain milling? Describe the working principle of a hammer mill.

  UK·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (ii) | 10M

- Explain various unit operations in processing of agricultural produce (cereals, pulses and oilseeds).

  OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.5 (b), (i) | 12M

- What are the criteria for selection of cleaning and grading machines?

  OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.5 (b), (ii) | 8M

- What do you understand by solvent extraction? Explain its various components and processes. Sketch out the process flow chart.

  OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.5 (c), (ii) | 10M

- How sorting and grading is useful in fruits and vegetables? Explain, in detail, various processes and equipments used for sorting and grading.

  OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.6 (b) | 20M

- What do you understand by Fineness Modulus and Uniformity Index? Describe the method for determining the Fineness Modulus of a feed in the laboratory.

  UK·PSC ACF (Mains) 2019 | Agri. Engineering | Q.7 (i) | 10M

- What is grain milling? Describe the working principle of a hammer mill.

  UK·PSC ACF (Mains) 2019 | Agri. Engineering | Q.7 (ii) | 10M

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- Explain the functioning of specific gravity separator and its uses.

  OPSC·Forest Forest (Main) 2019-20 | Agri. Engineering | Paper-II, Q.5 (a) | 20M

- What are the principles applied for cleaning and grading of grains and seeds?

  OPSC·CSE CSE (Main) 2018-19 | Agri. Engineering | Paper-II, Q.5 (a) | 20M

- The power requirement for milling wheat from 4.33 mm to 0.35 mm size was 8 kW. Calculate the power requirement for milling the same to final size of 0.157 mm using (i) Rittinger's law and (ii) Kick's law.

  OPSC·CSE CSE (Main) 2018-19 | Agri. Engineering | Paper-II, Q.7 (c) | 20M

- Explain the importance of rice processing. Describe the working of a rubber roll sheller.

  OPSC·CSE CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.5 (a) | 20M

- Describe the working and important features of a seed processing plant.

  OPSC·CSE CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.5 (b) | 20M

- Explain unit operations in processing of cereals, oil seeds and pulses.

  OPSC·CSE CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.5 (c) | 20M

- Describe the various unit operations in paddy processing.

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.5 (b) | 20M

- Describe the status of rice milling in your state.

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.5 (c) | 20M

- Write brief notes on: Solvent extraction

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.8 (c) | 20M

- Write brief notes on: Juice extraction

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.8 (c) | 20M

- What are the principles of size reduction? Derive an equation for energy and power requirement in size reduction.

  UK·PSC RFO (Mains) 2015 | Agri. Engineering | Q.7 (iii) | 10M

- It is found that the energy required to reduce particles from a mean diameter of 10 mm to 3 mm is 10 kJ/kg. Using Rittinger's law, Calculate the energy required to reduce the same material from a diameter of 1 mm to 0.3 mm.

  UK·PSC RFO (Mains) 2015 | Agri. Engineering | Q.7 (iv) | 10M

- Briefly explain the major operations performed by any modern rice milling plant. What is the purpose of parboiling of rice?

  OPSC·CSE CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.7 (a) | 20M

- Describe various unit operations in Agricultural Processing.

  OPSC·Forest Forest (Main) 2015-16 | Agri. Engineering | Paper-II, Q.5 (a) | 20M

- Explain the main features and important components of seed processing plant.

  OPSC·Forest Forest (Main) 2015-16 | Agri. Engineering | Paper-II, Q.5 (b) | 20M

- Discuss working of huller. Also discuss advantages and disadvantages of huller.

  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.5 (B) | 20M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	20	19	18	17	16	15	12	TOTAL
IFoS	4	3	1	·	1	2	1	·	2	2	·	·	16
OPSC·CSE	·	1	3	2	·	4	·	2	3	4	1	·	20
OPSC·Forest	·	·	·	·	·	·	1	·	·	·	2	·	3
AP·PSC	·	·	·	·	·	·	·	·	·	·	·	1	1
HP·PSC	·	·	·	·	3	·	·	·	·	·	·	·	3
MH·PSC	·	1	·	·	·	·	·	·	·	·	·	·	1
UK·PSC	2	·	·	·	2	·	2	·	·	·	2	·	8

HOT SUBTOPICS — Most-asked themes in Chapter 2

- **Mills (hammer, roller, jaw, huller, dal mill)** (17 questions)
- **Size reduction & crushing laws (Rittinger/Kick/Bond)** (15 questions)
- **Cleaning, grading & sorting** (8 questions)
- **Separators (air-screen, specific gravity, cyclone)** (5 questions)
- **Filtration** (2 questions)

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CHAPTER

3

DRYING, DEHYDRATION, EVAPORATION & FREEZING

Dryers & drying curves · Psychrometry · Evaporation & concentration · Freezing & refrigeration

OFFICIAL SYLLABUS – Chapter 3 Scope

UPSC IFoS — Agricultural Engineering, Paper II, Section B — Topic 3: Agricultural Process Engineering

- **Chapter 3 covers: Drying and dehydration (dryers, drying curves); psychrometry; evaporation and concentration; freezing and refrigeration.**

Full Topic 3 syllabus: Post harvest technology of crops and its scope. Engineering properties of agricultural produces and by-products. Unit operations — cleaning, grading, size reduction, densification, concentration, drying/dehydration, evaporation, filtration, freezing and packaging of agricultural produces and by-products. Material handling equipment — belt and screw conveyors, bucket elevators, their capacity and power requirement. Processing of milk and dairy products — homogenization, cream separation, pasteurization, sterilization, spray and roller drying, butter making, ice cream, cheese and shrikhand manufacture. Waste and by-product utilization — rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.

SECTION A – UPSC IFoS Previous-Year Questions	*26 questions • 2016 – 2025*
2025	✎ Write short notes on the following : (i) Specific Humidity (ii) Dew Point (DP) Temperature (iii) Wet Bulb (WB) Temperature (iv) Decortication of Oilseeds [P2/5(a) | 8 M] ✎ 5000 kg of apples are to be cooled from 25°C to 10°C in 24 hours. Specific heat of apple is 3·25 kJ/kg·°C. The heat of respiration in 24 hours is 3400 kJ per tonne of apples. Due to different sources, the infiltration of heat is 4100 kJ per tonne of apples during 24 hours. The lighting load is 150 W. Calculate the refrigeration capacity [tonne of refrigeration (TR)] of machine required. Note : 1 TR = 3·5 kW = 210 kJ/min. [P2/6(b) | 10 M]
2024	✎ Find out the evaporation rate in a drum drier for the data given. The steam temperature is 160 °C. The vaporization temperature of milk is 105 °C. The overall heat transfer coefficient is 1200 kcal/h·m2·°C. The drum diameter is 0·7 m. The length of the drum is 105 cm. The latent heat of vaporization is 540 kcal/kg. The product is scrapped at 80% of the revolution of the drum. [P2/5(b) | 8 M] ✎ Explain freeze drying system and its merits. [P2/7(c) | 8 M]

2023	✎ What are the different parameters which can be determined using psychrometric chart? Give four common uses of psychrometric chart in analysis of the drying process. [P2/5(b) | 8 M] ✎ Differentiate between the following : (i) Thin layer drying and Deep bed drying (ii) Bulk density and True density (iii) Rittinger's law of size reduction and Bond's law of size reduction (iv) Pneumatic separation and Gravity separation (v) Modified Atmosphere packaging and Controlled Atmosphere packaging. [P2/6(a) | 10 M] ✎ What is spray drying and what are its main advantages in food processing industries? Explain spray dryer with the help of a schematic diagram. [P2/7(b) | 15 M]
2022	✎ Write the advantages of blanching of fruits and vegetables. [P2/5(a) | 8 M] ✎ Write a short note on different quick-freezing methods. What are the advantages of frozen foods? [P2/5(b) | 8 M] ✎ Estimate the steam requirement during the initial stage of heating 120 L of cream in a jacketed pan, if the initial temperature of the cream is 18 °C and the steam used is at 2 kg/cm2 abs. pressure. The pan has a heating surface area of 1 m2 and the overall heat transfer coefficient is assumed to be 250 kcal/m2·h·°C. Data given : Saturation temperature of steam = 119·6 °C Latent heat, L = 526 kcal/kg at 2 kg/cm2 abs. pressure [P2/6(a) | 10 M] ✎ Potatoes are dried from 14% total solids to 93% total solids. What is the product yield from each 1000 kg of raw potatoes assuming that 8% by weight of the original potatoes is lost in peeling? Calculate the product yield (%) along with mass balance. [P2/7(a) | 10 M] ✎ Explain and explain the following in relation to drying : (i) Fuel efficiency (ii) Thermal efficiency (iii) Drying efficiency. [P2/8(c) | 10 M]
2021	✎ Enlist the different types of dryers used for drying agricultural commodities. Explain foam mat drying for liquid juices. [P2/5(d) | 8 M] ✎ (i) Describe the construction and operation of Recirculatory batch dryer (RPEC type) with neat sketch. [10 M] (ii) Explain the mini dal/dhal mill for milling of pulses. [5 M] [P2/7(a) | 15 M]
2020	✎ 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. [P2/5(c) | 8 M] ✎ 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. [P2/6(c) | 15 M]
2019	✎ What is the importance of dehydration in processing of food? State the principle of operation of a tray dryer. [P2/5(b) | 8 M] ✎ What is boiling point elevation? State the principle of operation of a falling film evaporator. Why is this type of evaporator preferred for concentrating heat-sensitive materials like fruit juice and milk? [P2/6(b) | 15 M] ✎ Orange juice needs to be concentrated using an evaporator from an initial moisture content of 80% (wet basis) to a final moisture content of 45% (dry basis). Calculate the amount of moisture to be removed from 100 kg of orange juice. [P2/6(c) | 10 M] ✎ State why freezing can be considered as a method of preservation of food. What are the advantages and disadvantages of quick freezing? [P2/7(c) | 10 M]
2018	✎ Write the basic mass and energy balance equations for a single effect evaporator, clearly defining each term. [P2/7(a) | 10 M]

