

CSM – 13 / 15
Agricultural Engineering
Paper – II

Time : 3 hours

Full Marks : 300

The figures in the right-hand margin indicate marks.

*Candidates should attempt Q. No. 1 from
Section – A and Q. No. 5 from Section – B
which are compulsory and **three** of the remaining
questions, selecting at least **one** from each Section.*

Section – A

1. Answer any **three** of the following (each answer should be in about **200** words) : $20 \times 3 = 60$
 - (a) State the importance, limitation and scope of farm mechanization in India. What is the status of farm power in India ? Write the impact of mechanical power on draught animal power in Indian farming.
 - (b) 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.

- (c) 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.

- (d) Find out tractive force of a tractor and weight transfer to the rear wheel with the following data:

Tractor weight : 2,500 kg. wheel base : 2.2 m,
C. G. from rear 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 : $2,000 \text{ cm}^2$, soil resistance: 0.1 kg/cm^2 .

2. (a) 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.

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(b) 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/cm^2 . 20

(c) 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. 20

3. (a) 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. 20
- (b) 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/cm^2 , 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. 20
- (c) Which combination is best for general Indian condition : (i) Combine harvester or (ii) Self propelled reaper and thresher or (iii) Tractor drawn front mounted reaper and thresher ? State your comments with supporting reasons. Discuss the working of power thresher, its classification and important terminology. 20

4. (a) 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/m^3 , bio-gas production from dung : $0.1\text{m}^3/\text{kg}$ dung. 20

- (b) Explain, in detail, the working (with neat sketch) of (any two) : (i) down draft biomass gasifier (ii) solar photovoltaic cell for power generation (iii) solar flat plate collector system 20

- (c) A 5 m width of cut self-propelled combine takes an average stop of 5 min every time its 1.2 ton grain tank is to be unloaded. This stop includes the time for adjustment, lubrication, refuelling and operator's personal time. The gross yield of the field is 5 t/ha. Material losses are measured as 0.05 ton/ha . The operating speed is 4.5 km/hr. The

time for turning on a headland at the ends of the 200 m field is 10 seconds. The average actual width of cut is 0.95 of the theoretical.

Calculate :

- (i) Theoretical field capacity
- (ii) Effective field capacity
- (iii) Percentage of time lost
- (iv) Material efficiency

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Section – B

5. Answer any **three** of the following : $20 \times 3 = 60$

- (a) Starting from homogenization of milk and cream separation explain the operation of butter manufacturing unit.
- (b) What are the different methods of food preservation ? Explain the operation of a triple effect evaporator. What is vacuum evaporator ?
- (c) 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.

- (d) What is sensor ? Explain the working principle of rectifier, amplifier and oscillators.
6. (a) 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. 20
- (b) 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. 20
- (c) Explain the systems of a microprocessor-based operation to study a few engineering properties of any food product. 20
7. (a) Briefly explain the major operations performed by any modern rice milling plant. What is the purpose of parboiling of rice ? 20
- (b) Explain how the oil is extracted from rice bran by solvent extraction method. Give only flow diagram to show the modern milling of pulses. 20

- (c) 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 ?

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8. (a) 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.

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

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

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