Advanced Machinery and Processing Engineering (EN4102)   **Time 3hrs**
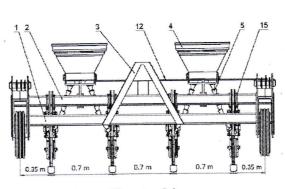
Structured and Essay Type

Index No:

Give answers to questions of Part A (questions 1 & 2) in the space provided.
Use the given answer book to answer THREE questions in Part B.
Only non-programmable calculators are permitted.
All question carry equal marks.

Part- A (Structured Type)

Answer all questions.

1.

Figure;01

1, 2 – lower and upper frame parts; 3 – hitch linkage; 4 – fertilizer hopper; 5 – fertilizer pipe; 6 – DPFA; 7 – DPFA's knife; 8 – seed-feeding mechanism; 9 – suspension; 10 – driving wheel; 11 – reduction gear; 12 – fertilizer hopper shaft; 13 – fertilizer hopper shaft drive chain; 14 – DPFA bolt connectors; 15 – frame parts connecting plate.

a).(i). A Farmer wishes to seed one hectare of land with bullock drawn seed drill (**Figure 01**). The speed of bullocks is 3 km/hr. Calculate the cost of seeding, if the hire charge for bullocks is Rs.100/hr. Per pair, the hire charge for seed drill is Rs.50 / hr. and the wage for the operator is Rs.100/hr.

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....**(25 marks)**
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(ii). Following observations were recorded while calibrating the above seed drill.

Number of furrows = 04

Spacing between the furrows = 70 cm

Diameter of the ground wheel = 1.5 m
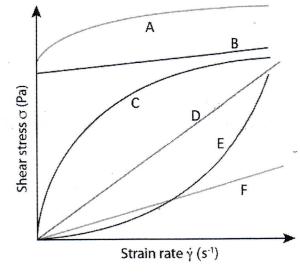
Speed of rotation of ground wheel = 500 rpm

Ratio between ground wheel and seed plate = 1: 2

Number of cell per seed plate = 05

Calculate the seed spacing of the above seeder?

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.... **(15 marks)**

(iii). Calculate the seed rate per hectare.

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....**(10 marks)**

b) (i).Enlist types of gasoline-electric hybrid engines.

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.... **(10 Marks)**

(ii). Write functions of following sensors attached to Electronic Fuel Injection unit (EFI) .
1). Throttle Position Sensor

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2) Oxygen sensor

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....**(10 Marks)**

(iii) Briefly explain the impact of regenerative braking system of hybrid vehicles on saving energy.

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 (10 Marks)

(iv) Briefly explain the traction modes of hybrid electric vehicles.

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 (20 Marks)
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2. (a). Shear diagram for different fluids are given in Figure 2.

Figure; 2

(i) Identify the different types of fluids and give one example for each.

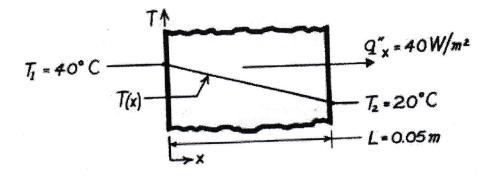| Fluid type	Name of fluid	Example
A		
B		
C		
D		
E		

(25 marks)

(ii) Identify following from Figure 2 and fill the given table

	Fluid from Figure 2	Nature of apparent viscosity
Shear thinning fluid		
Shear thickening fluid		

(10 marks)

4

(b). Heat flux and the surface temperatures of a wood slab with 0.05 m thickness are given in the Figure 3. Calculate the thermal conductivity of the wood.

(15 marks)

Figure; 3

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(a) A 0.5 m² area heated surface of 150°C temperature is placed in a large vacuum chamber of 25°C. (Figure; 04). The Stefan–Boltzmann constant is 5.67×10^{-7} W/m² K⁴. Calculate the rate of radiation emission from the surface and net radiation exchange between surface and chamber wall.

(15 marks)

$T_{sur} = 25°C$

$A = 0.5 m^2$
$T_4 = 150°C$
$\varepsilon = 0.8$

Figure; 4

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(b) When radiation strikes a surface, a portion of it is reflected, and the rest enters the surface. Of the portion that enters the surface, some are absorbed by the material, and the remaining radiation is transmitted through.