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	✎ What is a filter aid? Name any one material that is used as a filter aid. Describe the operation of any one batch filter used in agricultural processes. [P2/7(c) | 15 M]
2017	✎ Write the physical and thermal properties of food and their importance in food processing. Apple juice needs to be concentrated using an evaporator from an initial moisture content of 85% (w.b.) to a final moisture content of 50% (d.b.). Calculate the amount of moisture required to be removed from 100 kg of apple juice to achieve the same. Draw a mass balance diagram for the same. [P2/7(b) | 10 M] ✎ Define water activity. Draw a typical drying curve and explain the mechanism of drying. How moisture content could be quickly removed - explain various measures. [P2/7(c) | 10 M] ✎ Discuss the advantages of cold storage in respect of food processing. What is cold food chain? How it works? [P2/5(a) | 10 M]
2016	✎ Write about the basic drying principle(s) involved in the following : (i) Mechanical drying (ii) Chemical drying (iii) Vacuum drying (iv) Freeze drying. [P2/5(e) | 8 M]

SECTION B : State PSC Previous-Year Questions	*24 questions • All states · year-descending*
✎ Differentiate between refrigeration and freezing. UK·PSC **ACF RFO Logging officer (Mains) 2025 | Agri. Engineering | Q.7 (i), (a) | 5M**	
✎ Describe the relationship between drying rate and grain moisture content in grain drying. What is the role of critical moisture content in drying kinetics? A bin holding 2000 kg of wet grain containing 500 kg of water is to be dried to a final moisture content of 14% (w.b.). What are the initial and final moisture contents of the grain? How much water is removed during drying? OPSC·CSE **CSE (Main) 2024-25 | Agri. Engineering | Paper-II, Q.7 | 15M**	
✎ A 5 cm od (outside diameter) steel pipe carries steam at 150°C. The pipe is insulated with a cylindrical shell of insulator, 3 cm thick (k=0.03 Wm-1K-1). Calculate the rate of heat loss per meter of pipe length if the insulation's outer surface temperature is 35°C. OPSC·CSE **CSE (Main) 2023-24 | Agri. Engineering | Paper-II, Q.17 (a) | 20M**	
✎ Illustrate the process of grain drying psychometrically. OPSC·CSE **CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.5 (a) | 5M**	
✎ Describe the characteristic features of Louisiana State University (LSU) dryer. OPSC·CSE **CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.5 (c) | 5M**	
✎ Describe the constructional features and operational principle of rising film long tube evaporator. OPSC·CSE **CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.16 (a) | 10M**	
✎ How much water should be evaporated from 1 kg of sugar solution at 30°C to concentrate it up to a level of 50%? Calculate the specific energy required, if the efficiency of the evaporator is 85%. Use the following data: Specific heat of sugar solution = 3.95 kJ/kg°C; Boiling point of sugar solution = 105°C; Latent heat of vaporization of water = 2502.3 kJ/kg. OPSC·CSE **CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.16 (b) | 10M**	
✎ Differentiate between: Constant rate period drying and Falling rate period drying HP·PSC **RFO (Mains) 2021 | Agri. Engineering | Q.7 (c) | 10M**	
✎ Briefly explain: Heat utilization factor	

HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (d) | 10M

- Briefly explain: Thawing

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (d) | 10M

- Give a brief account of the various methods of drying grains.

  OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.5 (a), (i) | 8M

- A drum dryer is designed for drying a product from initial TS of 12 % and a final moisture content of 4%. An average temperature difference between the roller surface and the product of 65℃ will be used and the overall heat transfer coefficient is 1.74 kw/m2-K. Determine the surface area of the roller required to provide a production rate of 50 kg product/hr.

  OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.5 (a), (ii) | 12M

- What principles are involved in thin layer and deep bed drying of food grain? Discuss the factors which affect these methods of drying.

  OPSC·Forest Forest (Main) 2019-20 | Agri. Engineering | Paper-II, Q.5 (c) | 20M

- With the help of a simplified diagram explain the working of a forward feed double effect evaporator.

  OPSC·Forest Forest (Main) 2019-20 | Agri. Engineering | Paper-II, Q.6 (a) | 20M

- Discuss the principle of working of (i) drum dryer and (ii) spray dryer.

  OPSC·Forest Forest (Main) 2019-20 | Agri. Engineering | Paper-II, Q.8 (b) | 20M

- Cane sugar solution is concentrated in an evaporator @ 10000 kg/day. The feed solution contains 38% sugar by weight which is increased to 74% after concentration. Calculate the amount of product and water removed.

  OPSC·CSE CSE (Main) 2018-19 | Agri. Engineering | Paper-II, Q.5 (d) | 20M

- Discuss the principle of working of (i) Drum dryer and (ii) Spray dryer.

  OPSC·CSE CSE (Main) 2018-19 | Agri. Engineering | Paper-II, Q.6 (c) | 20M

- What principles are involved in thin layer and deep bed drying of food grain? Discuss the factors which affect these methods of drying.

  OPSC·CSE CSE (Main) 2018-19 | Agri. Engineering | Paper-II, Q.7 (b) | 20M

- Explain the functioning of compression refrigeration system with the help of suitable sketch. What are cares to be taken for proper maintenance?

  OPSC·CSE CSE (Main) 2018-19 | Agri. Engineering | Paper-II, Q.8 (c) | 20M

- Wheat grain is dried from 15% to 7% (wet basis) by flowing fresh warm air mixed with recycled air over the material in a continuous dryer. The absolute humidity of fresh, recycled and mixed (at the dryer inlet) air stream are 0.01, 0.1 and 0.03 kg/kg respectively. Calculate the flow rates of each air stream (kg of dry air/h), moisture removed and the product flow rate for a feed rate of 100 kg/h.

  OPSC·CSE CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.6 (c) | 20M

- Write brief notes on: Food dehydration

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.8 (c) | 20M

- What are the different methods of food preservation? Explain the operation of a triple effect evaporator. What is vacuum evaporator?

  OPSC·CSE CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.5 (b) | 20M

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- What are the basic objectives of grain drying? Differentiate between drying and dehydration. Explain the working principle of a LSU dryer with suitable sketch and specific mention of its parts.

  OPSC·CSE CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.6 (b) | 20M

- Explain various methods and equipments being used for drying and freezing of food materials.

  UK·PSC RFO (Mains) 2012 | Agri. Engineering | Q.5 (iv) | 10M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	20	19	18	17	16	15	12	TOTAL
IFoS	2	2	3	5	2	2	4	2	3	1	·	·	26
OPSC·CSE	·	1	1	4	·	2	·	4	1	1	2	·	16
OPSC·Forest	·	·	·	·	·	·	3	·	·	·	·	·	3
AP·PSC	·	·	·	·	·	·	·	·	·	·	·	·	0
HP·PSC	·	·	·	·	3	·	·	·	·	·	·	·	3
MH·PSC	·	·	·	·	·	·	·	·	·	·	·	·	0
UK·PSC	1	·	·	·	·	·	·	·	·	·	·	1	2

HOT SUBTOPICS — Most-asked themes in Chapter 3

- **Drying & dryers (tray, drum, curves, thin/deep bed)** (27 questions)
- **Evaporation & concentration** (11 questions)
- **Freezing & refrigeration** (9 questions)
- **Psychrometry (RH, humidity, dew point, wet bulb)** (3 questions)

CHAPTER

4

PACKAGING & MATERIAL HANDLING EQUIPMENT

Food packaging & MAP/CAP · Belt & screw conveyors · Bucket elevators · Grain handling

OFFICIAL SYLLABUS – Chapter 4 Scope

UPSC IFoS — Agricultural Engineering, Paper II, Section B — Topic 3: Agricultural Process Engineering

- **Chapter 4 covers: Packaging of agricultural produce; material-handling equipment — belt & screw conveyors and bucket elevators, their capacity and power requirement.**

Full Topic 3 syllabus: Post harvest technology of crops and its scope. Engineering properties of agricultural produces and by-products. Unit operations — cleaning, grading, size reduction, densification, concentration, drying/dehydration, evaporation, filtration, freezing and packaging of agricultural produces and by-products. Material handling equipment — belt and screw conveyors, bucket elevators, their capacity and power requirement. Processing of milk and dairy products — homogenization, cream separation, pasteurization, sterilization, spray and roller drying, butter making, ice cream, cheese and shrikhand manufacture. Waste and by-product utilization — rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.

