

2010

AGRICULTURAL ENGINEERING - I (Optional)

100075

Standard : Degree

Total Marks : 200

Nature : Conventional (Essay) type

Duration : 3 Hours

Note :

- (i) Answers must be written in English.
- (ii) Question No. 1 is **Compulsory**. Of the remaining questions, attempt **any four** selecting one question from each section.
- (iii) Figures to the **RIGHT** indicate marks of the respective question.
- (iv) Use of log table, Non-Programmable calculator is permitted, but any other Table/Code/Reference book are not permitted.
- (v) Make suitable assumptions, wherever be necessary and state the same.
- (vi) Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.
- (vii) Credit will be given for orderly, concise and effective writing.
- (viii) Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he/she will be penalised.
- (ix) For each slab of 10 and 15 marks, the examinee is expected to write answers in 125 and 200 words respectively.

1. Answer any four of the following questions :

- (a) (i) Write in brief about different unit operations involved in agricultural processing. 5
- (ii) Write down the principle of operation air screen cleaner and indented cylinder separator. 5
- (b) Using simple stacking design a bag storage structure for storage of 1000Tones of paddy. Given bulk density of paddy =550kg/m³. Assume that a standard bag (110cm×70cm) carries 75 kg of paddy. 10
- (c) (i) Name the different types of renewable energy sources ? List the components in a PV (photo-voltaic) water pumping system with sketch. 5

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	(ii) Explain the operating principles and components in a non-pressurized circulation type solar water heater with a neat diagram.	5
(d)	(i) A plot of 500m × 300m is to be planted with maize by a tractor operated inclined plate planter at a recommended speed of 1.5 km/h. The planter is having 6 rows with spacing of 60 cm. Calculate the performance index assuming time lost in each turn is 10 sec and filling hoppers and other interruptions is 15 minutes per hectare. An overlap of 5 cm may also be assumed in each run.	6
	(ii) Explain how sprayers are classified on the basis of spray volume.	4
(e)	(i) Estimate the operating cost per hour of a 35 hp tractor purchased at a cost of 3.5 lakhs assuming the life span of the tractor as 10 years and 10,000 hours (as per BIS standard).	6
	(ii) A 9-row tractor mounted seed drill is adjusted to deliver 30 kg of green gram per hectare. The ground wheel diameter is 45 cm. How much seed should be dropped by the machine in 25 revolutions of the ground wheels if the distance between the two furrow openers is 20 cm ?	4

SECTION - A

2. Answer the following sub-questions :

(a)	(i) Define equilibrium moisture content. Write in brief the procedure for its determination by static method.	5
	(ii) Calculate the amount of moisture to be removed for drying 2 tonnes of paddy from an initial moisture content of 30% (w.b) to 14% (w.b).	5
(b)	(i) Write down the factors to be considered for design of a heated air grain dryer.	5
	(ii) With neat sketch describe the working principle of a LSU dryer.	5
(c)	(i) If three mutually perpendicular dimensions of paddy grain are 8mm, 3 mm and 2 mm, Calculate the equivalent diameter and sphericity of the grain assuming it to be ellipsoid.	5
	(ii) Define specific heat, thermal conductivity and thermal diffusivity of biological materials.	5
(d)	(i) Define terminal velocity. State the expression for determination of terminal velocity.	5
	(ii) Describe ideal elastic, ideal plastic and ideal viscous behaviour with suitable example.	5

