

CSM—11/23
PART—II/PAPER—VII
AGRICULTURAL ENGINEERING
PAPER—II

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Time : 3 Hours

Full Marks : 250

*The question paper contains **18 (Eighteen)** questions
in **GROUP—A (12)** and **GROUP—B (06)** together.*

GROUP—A

*Candidates to attempt **10 (ten)** questions within word limit of **250**.
Each question carries **15** marks.*

1. (a) How has mechanization influenced the agricultural sector globally and what are its advantages and disadvantages?
(b) How do solar and wind power contribute to sustainable agricultural practices and what advantages do they offer for various on-farm applications?
2. (a) Explain the working principle of the Otto cycle with the help of the P-V and T-S diagram.
(b) What are the primary factors influencing the thermal efficiency of internal combustion engines and how do they impact fuel energy conversion into useful work?
3. (a) Explain the working principle of a 4-stroke diesel engine with the help of suitable figures.
(b) 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?
4. (a) What are the components of a tractor engine's lubrication system and why is lubrication important for engine function?
(b) Describe the role of the clutch, gearbox and differential in transmitting power from the engine to the wheels of a tractor.

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5. (a) Explain the importance of regular maintenance procedures for extending the life and performance of farm tractors and engines.
- (b) How does considering human factors influence the design process of tractor dashboard instrument panels to enhance usability? Explain.
6. (a) 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.
- (b) 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?
7. (a) 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?
- (b) 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/m^3 .
8. (a) Explain the working principle of updraft and downdraft gasifiers and draw the diagram for updraft and downdraft gasifiers.
- (b) How does producer gas technology align with sustainable agricultural practices and what advancements or innovations are being made in this field?
9. (a) How does the location of a tractor's Center of Gravity (CG) influence the performance of tillage implements?
- (b) Describe the critical design features of primary tillage equipment that contribute to their efficiency.
10. (a) How is power measurement essential for optimising the performance of tractors and what role does it play in cost estimation for hiring tractors?
- (b) What measures can farmers adopt to balance the need for land clearing with preserving biodiversity and ecosystem health in sustainable agriculture?

11. (a) Discuss the significance of ergonomics in the man-machine system related to tractor operation.
- (b) What are the potential benefits and drawbacks of utilising biogas in internal combustion engines for electricity generation and how do these factors impact agricultural sustainability?
12. (a) What are the primary challenges in implementing renewable energy solutions within the agricultural sector?
- (b) Explore the concept of energy-efficient cooking stoves and their significance in the context of sustainable agriculture.

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GROUP—B

Candidates to attempt 05 (five) questions within word limit of 300.

Each question carries 20 marks.

13. (a) How does post-harvest technology contribute to optimizing the handling, storage and processing of agricultural produce?
- (b) 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?
14. (a) 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.
- (b) Describe the key steps in determining moisture content in agricultural products and its importance in post-harvest technology.
15. (a) What are the key unit operations involved in processing cereals and how do they contribute to producing safe, nutritious and marketable cereal products?
- (b) Sugar crystals were ground from an average Sauter diameter of 500 μm to a power 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?
- (i) According to Rittinger's law
- (ii) According to Kick's law

16. (a) 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?
- (b) Discuss the physical properties of fruits and vegetables and their relevance in sorting, washing and preservation technology.
17. (a) 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 ($k = 0.03 \text{ Wm}^{-1}\text{K}^{-1}$). Calculate the rate of heat loss per meter of pipe length if the insulation's outer surface temperature is 35 °C.
- (b) 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?
18. (a) How is microprocessor programming applied in Agricultural Engineering and what are the key steps involved, from selecting hardware to testing and documentation?
- (b) 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?

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