SECTION A – UPSC IFoS Previous-Year Questions	*10 questions • 2016 – 2025*
2025	✎ Explain different types of food packaging materials with their characteristics. [P2/5(b) | 8 M] ✎ A bucket elevator is installed to be used up to a height of 25 m for vertically lifting foodgrains (750 kg/m3). Each bucket has a volume of 3500 cc and spaced 40 cm apart on a belt. The centre-to-centre distance between head and foot wheel is 25·30 metres. The head pulley is 30 cm in diameter and rotates on a shaft of 5 cm diameter. The belt and the empty buckets weigh on an average 5 kg per metre length. Assume degree of lifting as 80% and coefficient of friction as 0·4 at the axle of the pulley. Find the speed and power required to lift 4 tonnes of foodgrains (750 kg/m3) per hour. [P2/7(b) | 10 M]
2023	✎ Explain the working principle of screw conveyor with a neat drawing. List various shapes of screw conveyor trough. [P2/5(c) | 8 M]
2021	✎ Design a bag storage structure for storing 500 tonnes of wheat. Assume bag size is 70 × 50 × 30 cm to hold 50 kg grain in it. Keep 15 bags in length and 15 bags in width per stack with height/layer of 15 stacks. Assume reasonable data where necessary. [P2/7(b) | 15 M]

2020	✎ 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. [P2/8(c) | 10 M]
2019	✎ Among the two types of conveyors - belt and screw, which type consumes more power and why? With a diagram, explain the operation of a screw conveyor. [P2/6(a) | 15 M]
2018	✎ With a neat diagram describe the operation of a belt conveyor indicating the placement of valves and motors. [P2/6(a) | 15 M] ✎ The mass of a material on a belt conveyor of length 20 m is 200 kg and the conveyor is moving with a speed of 2 m/min. Calculate the capacity i.e. the flow rate of material on the belt conveyor in kg/s. [P2/6(b) | 10 M]
2017	✎ What parameters are to be considered while designing a bucket elevator? Describe briefly. [P2/5(b) | 10 M]
2016	✎ What are the common types of equipment used in grain handling? Discuss in brief the factors considered in their selection. [P2/7(a) | 10 M]

SECTION B : State PSC Previous-Year Questions

17 questions • All states · year-descending

✎ Discuss design considerations in bag storage structures for grains. Design a bag storage structure for storing 200 tonnes of paddy. Make rational assumptions.

MH·PSC **Forest Services (Mains) 2024 | Agri. Engineering | Q.3 (b) | 15M**

✎ Explain the construction and working principle of screw conveyor. State the formulae to express the capacity and power requirement of screw conveyor with detail notations. Among the two types of conveyors - belt and screw, which type consume more power and why?

MH·PSC **Forest Services (Mains) 2024 | Agri. Engineering | Q.7 (a) | 15M**

✎ Describe the characteristic features of a bucket elevator. Calculate the power required for a bucket elevator to convey 0.5 tonnes of paddy per min to a height of 11 m. Consider an allowance of 20% for frictional and transmission losses in the power train.

OPSC·CSE **CSE (Main) 2024-25 | Agri. Engineering | Paper-II, Q.8 | 15M**

✎ Describe the characteristic features of a bucket elevator.

OPSC·CSE **CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.8 (a) | 10M**

✎ Calculate the power required for a bucket elevator to convey 0.5 tonnes of paddy per min to a height of 11 m. Consider an allowance of 20% for frictional and transmission losses in the power train.

OPSC·CSE **CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.8 (b) | 5M**

✎ Describe the working principle of centrifugal type bucket elevator used for handling grains. Describe the formula for determining the power requirement of a bucket elevator.

UK·PSC **RFO (Mains) 2021 | Agri. Engineering | Q.7 (iv) | 10M**

✎ What are various types of food grain storage structures? Explain aluminum bin and R.C.C. bin with schematic diagram. List out the factors affecting the design of silo.

OPSC·CSE **CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.6 (a) | 20M**

✎ Why packaging is essential? Describe the requirements, advantages and classify the materials used for packaging.

OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.6 (c) | 20M

- Explain, in detail, the working of screw conveyors, belt conveyors and bucket elevators, along with its capacity and power requirement.

  OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.7 (a) | 20M

- Describe the working principle of centrifugal type bucket elevator used for handling grains. Describe the formula for determining the power requirement of a bucket elevator.

  UK·PSC ACF (Mains) 2019 | Agri. Engineering | Q.7 (iv) | 10M

- What are the different uses of idler pulley in a conveyor belt as well as in mechanical transmission?

  OPSC·Forest Forest (Main) 2019-20 | Agri. Engineering | Paper-II, Q.7 (b) | 20M

- Explain the various methods for feeding and discharge in a belt conveyor.

  OPSC·CSE CSE (Main) 2018-19 | Agri. Engineering | Paper-II, Q.5 (b) | 20M

- What are the different uses of idler pulley in a conveyor belt as well as in mechanical transmission?

  OPSC·CSE CSE (Main) 2018-19 | Agri. Engineering | Paper-II, Q.6 (a) | 20M

- Describe the working with details of capacity and power requirement of belt and screw conveyors, bucket elevators.

  OPSC·CSE CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.7 (b) | 20M

- Name the different grain handling equipments. Explain any one, stating its design consideration, components and operational characteristics.

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.7 (a) | 20M

- What do you mean by value added product with reference to food industries? Explain the operation of belt and screw conveyor and also bucket elevator.

  OPSC·CSE CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.5 (c) | 20M

- With the help of a neat sketch, explain the functions of different components, working principle and power requirement of a belt-conveyer.

  UK·PSC RFO (Mains) 2012 | Agri. Engineering | Q.6 (iii) | 10M

SECTION C — Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	20	19	18	17	16	15	12	TOTAL
IFoS	2	·	1	·	1	1	1	2	1	1	·	·	10
OPSC·CSE	·	1	·	2	·	3	·	2	1	1	1	·	11
OPSC·Forest	·	·	·	·	·	·	1	·	·	·	·	·	1
AP·PSC	·	·	·	·	·	·	·	·	·	·	·	·	0
HP·PSC	·	·	·	·	·	·	·	·	·	·	·	·	0
MH·PSC	·	2	·	·	·	·	·	·	·	·	·	·	2
UK·PSC	·	·	·	·	1	·	1	·	·	·	·	1	3

HOT SUBTOPICS — Most-asked themes in Chapter 4

- **Belt & screw conveyors** (11 questions)
- **Bucket elevators (capacity & power)** (10 questions)
- **Grain handling & storage design** (6 questions)
- **Food packaging & MAP/CAP** (3 questions)

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CHAPTER

5

DAIRY & MILK PROCESSING

Homogenization & cream separation · Pasteurization & sterilization · Butter, ice-cream, cheese, shrikhand · Milk powder

OFFICIAL SYLLABUS – Chapter 5 Scope

UPSC IFoS — Agricultural Engineering, Paper II, Section B — Topic 3: Agricultural Process Engineering

- **Chapter 5 covers: Processing of milk and dairy products — homogenization, cream separation, pasteurization, sterilization, spray & roller drying, butter making, ice cream, cheese and shrikhand manufacture.**

Full Topic 3 syllabus: Post harvest technology of crops and its scope. Engineering properties of agricultural produces and by-products. Unit operations — cleaning, grading, size reduction, densification, concentration, drying/dehydration, evaporation, filtration, freezing and packaging of agricultural produces and by-products. Material handling equipment — belt and screw conveyors, bucket elevators, their capacity and power requirement. Processing of milk and dairy products — homogenization, cream separation, pasteurization, sterilization, spray and roller drying, butter making, ice cream, cheese and shrikhand manufacture. Waste and by-product utilization — rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.