Marks

3. Answer the following sub-questions :
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| (a) (i) | Define psychrometric chart. Show the heating and drying operation in a psychrometric chart. | 5 |
| (ii) | Write down different methods of moisture content measurement of food grains. | 5 |
| (b) (i) | Write down the working principle of a solar dryer and its advantages over sun drying. | 5 |
| (ii) | It is estimated that 350000kcal of heat is required for drying of 2 tonnes of paddy in a continuous grain dryer. If the inlet and exhaust temperature of air in the dryer are 80°C and 40°C respectively and drying time is 3 hours, calculate the required air flow rate. Assume specific heat of air to be 0.25kcal/kg°C. | 5 |
| (c) (i) | Write in brief about different electrical properties of biological materials. | 5 |
| (ii) | Write down importance of mechanical properties of biological materials in design and operation of machines. | 5 |
| (d) (i) | Write in brief the working principle of belt conveyor and bucket elevator. | 5 |
| (ii) | A horizontal screw conveyor has screw pitch and diameter both equal to 40cms. Estimate its actual capacity for conveying wheat while operating at 150 rpm. Given bulk density of wheat =850kg/m ³ . Assume loading efficiency to be 40%. | 5 |

SECTION - B

4. Answer the following sub-questions :
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| (a) | A drum dryer is being designed for drying a product from an initial total solids content of 12% to 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 1500kcal/h-m ² -°C. Determine the surface area of the roller required to provide a production rate of 50 kg of product per hour. Calculate the diameter of drum if its length is given to be 1.37m. Assume latent heat of vaporization to be 540 kcal/kg. Assume any other data if required. | 10 |
| (b) | Differentiate between controlled atmospheric (CA) and modified atmospheric (MA) storage for horticultural crops. Briefly explain advantages of CA and MA storage over cold storage. | 10 |
| (c) | Explain important design considerations for a tail to tail double row dairy barn with a neat cross-sectional view. | 10 |
| (d) (i) | Write short notes on Rittinger's and Kick's crushing Law. | 4 |
| (ii) | How much power is required to crush 2 tonnes/hr of material if 80% of the feed passes through IS sieve No.480 (4.75 mm opening) and 80% of the product passes through IS Sieve No. 50 (0.5 mm opening)? Given the work index of the material =6.30. | 6 |

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5. Answer the following sub-questions :	
(a) With neat sketch explain working principle of a spray dryer. Briefly explain different types of atomizer used for atomization/spraying of milk.	10
(b) Define aseptic packaging. Explain briefly importance, need and functions of food packaging.	10
(c) Explain important points to be considered for design of a deep litter poultry house for 500 birds.	10
(d) Write short notes on :	
(i) Jaw crusher	3
(ii) Gyrotory Crusher	3
(iii) Hammer mill	4

SECTION - C

6. Answer the following sub-questions :	
(a) (i) Explain the working principle of 2-stroke petrol engine with a neat diagram? Why these engines are used in Knapsack power sprayers?	5
(ii) Draw up a heat account in Kcal/min for a diesel engine using 11 kg of diesel per hr. having calorific value of 10,500 Kcal/kg. The engine develops 80 IHP (indicated horse power) and 55 BHP (brake horse power). Water in the cooling jacket was circulated at the rate of 281/min with a temperature rise of 19°C.	5
(b) (i) Explain the cooling system of a tractor with a neat diagram.	5
(ii) What are the functions of coil and condenser in production of a spark in S.I engine? Write the advantages of electronic ignition over conventional ignition system with C.B (contact breaker) point.	5
(iii) Show a typical valve timing diagram of diesel tractor. Calculate the time in seconds for which both intake and exhaust valves remain closed, if engine rpm is 2200?	5
(c) (i) What is the function of a draft control device in a tractor? Explain how this device works?	5
(ii) What is traction? Write a mathematical expression for traction. Discuss the different methods employed to increase traction in tractors.	5
(iii) What is the method of preparation of soil and seedling mat for mat type paddy transplanter for its optimum performance?	5

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7. Answer the following sub-questions :

