CSM – 13/20

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 any **three** of the remaining questions, selecting at least **one** from each Section.*

SECTION – A

1. Answer any **three** of the following :

   (a) (i) Discuss the present status and scope of agricultural mechanization in your state as compared to that of the country. 10

(ii) 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. 10

(b) (i) Compare the present status and trend of different farm power sources in your state in comparison to the country. 10

(ii) 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 $\gamma = 1.4$. 10

(c) (i) Differentiate two stroke and four stroke single cylinder engines. 10

(ii) 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 6×10^5 Pa. If the piston makes 3000 strokes/min. Calculate : (a) B. H. P. of the engine (b) Air flow rate in m^3/min (c) Compression ratio. 10

(d) (i) Explain the forces acting on a tillage tool. Give a line diagram. Write the salient features and advantages of zero till seed drill. 8

(ii) 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. 12

2. (a) 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. 20

(b) (i) Explain the term "Registration", and "Alignment" as applied to the cutter bar of a Mower and state how these adjustments are done ? 8

(ii) 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 ? 12

(c) (i) Differentiate among "Reaper", "Mower" and "Reaper Binder". 8

(ii) While testing a two bottom tractor drawn M. B. plough the following observations are noted : 12

(A) Total draft indicated by the dynamometer = 1200 kgf

(B) Distance moved by the tractor while ploughing = 50 meters

(C) Time taken to move 50 meters by the tractor = 30 seconds

Calculate the drawbar horse power developed and the forward speed in km/hr.

3. (a) (i) What are the functions of differential, final drives and power take off in a tractor. 8

(ii) Why is the custom hiring of tractors becoming popular among small and marginal farmers ? 12

(b) (i) What is meant by the traction efficiency of a tractor ? And what are the factors affecting it ? 10

(ii) Explain human factors in tractor design. 10

(c) (i) Name the various types of furrow openers used in seed drills and explain under what conditions these are preferred ? 8

(ii) Explain the operation and maintenance schedule of tractor and farm machinery. 12

4. (a) (i) Describe, in brief, the ergonomics of man-machine system. 8

(ii) What are the main functions of a combine ? What are the possible reasons for getting un-threshed materials from the combine ? 12

(b) (i) Discuss the energy requirements in various agricultural operations. 8

(ii) Illustrate the design of energy efficient cooking stoves. What should be the strategy in popularizing solar cooker ? 12

(c) Write short notes on any **four** of the following :

(i) Earth moving and development machinery 5

(ii) Principles of prony brake dynamometer 5

(iii) Haulage of agricultural and forest produce 5

(iv) Producer gas and bio gas for running I. C, engines 5

(v) Biomass gasification 5

SECTION – B

5. Answer any **three** of the following :

(a) (i) Give a brief account of the various methods of drying grains. 8

(ii) 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°C will be used and the overall heat transfer coefficient is 1.74 kw/m^2-K. Determine the surface area of the roller required to provide a production rate of 50kg product/hr. 12

(b) (i) Explain various unit operations in processing of agricultural produce (cereals, pulses and oilseeds). 12

(ii) What are the criteria for selection of cleaning and grading machines ? 8

(c) (i) What do you understand by pasteurization, homogenization and sterilization of milk ? What are its purpose and advantages ? Explain how it is carried out ? 10

(ii) What do you understand by solvent extraction ? Explain its various components and processes. Sketch out the process flow chart. 10

(d) Write short notes on any four of the following :

(i) Washing, handling, peeling 5

(ii) Slicing, blanching and mixing 5

(iii) Storage and preservation technology 5

(iv) Properties of dairy and food products 5

(v) Process flow chart for product manufacturing 5

6. (a) 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. 20

(b) How sorting and grading is useful in fruits and vegetables ? Explain, in detail, various processes and equipments used for sorting and grading. 20

(c) Why packaging is essential ? Describe the requirements, advantages and classify the materials used for packaging. 20

7. (a) Explain, in detail, the working of screw conveyors, belt conveyors and bucket elevators, along with its capacity and power requirement. 20

(b) Describe how best and in which form the agricultural waste and by-product (rice husk, rice bran, plant residues) can be utilized. 20

(c) Write, in detail, various steps and processes involved in butter manufacturing supplemented with process flow chart/line diagram. 20

8. (a) Explain the systems of a microprocessor based operation to study some of the engineering properties of food product. 20

(b) Illustrate at least five applications of computer techniques used in design optimization of process/equipment used in processing of agricultural and horticultural produce. 20

(c) Explain the principle, working and uses of strain gauge dynamometer and torsion dynamometer. 20