SECTION A – UPSC IFoS Previous-Year Questions	*20 questions • 2016 – 2025*
2025	✎ Discuss various advantages and limitations of ice cream ingredients such as milk fat, milk-solids-not-fat, sugar, stabilizer, emulsifier, total solids, flavour and colour. [P2/7(a) | 15 M] ✎ Define Shrikhand. Discuss the standardised method of preparation of Shrikhand. [P2/8(c) | 10 M]
2024	✎ Mention the ingredients of ice cream and describe in detail its preparation. [P2/6(a) | 15 M] ✎ If the volume of milk flow in a homogenizer is 1000 L/h, at a pressure of 250 kg/cm2, calculate the horsepower required for homogenization. [P2/6(b) | 10 M] ✎ Discuss the techniques involved in standardization of milk. [P2/8(d) | 10 M]
2023	✎ What are common types of heat exchangers used in the food industry? How are heat exchangers classified based on relative direction of motions of fluid flow? [P2/6(c) | 15 M] ✎ (i) Explain about homogenization. Calculate the horse-power (hp) required for homogenization. Given value of Q is 1000 l/h and p is 250 kg/cm2. [10 M] (ii) Describe In-bottle sterilization of milk. [5 M] [P2/7(a) | 15 M] ✎ Why is freezing of cream done? Explain any two methods of cream freezing. [P2/7(c) | 10 M]
2022	✎ (i) Why is chilling of milk essential? Write the different types of milk chilling systems. (ii) Write a short note on overrun in ice cream. [P2/8(b) | 15 M]

2021	✎ Define Ice-cream. Write the method/flowchart of manufacturing, packaging, hardening and storage of ice-cream. [P2/5(c) | 8 M] ✎ How many kg each of 28% cream and 3% milk will be required to make 500 kg of a mixture testing 4% fat? Also do proof showing fat in individual items. [P2/6(b) | 15 M]
2020	✎ What is pasteurisation of milk? Enlist the methods of pasteurization of milk. Write the advantages of high temperature short time (HTST) pasteurization of milk. [P2/5(d) | 8 M] ✎ 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 given for the mass is concentrated is 0·35 m and time to reach the running speed is 300 s. [P2/7(a) | 15 M] ✎ 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? [P2/7(c) | 10 M]
2019	✎ Why is homogenisation of milk important in the dairy industry? With the help of a neat diagram, describe the operation of a cream separator. [P2/7(a) | 15 M] ✎ Describe how milk powder can be produced from liquid milk slurry in a spray dryer. [P2/7(b) | 15 M]
2018	✎ What are the reasons for fouling of heat exchangers during milk processing? [P2/5(a) | 8 M] ✎ Draw the flowchart of making butter from milk in a continuous process. [P2/8(a) | 15 M] ✎ What is the difference between sterilisation and pasteurisation? What are the steps involved in making cheddar cheese from milk? [P2/8(b) | 15 M]
2016	✎ Differentiate between the working principle and application of Spray and Roller driers in Milk Powder manufacture. [P2/7(c) | 10 M]

SECTION B : State PSC Previous-Year Questions

29 questions • All states · year-descending

✎ How many kg of each of cream having 30% fat and milk having 5% fat will be required to make 1000 kg of mixture having 10% fat?

MH·PSC **Forest Services (Mains) 2024 | Agri. Engineering | Q.6 (c) | 10M**

✎ What is meant by pasteurization of milk? Explain the thermal destruction kinetics in terms of D-value and Z-value. With the aid of a schematic, explain the features of a batch pasteurizer.

OPSC·CSE **CSE (Main) 2024-25 | Agri. Engineering | Paper-II, Q.16 | 20M**

✎ How do UHT treatment and steam sterilization ensure the safety and longevity of dairy products and what are their benefits in extending shelf life, maintaining product quality and facilitating global distribution?

OPSC·CSE **CSE (Main) 2023-24 | Agri. Engineering | Paper-II, Q.17 (b) | 20M**

✎ Explain about role of different constituents in ice cream making and also explain about unit operations involved in making an ice cream.

OPSC·Forest **Forest (Main) 2023-24 | Agri. Engineering | Paper-II, Q.6 (a) | 20M**

✎ What are pasteurization, sterilization and homogenization? Explain about first and second stage of homogenization.

OPSC·Forest **Forest (Main) 2023-24 | Agri. Engineering | Paper-II, Q.8 (b) | 20M**

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- Highlight the salient features of Plate Heat Exchangers used in dairy industry.

  OPSC·CSE CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.7 (a) | 10M

- Differentiate 'D' value from 'z' value in thermal processing of foods.

  OPSC·CSE CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.7 (b) | 5M

- List out the general design considerations for milk processing plant.

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (b) | 10M

- Briefly explain: Homogenization efficiency

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (d) | 10M

- Define pasteurization and sterilization of milk. Describe the working of a batch type pasteurizer.

  UK·PSC RFO (Mains) 2021 | Agri. Engineering | Q.7 (iii) | 10M

- What do you understand by pasteurization, homogenization and sterilization of milk? What are its purpose and advantages? Explain how it is carried out?

  OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.5 (c), (i) | 10M

- Write, in detail, various steps and processes involved in butter manufacturing supplemented with process flow chart/line diagram.

  OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.7 (c) | 20M

- Define pasteurization and sterilization of milk. Describe the working of a batch type pasteurizer.

  UK·PSC ACF (Mains) 2019 | Agri. Engineering | Q.7 (iii) | 10M

- Explain the working principles of equipments for pasteurization, sterilization and homogenization.

  OPSC·Forest Forest (Main) 2019-20 | Agri. Engineering | Paper-II, Q.6 (b) | 20M

- What do you understand by pasteurization? Describe the working of HTST pasteurizer with the help of a neat diagram. How it differs with batch type pasteurizer?

  OPSC·CSE CSE (Main) 2018-19 | Agri. Engineering | Paper-II, Q.8 (a) | 20M

- Explain the working principles of equipments for receiving, pasteurization, sterilization and homogenization.

  OPSC·CSE CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.8 (a) | 20M

- Explain the working principles of equipments for sterilization and homogenization of milk.

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.6 (a) | 20M

- What is Pasteurization? What are its various types, methods and purpose? Give operational details of HTST.

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.6 (b) | 20M

- Milk pasteurization is carried out either at 85°C temperature for 4s or at 71°C for 40s. In both the cases the sterilizing value is 8. What are the decimal reduction times for these two processes? Calculate the Z value for reference temperatures of 71°C and 85°C. Also obtain the activation energy value for pasteurization process.

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.7 (b) | 20M

- Differentiate between HTST pasteurizer and Batch type Pasteurizer.

  UK·PSC RFO (Mains) 2015 | Agri. Engineering | Q.8 (i) | 10M

- Starting from homogenization of milk and cream separation explain the operation of butter manufacturing unit.
  OPSC·CSE CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.5 (a) | 20M
- What are the different methods of pasteurization of milk? Explain the operational details of high temperature short time (HTST) plant with a neat sketch showing all components.
  OPSC·CSE CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.6 (a) | 20M
- What are the important considerations in processing of milk and dairy products? Explain in detail.
  OPSC·Forest Forest (Main) 2015-16 | Agri. Engineering | Paper-II, Q.6 (a) | 20M
- What is Homogenization and Sterilization? Describe the purpose and methods of homogenization in brief.
  OPSC·Forest Forest (Main) 2015-16 | Agri. Engineering | Paper-II, Q.6 (b) | 20M
- What do you mean by 'homogenization' of milk?
  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.1 (B) | 4M
- What are steps involved in manufacturing of ice cream?
  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.1 (C) | 4M
- Define the terms 'standardization' and 'skimming efficiency'.
  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.2 (F) | 5M
- Why should milk be pasteurized? Explain the working of HTST pasteurizer.
  AP·PSC RFO (Mains) 2012 | Agri. Engineering | Q.4 (D) | 10M
- Describe the method of High Temperature Short Time (HTST) pasteurization with the help of a neat sketch.
  UK·PSC RFO (Mains) 2012 | Agri. Engineering | Q.6 (ii) | 10M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	20	19	18	17	16	15	12	TOTAL
IFoS	2	3	3	1	2	3	2	3	·	1	·	·	20
OPSC·CSE	·	1	1	2	·	2	·	1	1	3	2	·	13
OPSC·Forest	·	·	2	·	·	·	1	·	·	·	2	·	5
AP·PSC	·	·	·	·	·	·	·	·	·	·	·	4	4
HP·PSC	·	·	·	·	2	·	·	·	·	·	·	·	2
MH·PSC	·	1	·	·	·	·	·	·	·	·	·	·	1
UK·PSC	·	·	·	·	1	·	1	·	·	·	1	1	4

HOT SUBTOPICS — Most-asked themes in Chapter 5

- **Pasteurization & sterilization** (20 questions)
- **Cream separation, homogenization & standardization** (15 questions)
- **Ice cream, butter, cheese & shrikhand** (11 questions)
- **Heat exchangers & milk chilling** (4 questions)
- **Milk powder (spray & roller drying)** (2 questions)

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CHAPTER

6

WASTE & BY-PRODUCT UTILIZATION

Rice husk & bran · Sugarcane bagasse · Plant residues & coir pith · Wealth from waste

OFFICIAL SYLLABUS – Chapter 6 Scope

UPSC IFoS — Agricultural Engineering, Paper II, Section B — Topic 3: Agricultural Process Engineering

- **Chapter 6 covers: Waste and by-product utilization — rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.**

Full Topic 3 syllabus: Post harvest technology of crops and its scope. Engineering properties of agricultural produces and by-products. Unit operations — cleaning, grading, size reduction, densification, concentration, drying/dehydration, evaporation, filtration, freezing and packaging of agricultural produces and by-products. Material handling equipment — belt and screw conveyors, bucket elevators, their capacity and power requirement. Processing of milk and dairy products — homogenization, cream separation, pasteurization, sterilization, spray and roller drying, butter making, ice cream, cheese and shrikhand manufacture. Waste and by-product utilization — rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.