Figure; 5

    (i)   What are the three radioactive properties of surface related to the incident radiation on surface?

1. ....

2. ....

3. ....

(10 marks)

    (ii)   Write down the relationship of among these properties with irradiation.

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(05 marks)

(c) What is the importance of R value and U value in heat conduction?

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(20 marks)

Part- B: Essay (Answer three Questions Only)

a). A farm family of 6 persons operates a dairy with 60 producing milk cows, 20 dry cows, and 4 horses. There are 3 water outlets in the dairy barn and 2 in the milk house that may all be open at milking time. Also, at least 3 faucets in the house (kitchen and bathrooms) may be open during milking time. Calculate the peak water demand of the farm (State your own assumptions)

DAILY WATER REQUIREMENTS;

Uses	Unit Requirement (L/day)
Each member of family	225
Horse	54
Cow producing milk	180
Dry cow or steer	54
Sheep	9
100 chickens	27
Garden hose. ¾ -in. nozzle (1 hr)	1350
Garden hose, ½ -in. nozzle (1 hr)	900
Minimum Fire protection	900

(50Marks)

b). A new metering device of a seeder is indicated in the following Figure 6.

Figure 6

Calculate the actual time required for sowing 1.6 hectares of land by the seeder working at 12.5 cm depth. The speed of the seed drill is 3.2 km/hr. The space between furrow openers is 1 m and time loss in turning and other unproductive activities are 10%.

(50Marks)

(2) (a) Briefly explain the function of ECU (engine control unit) of internal combustion engine with suitable sketches.

(50Marks)

(b) Discuss the impact of variable valve timing system on the performance of internal combustion engines.

(50Marks)

(3). (a) You were asked to determine the thermal conductivity of a meat product. What are the steps you need to follow?

(15 marks)

(b).

    (i) Define the term 'Rheology'.

    (ii) Derive the equation for dynamic viscosity 'μ'using shear stress and shear strain.

    (iii)What is the kinematic viscosity?

    (iv)What is the nature of apparent viscosity?

    (v) What is the relationship between dynamic viscosity and kinematic viscosity?

(20 marks)

(c). What is the Fourier's law of Thermal Conduction?

(10 marks)

(d). The heat flux is 6000 W/m^2 at the surface of the electric heater. The heater temperature is 120°C when it is cooled by air at 70°C. What is the convective heat transfer coefficient? What will the heat temperature be if the power is reduced and the heat flux is 2000 W/m^2?

(15 marks)

(e). An uninsulated steam pipe passes through a room in which the air and walls are at 25°C. Its surface temperature and emissivity are 200°C and 0.8, respectively. The outside diameter of the pipe is 70 mm. What are the surface emissive power and irradiation? If the coefficient associated with free convection heat transfer from the surface to the air is 15 W/m^2 K, what is the rate of heat loss from the surface per unit length of pipe?

(40 marks)

(4).

    (a) Briefly explain different types of forced used in size reduction devices with suitable examples

<div align="right">(20 Marks)</div>

    (b) What are the benefits of size reduction in food processing in Agriculture?

<div align="right">(20 Marks)</div>

    (c) Sorghum (5.2 mm size) was milled by a burr mill at two different gaps (2 settings) of the bur stones for two produce two different food products. The flour was analyzed by IS sieves for particle size determination as shown in Table; 1 given below. The power required to mill sorghum at first setting was 10 kW. The capacity of the mill was 100 kg/hr.

<div align="center">Table 1</div>

IS sieve No	Weight of flour retained over sieve, (g)	
	First setting	Second setting
100	0	0
70	14.25	2.8
50	58	11.9
40	87.75	36.1
30	46	72.1
20	23.25	108.4
15	14.5	7.2
Pan	6.25	11.5

(i). Find the average particle size of the product for first setting and second setting of the mill separately.

<div align="right">(30 Marks)</div>

(ii). Calculate the power requirement of the mill in second setting using Rittinger's law

<div align="right">(Marks 30)</div>

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