- (a) (i) Discuss the major reasons for deviation of real cycle from actual thermodynamic cycles in an I.C engine? 4
- (ii) A four cylinder four stroke petrol engine with 7.5cm bore and 8.75 cm stroke operates at 28.2% indicated thermal efficiency. The engine rpm is 2400 and bmep is 7kg/cm². The engine uses 9 kg of fuel per hour having calorific value of 10,500 kcal/kg. Calculate: 6
- 1) Brake thermal efficiency
 - 2) Mechanical efficiency
 - 3) Specific fuel consumption in kg/bhp/h
- (b) (i) Does agricultural mechanization displace labour from this sector? What are the constraints of agricultural mechanization in your state? 5
- (ii) Describe in brief the secondary tillage equipments? Explain the difference in working principle between a disc harrow and disc plow. 5
- (iii) Describe various harvesting and threshing equipments for wheat and paddy crop in brief. 5
- (c) (i) Explain why rotary tillage device is provided in power tillers rather than M.B. plows ? Assign important reasons. 5
- (ii) What is the difference between a seed drill and a planter? Describe in brief the different types of metering mechanisms and furrow openers used for planting maize and groundnut? 5
- (iii) Discuss briefly the different types of threshing elements used in threshing cereals and pulses. What difference is found in axial flow threshers as compared to flow through threshers? 5

SECTION - D

8. Answer the following sub-questions :

- (a) (i) What are the advantages of V-belt drive over roller chain drive and write its limitations? 4
- (ii) A sprocket with 15 teeth rotating at 1800 rpm transmits power by a roller chain to the driven sprocket rotating at 660 rpm. If the chain pitch is 9.52 mm. Calculate: 6
- 1) Number of teeth in driven sprocket
 - 2) Velocity ratio of sprockets
 - 3) Chain velocity
- (iii) What are the methods for adjustment of belt tension in V-belts? Explain what is a rock wood drive with a sketch? 5

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- (b) (i) A bullock drawn mould board plough has a pull of 65 kgf while the line of pull makes an angle of 30° , with the horizontal and lies in the vertical plane at an angle of 12° , with the direction of motion. Calculate the draft, side draft, vertical component of pull. Find the horse power required to pull this plough at a speed of 1.5 km/h 6
- (ii) What are the reasons for accident during operation of a power thresher? What safety aspects should be considered while designing components responsible for accidents? 4
- (c) (i) Compare a Janata model (fixed dome) bio-gas plant and KVIC model (floating dome) plant with a sketches. 5
- (ii) Write notes on: 6
- 1) Wind energy application
 - 2) Savonius rotor
 - 3) Fuel properties of bio-gas
- (iii) Write in brief the technologies for conversion of biomass to fuel. 4

9. Answer the following sub-questions :

- (a) (i) Explain how design dimension and weight of different components of hand tools for interculture and manually operated hand pumps can be optimized on the basis of ergonomical aspects to maximize their output. 4
- (ii) Two pulleys in the ratio 1:4.5 of their diameter are connected by a V-belt drive to transmit power. If the driven pulley of 45 cm diameter runs at 150 rpm and centre to centre distance between two pulleys is one metre, then find out: 6
- 1) Speed of driving pulley
 - 2) Belt speed
 - 3) Belt length
- (iii) Define circular pitch, module and back lash in gears and write the names of gears used between intersecting shafts. 5
- (b) (i) Explain how the peripheral velocity of seed metering plate and length of seed tube in planters using bold seeds affect the seed to seed distance? 4
- (ii) A cotton planter is designed for planting seeds at 50 cm spacing. The ground wheel diameter is 48 cm and gear ratio is such that the seed metering plate makes 30 revolutions per minute for a constant forward speed. Assuming peripheral speed of metering plate as 10.5 m/min and speed ratio 5:3 of ground wheel to rotor, calculate the number of cells in the metering plate and its diameter. 6

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| (c) | (i) Derive an expression for maximum power developed by a wind mill. What are the main considerations for selection of site to install an aero-turbine electricity generator? | 6 |
| | (ii) Calculate the volume of a biogas digester if a person has seven cows with a dry matter feeding of 2.5 kg. The bio-gas yield from this digester is 0.24 m ³ /kg. | 4 |
| | (iii) What are the techniques suggested for maintaining biogas production from a digester? | 5 |

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