SECTION A – UPSC IFoS Previous-Year Questions	*10 questions • 2016 – 2024*
2024	✎ Explain the process of extracting crude bran oil through batch type solvent extraction method. [P2/8(b) | 12 M]
2023	✎ (i) What are the different methods of stabilization of rice bran? [8 M] (ii) Explain the process of extraction and refining of rice bran oil. [7 M] [P2/6(b) | 15 M]
2022	✎ Explain the by-products generation from sugarcane in sugar and jaggery industries. Show potential utilization of sugarcane industry waste for generation of wealth from waste through process flowchart. [P2/6(b) | 15 M]
2020	✎ 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/m3 whereas that of densified straw as 400 kg/m3. The transportation cost may be considered as ₹ 2000 per truck from city A to city B. Consider the volume of one truck as 10 m3. [P2/6(a) | 15 M]
2019	✎ What is rice husk? Describe how energy can be generated from rice husk. [P2/5(c) | 8 M]
2018	✎ What are the steps involved in producing alcohol from sugarcane bagasse? [P2/5(d) | 8 M]

2016	✎ Which are the by-products generated during milling of paddy? Describe how the by-products can be profitably used. [P2/6(d) | 10 M] ✎ Describe how sugarcane bagasse can be utilized, not going as waste. [P2/7(d) | 10 M]
	✎ Write different technological solutions available for utilization of rice husk. [P2/8(c) | 10 M] ✎ Write the problem associated with storage of rice bran and its possible reasons. Explain with the help of suitable flow diagram the extraction of oil from rice bran. [P2/8(d) | 10 M]

SECTION B : State PSC Previous-Year Questions

9 questions • All states · year-descending

✎ Define agricultural wastes and by-products. How can these be utilized?

UK·PSC **ACF RFO Logging officer (Mains) 2025 | Agri. Engineering | Q.7 (iii) | 10M**

✎ Name various method for extracting rice bran oil. Briefly describe rice bran oil extraction by solvent extraction method and give its advantages.

UK·PSC **RFO (Mains) 2021 | Agri. Engineering | Q.8 (iv) | 10M**

✎ Describe how best and in which form the agricultural waste and by-product (rice husk, rice bran, plant residues) can be utilized.

OPSC·CSE **CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.7 (b) | 20M**

✎ Name various method for extracting rice bran oil. Briefly describe rice bran oil extraction by solvent extraction method and give its advantages.

UK·PSC **ACF (Mains) 2019 | Agri. Engineering | Q.8 (iv) | 10M**

✎ Describe the waste and by-product utilization of rice husk, rice bran, plant residues and coir pith.

OPSC·CSE **CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.8 (b) | 20M**

✎ What do you understand by agricultural by-product and wastes? Explain the utilization of rice husk and rice bran.

OPSC·CSE **CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.5 (a) | 20M**

✎ Explain how the oil is extracted from rice bran by solvent extraction method. Give only flow diagram to show the modern milling of pulses.

OPSC·CSE **CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.7 (b) | 20M**

✎ What are the factors to be considered in waste disposal problem? Write, in brief, regarding waste utilization and their treatment.

OPSC·CSE **CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.8 (b) | 20M**

✎ Explain the ways and means to utilize the by-products such as rice-husk, rice-bran, sugarcane-bagasse and coir pith.

UK·PSC **RFO (Mains) 2012 | Agri. Engineering | Q.8 (iii) | 10M**

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	20	19	18	17	16	15	12	0	TOTAL
IFoS	·	1	1	1	·	1	1	1	·	2	·	·	2	10
OPSC·CSE	·	·	·	·	·	1	·	·	1	1	2	·	·	5
OPSC·Forest	·	·	·	·	·	·	·	·	·	·	·	·	·	0

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AP·PSC	·	·	·	·	·	·	·	·	·	·	·	·	·	**0**
HP·PSC	·	·	·	·	·	·	·	·	·	·	·	·	·	**0**
MH·PSC	·	·	·	·	·	·	·	·	·	·	·	·	·	**0**
UK·PSC	**1**	·	·	·	**1**	·	**1**	·	·	·	·	**1**	·	**4**

HOT SUBTOPICS — Most-asked themes in Chapter 6

- **Rice bran & bran oil** (10 questions)
- **By-products & biomass densification** (10 questions)
- **Rice husk utilization** (6 questions)
- **Sugarcane bagasse & sugar/jaggery by-products** (4 questions)

CHAPTER

7

ELECTRONIC DEVICES

Rectifiers · Amplifiers · Oscillators · Multivibrators

OFFICIAL SYLLABUS – Chapter 7 Scope

UPSC IFoS — Agricultural Engineering, Paper II, Section B — Topic 4: Instrumentation and Computer Applications

- **Chapter 7 covers: Electronic devices and their characteristics — rectifiers, amplifiers, oscillators and multi-vibrators.**

Full Topic 4 syllabus: Electronic devices and their characteristics — rectifiers, amplifiers, oscillators, multi-vibrators. Digital circuits — sequential and combinational system. Application of microprocessors in data acquisition and control of agricultural engineering processes — measurement systems for level, flow, strain, force, torque, power, pressure, vacuum and temperature. Computers — introduction, input/output devices, central processing unit, memory devices, operating systems, processors, keyboards and printers. Algorithms, flowchart specification, programme translation and problem analysis in Agricultural Engineering. Multimedia and Audio-Visual aids.

SECTION A – UPSC IFoS Previous-Year Questions	*2 questions • 2022 – 2025*
2025	✎ Define electrical amplifying elements and discuss their voltage amplification, current amplification and gain. [P2/5(d) | 8 M]
2022	✎ Discuss in detail about (i) amplifiers and (ii) multivibrators. [P2/5(e) | 8 M]

SECTION B : State PSC Previous-Year Questions	*9 questions • All states · year-descending*

✎ What are the advantages of operational amplifiers over discrete devices? State the typical specifications of a general-purpose operational amplifier. Explain the following terminologies: Input offset voltage; Input offset current; Slew rate.

OPSC·CSE **CSE (Main) 2024-25 | Agri. Engineering | Paper-II, Q.12 | 15M**

✎ Explain the design of a full-wave bridge rectifier. What is meant by ripple effect? Explain the role of smoothing capacitor in a rectifier circuit.

OPSC·CSE **CSE (Main) 2024-25 | Agri. Engineering | Paper-II, Q.18 | 20M**

✎ What is PN junction? Draw and Explain its characteristics with diagram.

OPSC·Forest **Forest (Main) 2023-24 | Agri. Engineering | Paper-II, Q.5 (a) | 20M**

✎ Diagrammatically explain the working of full wave center tap rectifier.

OPSC·Forest **Forest (Main) 2023-24 | Agri. Engineering | Paper-II, Q.7 (b) | 20M**

- Describe the principle of operation of a single phase full wave bridge rectifier.

  OPSC·CSE CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.12 (a) | 10M

- What is the significance of ripple factor in the design of bridge rectifier?

  OPSC·CSE CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.12 (b) | 5M

- How an oscillator differs from an amplifier? Draw the circuit diagram of half wave rectifier and describe its functioning and characteristics.

  UK·PSC RFO (Mains) 2021 | Agri. Engineering | Q.8 (i) | 10M

- How an oscillator differs from an amplifier? Draw the circuit diagram of half wave rectifier and describe its functioning and characteristics.

  UK·PSC ACF (Mains) 2019 | Agri. Engineering | Q.8 (i) | 10M

- What is sensor? Explain the working principle of rectifier, amplifier and oscillators.

  OPSC·CSE CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.5 (d) | 20M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	19	15	TOTAL
IFoS	1	·	·	1	·	·	·	2
OPSC·CSE	·	2	·	2	·	·	1	5
OPSC·Forest	·	·	2	·	·	·	·	2
AP·PSC	·	·	·	·	·	·	·	0
HP·PSC	·	·	·	·	·	·	·	0
MH·PSC	·	·	·	·	·	·	·	0
UK·PSC	·	·	·	·	1	1	·	2

HOT SUBTOPICS — Most-asked themes in Chapter 7

- **Rectifiers** (7 questions)
- **Amplifiers** (6 questions)
- **Oscillators** (3 questions)
- **Multivibrators** (1 questions)

CHAPTER

8

DIGITAL CIRCUITS & MICROPROCESSORS

Sequential & combinational circuits · Logic gates · Microprocessors in data acquisition & control

OFFICIAL SYLLABUS – Chapter 8 Scope

UPSC IFoS — Agricultural Engineering, Paper II, Section B — Topic 4: Instrumentation and Computer Applications

- **Chapter 8 covers: Digital circuits — sequential and combinational systems; application of microprocessors in data acquisition and control of agricultural engineering processes.**

Full Topic 4 syllabus: Electronic devices and their characteristics — rectifiers, amplifiers, oscillators, multi-vibrators. Digital circuits — sequential and combinational system. Application of microprocessors in data acquisition and control of agricultural engineering processes — measurement systems for level, flow, strain, force, torque, power, pressure, vacuum and temperature. Computers — introduction, input/output devices, central processing unit, memory devices, operating systems, processors, keyboards and printers. Algorithms, flowchart specification, programme translation and problem analysis in Agricultural Engineering. Multimedia and Audio-Visual aids.

SECTION A – UPSC IFoS Previous-Year Questions

4 questions • 2016 – 2019

2019	✎ State how microprocessors can be utilised in acquisition of data and can subsequently be used in agricultural engineering. [P2/5(d) | 8 M] ✎ Differentiate between the working principles of sequential and combination systems of digital circuits. [P2/8(b) | 15 M]
2016	✎ How are Microprocessors used in data acquisition and control of Agricultural Engineering processes? [P2/8(a) | 10 M] ✎ Differentiate between the working principle of sequential and combination systems of Digital circuits. [P2/8(d) | 10 M]

SECTION B : State PSC Previous-Year Questions

11 questions • All states · year-descending

✎ How is microprocessor programming applied in Agricultural Engineering and what are the key steps involved, from selecting hardware to testing and documentation?

OPSC·CSE **CSE (Main) 2023-24 | Agri. Engineering | Paper-II, Q.18 (a) | 20M**

✎ Differentiate: Programmable logic controller and Programmable automation controller

HP·PSC **RFO (Mains) 2021 | Agri. Engineering | Q.8 (b) | 10M**

- Write in brief: Micro-controller

  HP·PSC RFO (Mains) 2021 | Agri. Engineering | Q.8 (c) | 10M

- What are the functions of combinational digital logic gates? Explain the application of microprocessor for measurement of force.

  UK·PSC RFO (Mains) 2021 | Agri. Engineering | Q.8 (ii) | 10M

- Explain the systems of a microprocessor based operation to study some of the engineering properties of food product.

  OPSC·CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.8 (a) | 20M

- What are the functions of combinational digital logic gates? Explain the application of microprocessor for measurement of force.

  UK·PSC ACF (Mains) 2019 | Agri. Engineering | Q.8 (ii) | 10M

- Write programming of microprocessors and data acquisition and control of agricultural engineering processes.

  OPSC·CSE CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.6 (b) | 20M

- Write short notes on application of micro processors in data acquisition in deep forests.

  UK·PSC RFO (Mains) 2015 | Agri. Engineering | Q.8 (ii) | 10M

- Explain the systems of a microprocessor-based operation to study a few engineering properties of any food product.

  OPSC·CSE CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.6 (c) | 20M

- Differentiate between sequential and combinational circuits with an example.

  OPSC·Forest Forest (Main) 2015-16 | Agri. Engineering | Paper-II, Q.7 (a) | 20M

- Explain the digital circuits of sequential and combinational systems. Also, explain the application of microprocessor in the measurement of flow-rate and temperature.

  UK·PSC RFO (Mains) 2012 | Agri. Engineering | Q.8 (iv) | 10M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	23	21	20	19	17	16	15	12	TOTAL
IFoS	·	·	·	2	·	2	·	·	4
OPSC·CSE	1	·	1	·	1	·	1	·	4
OPSC·Forest	·	·	·	·	·	·	1	·	1
AP·PSC	·	·	·	·	·	·	·	·	0
HP·PSC	·	2	·	·	·	·	·	·	2
MH·PSC	·	·	·	·	·	·	·	·	0
UK·PSC	·	1	·	1	·	·	1	1	4

HOT SUBTOPICS — Most-asked themes in Chapter 8

- **Microprocessors in data acquisition & control** (11 questions)
- **Sequential & combinational circuits** (6 questions)
- **Digital logic gates** (2 questions)

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CHAPTER

9

MEASUREMENT SYSTEMS IN AGRICULTURAL ENGINEERING

Level, flow, strain, force, torque, power, pressure, vacuum & temperature · Transducers & sensors

OFFICIAL SYLLABUS – Chapter 9 Scope

UPSC IFoS — Agricultural Engineering, Paper II, Section B — Topic 4: Instrumentation and Computer Applications

- **Chapter 9 covers: Measurement systems for level, flow, strain, force, torque, power, pressure, vacuum and temperature; transducers, sensors and their characteristics.**

Full Topic 4 syllabus: Electronic devices and their characteristics — rectifiers, amplifiers, oscillators, multi-vibrators. Digital circuits — sequential and combinational system. Application of microprocessors in data acquisition and control of agricultural engineering processes — measurement systems for level, flow, strain, force, torque, power, pressure, vacuum and temperature. Computers — introduction, input/output devices, central processing unit, memory devices, operating systems, processors, keyboards and printers. Algorithms, flowchart specification, programme translation and problem analysis in Agricultural Engineering. Multimedia and Audio-Visual aids.

SECTION A – UPSC IFoS Previous-Year Questions	*34 questions • 2016 – 2025*
2025	✎ Write the principle of operation of the following transducer elements and mention their input and output variables : (i) Bourdon gauge (ii) Venturimeter/Orifice meter (iii) Piezo-electric device (iv) Solar cell [P2/6(c) | 8 M] ✎ With a neat sketch, explain the cistern-type manometer used for measuring static pressure. [P2/7(d) | 7 M]
2024	✎ Write the principle of operation of the following and mention their input and output variables : (i) Thermocouple (ii) Resistance strain gauge (iii) Hot wire anemometer (iv) Resistance thermometer [P2/5(d) | 8 M] ✎ Write short note on precision, resolution and threshold of an instrument. [P2/6(c) | 8 M] ✎ Discuss the use of U-tube manometer. What are the desirable characteristics of manometric fluid? [P2/8(a) | 8 M]
2023	✎ Differentiate between the following : (i) Analog Signal and Digital Signal (ii) Force and Torque (iii) Accuracy and Precision (iv) Stress and Strain [P2/5(d) | 8 M] ✎ (i) Write in brief about the instrumentation used in measurement of temperature. [5 M] (ii) Calculate the steam requirement during the initial stage of heating of 120 l of cream in a pan, if

	the initial temperature of the cream is 18°C and the steam used is at 2·00 kg/cm2 abs. pressure. Heating surface area of pan is 1 m2 and overall heat transfer coefficient is 250 kcal/m2·h·°C. Given data from steam tables are : Saturation temperature of steam = 119·6°C; Latent heat = 526 kcal/kg at 2 kg/cm2 abs. pressure. [5 M] [P2/8(a) | 10 M] ✎ Explain with the help of neat figures : (i) Orifice meter (ii) Venturimeter [P2/8(b) | 10 M] ✎ Write the working principles involved in hydraulic load cell and pneumatic load cell in force measurements. [P2/8(c) | 10 M]
2022	✎ Explain the classification of the following analog instruments : (i) Indicating instruments (ii) Recording instruments [P2/5(d) | 8 M] ✎ Draw a figure of generalized measurement system and write about its functional elements. [P2/7(c) | 15 M] ✎ Write the principle of operations of thermocouple. Draw the common forms of thermocouple construction and explain. [P2/8(a) | 15 M]
2021	✎ What is an amplifier and what are their different types? With the help of neat sketch, explain the hydraulic amplifying element. [P2/8(a) | 15 M] ✎ Write in brief about the following : (i) Transmission Dynamometer (ii) Driving type Dynamometer (iii) Absorption Dynamometer [P2/8(b) | 15 M] ✎ For a certain thermistor, β = 3140 K and the resistance at 27°C is known to be 1050 Ω. The thermistor is used for temperature measurement and the resistance is measured as 2330 Ω. Find the measured temperature using equation of the temperature-resistance characteristics of the thermistor. [P2/8(c) | 10 M]
2020	✎ Write the types of instrumentation systems being used in food processing. Explain the elements of an analog data acquisition system. [P2/5(e) | 8 M] ✎ 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? [P2/8(a) | 15 M] ✎ 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. [P2/8(b) | 15 M]
2019	✎ What is meant by strain? Draw the typical stress – strain curve showing linear, necking and eventual break regions. What is the principle of operation of a metal strain-gauge? [P2/5(e) | 8 M] ✎ What is the basic difference between sensors and transducers? For what purpose is a rotameter used in fluid flow? How does it operate? [P2/8(a) | 15 M] ✎ What is Seebeck effect? Find the Seebeck emf, in mV, for a material with α = 60 μV/°C if the junction temperatures are 30°C and 100°C, where α is a proportionality constant. [P2/8(c) | 10 M]
2018	✎ Explain with a neat diagram how a diaphragm can be used for measuring pressure difference in a system. [P2/5(b) | 8 M] ✎ What is Seebeck effect? How is this principle applied in the operation of a thermocouple used for measuring temperature? [P2/6(c) | 15 M]
2017	✎ Write basic principles involved in working of thermocouples. How law of intermediate temperature and metals is used in design of thermocouples? Also explain the construction and advantages of thermopiles. [P2/5(d) | 10 M]

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	✎ Classify flow meters. Explain the functioning of a hot wire anemometer. Draw a neat sketch. [P2/6(a) | 10 M] ✎ Write the working principle of the following : (i) Piezoelectric transducer (ii) Pyrometer (iii) Semi conductor resistance sensors (iv) Signal conditioning (v) Vibration meter [P2/6(b) | 10 M] ✎ Describe different types of torque sensors along with their working principles. How the torque of PTO pulley can be measured? [P2/6(c) | 10 M] ✎ Explain five important static characteristic parameters of a simplified measuring system. Derive an expression for output of a first order instrument. [P2/7(d) | 10 M] ✎ Define precision and accuracy of an instrument with suitable examples. [P2/8(a) | 10 M]
2016	✎ Differentiate between the following : (i) Analog and Digital signals (ii) Readability and Span (iii) True value and Accuracy (iv) Force and Torque. [P2/5(a) | 8 M] ✎ Describe in brief the method of measurement calibration of the following : (i) Draft requirement of an animal drawn plough (ii) Draft requirement of a tractor drawn trailed disc harrow. [P2/5(b) | 8 M] ✎ How are the following measurements done? (i) Brake Horse Power of an engine using hydraulic brake dynamometer (ii) Calibration of a hydraulic tension dynamometer. [P2/5(c) | 8 M] ✎ Describe the basic methods of force measurement. [P2/6(c) | 10 M] ✎ Name the different types of strain measuring equipment and describe in brief the techniques adopted using strain gauges. [P2/7(b) | 10 M]

SECTION B : State PSC Previous-Year Questions	*29 questions • All states · year-descending*
✎ What are the different instruments for the measurement of flow? Explain them in brief. UK·PSC **ACF RFO Logging officer (Mains) 2025 | Agri. Engineering | Q.8 (ii) | 10M**	
✎ Describe the working of electrical resistance strain gauges. UK·PSC **ACF RFO Logging officer (Mains) 2025 | Agri. Engineering | Q.8 (iii) | 10M**	
✎ Explain in brief the different instruments used for measurements of temperature. Write the principle of operation of thermocouple. Explain the construction of thermocouple with neat sketch. MH·PSC **Forest Services (Mains) 2024 | Agri. Engineering | Q.7 (b) | 15M**	
✎ What are the types of thermocouples used in temperature measurement? Graphically explain the effect of temperature on the e.m.f. produced in thermocouples. Explain Seebeck, Peltier and Thomson effects in instrumentation with thermocouples. OPSC·CSE **CSE (Main) 2024-25 | Agri. Engineering | Paper-II, Q.11 | 15M**	
✎ What sensors and transducers are used in agricultural instrumentation and how do they contribute to precision agriculture by collecting data on soil, weather, crops and other parameters? OPSC·CSE **CSE (Main) 2023-24 | Agri. Engineering | Paper-II, Q.18 (b) | 20M**	
✎ Write short note on Thermocouples and their application. OPSC·Forest **Forest (Main) 2023-24 | Agri. Engineering | Paper-II, Q.7 (a) | 20M**	
✎ Define the following instrument parameters: Accuracy; Precision; Drift. OPSC·CSE **CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.11 (a) | 5M**	

- State the principle of flow measurement using a venturi tube.
  OPSC-CSE CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.11 (b) | 5M
- Compare the characteristics of Resistance Temperature Detectors (RTDs), Transistors and Thermocouples for temperature measurement.
  OPSC-CSE CSE (Main) 2022-23 | Agri. Engineering | Paper-II, Q.11 (c) | 5M
- With a block diagram explain the basic measuring instrumentation system.
  HP-PSC RFO (Mains) 2021 | Agri. Engineering | Q.8 (a) | 10M
- Differentiate: Static characteristics and Dynamic characteristics of instruments
  HP-PSC RFO (Mains) 2021 | Agri. Engineering | Q.8 (b) | 10M
- Differentiate: Response time and Rise time
  HP-PSC RFO (Mains) 2021 | Agri. Engineering | Q.8 (b) | 10M
- Write in brief: Hot wire anemometer
  HP-PSC RFO (Mains) 2021 | Agri. Engineering | Q.8 (c) | 10M
- Write in brief: Tachometer
  HP-PSC RFO (Mains) 2021 | Agri. Engineering | Q.8 (c) | 10M
- Write in brief: Noise
  HP-PSC RFO (Mains) 2021 | Agri. Engineering | Q.8 (c) | 10M
- What for pressure transducers are used? Write in brief about different types of pressure transducers.
  HP-PSC RFO (Mains) 2021 | Agri. Engineering | Q.8 (d) | 10M
- Explain the principle, working and uses of strain gauge dynamometer and torsion dynamometer.
  OPSC-CSE CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.8 (c) | 20M
- Describe the functioning of strain gauge type drawbar dynamometer.
  OPSC-Forest Forest (Main) 2019-20 | Agri. Engineering | Paper-II, Q.5 (b) | 20M
- What is a Transducer? Distinguish between active and passive transducers.
  OPSC-Forest Forest (Main) 2019-20 | Agri. Engineering | Paper-II, Q.7 (a) | 20M
- Describe the functioning of strain gauge type drawbar dynamometer.
  OPSC-CSE CSE (Main) 2018-19 | Agri. Engineering | Paper-II, Q.5 (c) | 20M
- Describe the working principle of torque transducers. Show the position of the strain gauges over the shaft and their circuit connectivity.
  OPSC-CSE CSE (Main) 2018-19 | Agri. Engineering | Paper-II, Q.6 (b) | 20M
- What is a Transducer? Distinguish between active and passive transducers.
  OPSC-CSE CSE (Main) 2018-19 | Agri. Engineering | Paper-II, Q.8 (b) | 20M
- Explain the applications of primary sensors and transducers in agricultural processing.
  OPSC-CSE CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.5 (d) | 20M
- Explain generalized instrumentation system.
  OPSC-CSE CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.6 (a) | 20M

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- Specify and name the measuring instruments for current, voltage, electrical power flow, pressure, temperature, humidity, strain, force, torque and energy.

  OPSC·CSE CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.8 (c) | 20M

- What are the different types of sensors / transducers used for measurement of temperature and humidity? Explain, in brief.

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.8 (b) | 20M

- What do you mean by absolute and secondary instruments? Briefly explain the operational principle of moving iron ammeter and voltmeter. What are the types of error?

  OPSC·CSE CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.7 (c) | 20M

- What is transducer? Classify and explain the basic requirements of a transducer.

  OPSC·CSE CSE (Main) 2015-16 | Agri. Engineering | Paper-II, Q.8 (c) | 20M

- Explain, in brief, different types of sensors/transducers used for measurement of temperature.

  OPSC·Forest Forest (Main) 2015-16 | Agri. Engineering | Paper-II, Q.7 (b) | 20M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	20	19	18	17	16	15	TOTAL
IFoS	2	3	4	3	3	3	3	2	6	5	·	34
OPSC·CSE	·	1	1	3	·	1	·	3	3	1	2	15
OPSC·Forest	·	·	1	·	·	·	2	·	·	·	1	4
AP·PSC	·	·	·	·	·	·	·	·	·	·	·	0
HP·PSC	·	·	·	·	7	·	·	·	·	·	·	7
MH·PSC	·	1	·	·	·	·	·	·	·	·	·	1
UK·PSC	2	·	·	·	·	·	·	·	·	·	·	2

HOT SUBTOPICS — Most-asked themes in Chapter 9

- **Instrument characteristics & generalized measurement system** (23 questions)
- **Strain, force & torque (strain gauge, dynamometer)** (17 questions)
- **Temperature measurement (thermocouple, Seebeck)** (15 questions)
- **Flow measurement (rotameter, anemometer, flow meters)** (9 questions)
- **Pressure measurement (manometer, Bourdon)** (8 questions)

CHAPTER

10

COMPUTERS, ALGORITHMS & MULTIMEDIA

CPU & memory devices · Operating systems · Algorithms & flowcharts · Multimedia & AV aids

OFFICIAL SYLLABUS – Chapter 10 Scope

UPSC IFoS — Agricultural Engineering, Paper II, Section B — Topic 4: Instrumentation and Computer Applications

- **Chapter 10 covers: Computers — input/output devices, CPU, memory devices, operating systems; algorithms, flowcharts, programme translation; multimedia and audio-visual aids.**

Full Topic 4 syllabus: Electronic devices and their characteristics — rectifiers, amplifiers, oscillators, multi-vibrators. Digital circuits — sequential and combinational system. Application of microprocessors in data acquisition and control of agricultural engineering processes — measurement systems for level, flow, strain, force, torque, power, pressure, vacuum and temperature. Computers — introduction, input/output devices, central processing unit, memory devices, operating systems, processors, keyboards and printers. Algorithms, flowchart specification, programme translation and problem analysis in Agricultural Engineering. Multimedia and Audio-Visual aids.

SECTION A – UPSC IFoS Previous-Year Questions	*15 questions • 2016 – 2025*
2025	✎ Explain in ascending order the data storage hierarchy in a computer. [P2/5(e) | 8 M] ✎ Write the algorithm and flowchart to find the sum of two numbers. [P2/6(d) | 7 M] ✎ What is Data? Describe the procedure of data processing to obtain information for decision-making. [P2/7(c) | 8 M]
2024	✎ Explain about Random Access Memory (RAM) and Read Only Memory (ROM) in a computer. [P2/5(c) | 8 M] ✎ Explain the major characters of computers that made them powerful and useful in agriculture. [P2/6(d) | 7 M] ✎ Explain the Central Processing Unit (CPU) of a computer. Also explain the main operations accomplished using CPU cycle. [P2/7(d) | 7 M]
2023	✎ Explain various steps involved in developing a programme using a computer. [P2/5(e) | 8 M] ✎ Explain the role of digital marketing using multimedia and audio-visual aids in Agro/Food Processing Industry. [P2/8(d) | 10 M]
2022	✎ What are the different components used in CPU? Explain in brief each of them. Discuss the primary memory and secondary memory units used in computers. [P2/6(c) | 15 M]

2021	✎ Write about digital computers. Draw digital computer system showing input and output devices. [P2/5(e) | 8 M]
2018	✎ Name any two input devices and two output devices of a computer. What are the primary and secondary storage of a computer system? What is the function of the central processing unit of a computer? [P2/5(e) | 8 M] ✎ Write the algorithm in any programming language for calculating the Reynolds number when various sets of values of diameter of a pipe (D), linear velocity of a fluid through the pipe (v), density of the fluid (ρ) and viscosity of the fluid (μ) are given. [P2/8(c) | 10 M]
2017	✎ Discuss the functions of CPU and memory devices in computers. How microprocessor helps in aquisition of data related to agriculture? [P2/8(b) | 10 M]
2016	✎ Describe in brief the application of Multimedia and Audio-Visual aids in propagation of forestation. [P2/8(b) | 10 M] ✎ Explain in brief the role of C.P.U. and memory devices in modern computers. [P2/8(c) | 10 M]

SECTION B : State PSC Previous-Year Questions

13 questions • All states · year-descending

✎ What is Computer-Aided Design (CAD)? Write its application in agricultural engineering.

UK·PSC **ACF RFO Logging officer (Mains) 2025 | Agri. Engineering | Q.8 (i) | 10M**

✎ What is Audio-visual aids? List out its type with examples. Enumerate the advantages of Audio-visual aids.

MH·PSC **Forest Services (Mains) 2024 | Agri. Engineering | Q.5 (d) | 8M**

✎ Differentiate: Display devices and Storage devices

HP·PSC **RFO (Mains) 2021 | Agri. Engineering | Q.8 (b) | 10M**

✎ Why operating system is needed in a computer? Differentiate between virtual memory and Random access memory and also describe the advantages of virtual memory?

UK·PSC **RFO (Mains) 2021 | Agri. Engineering | Q.8 (iii) | 10M**

✎ Process flow chart for product manufacturing

OPSC·CSE **CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.5 (d), (v) | 5M**

✎ Illustrate at least five applications of computer techniques used in design optimization of process/equipment used in processing of agricultural and horticultural produce.

OPSC·CSE **CSE (Main) 2020-21 | Agri. Engineering | Paper-II, Q.8 (b) | 20M**

✎ Why operating system is needed in a computer? Differentiate between virtual memory and Random access memory and also describe the advantages of virtual memory?

UK·PSC **ACF (Mains) 2019 | Agri. Engineering | Q.8 (iii) | 10M**

✎ Describe the process of flow chart for product manufacturing.

OPSC·CSE **CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.7 (a) | 20M**

✎ What are the applications of computer techniques in design optimization?

OPSC·CSE **CSE (Main) 2017-18 | Agri. Engineering | Paper-II, Q.7 (c) | 20M**

✎ Explain, in detail, the primary and secondary memory devices.

OPSC·CSE **CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.7 (c) | 20M**

- Explain, in brief, flow chart, multimedia, computer networks and applications of computer in agricultural processing.

  OPSC·CSE CSE (Main) 2016-17 | Agri. Engineering | Paper-II, Q.8 (a) | 20M

- Explain primary and secondary memory devices in detail.

  OPSC·Forest Forest (Main) 2015-16 | Agri. Engineering | Paper-II, Q.8 (a) | 20M

- Write short notes on any four of the following: Flow Chart; Multimedia; Hardware and Software; Computer Networks; Applications of Computer.

  OPSC·Forest Forest (Main) 2015-16 | Agri. Engineering | Paper-II, Q.8 (b) | 20M

SECTION C – Year × Source Heatmap

Dark = high frequency · Light = low frequency

SOURCE \ YEAR	25	24	23	22	21	20	19	18	17	16	15	TOTAL
IFoS	3	3	2	1	1	·	·	2	1	2	·	15
OPSC·CSE	·	·	·	·	·	2	·	·	2	2	·	6
OPSC·Forest	·	·	·	·	·	·	·	·	·	·	2	2
AP·PSC	·	·	·	·	·	·	·	·	·	·	·	0
HP·PSC	·	·	·	·	1	·	·	·	·	·	·	1
MH·PSC	·	1	·	·	·	·	·	·	·	·	·	1
UK·PSC	1	·	·	·	1	·	1	·	·	·	·	3

HOT SUBTOPICS — Most-asked themes in Chapter 10

- **CPU & memory devices (RAM/ROM, primary/secondary)** (14 questions)
- **Algorithms & flowcharts / programming** (7 questions)
- **Operating systems & computer fundamentals** (7 questions)
- **Multimedia & audio-visual aids** (6 questions)

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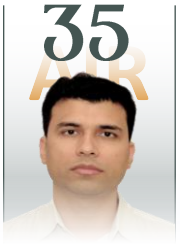
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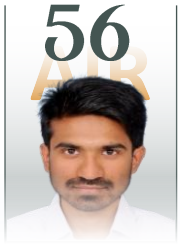
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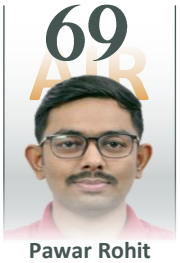
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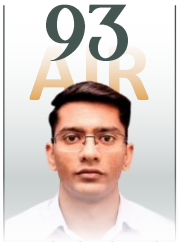
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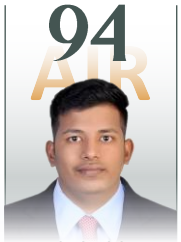
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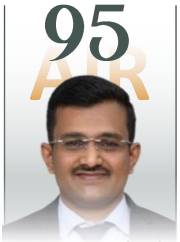
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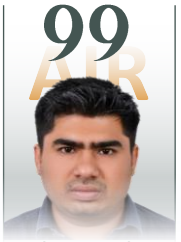
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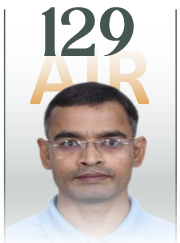
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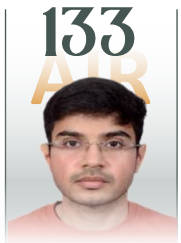
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