VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY (VSSUT), ODISHA

Even Mid Semester Examination for session 2023-24

COURSE NAME: B.Tech | SEMESTER: 2nd

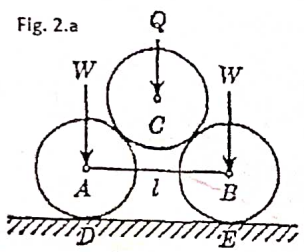
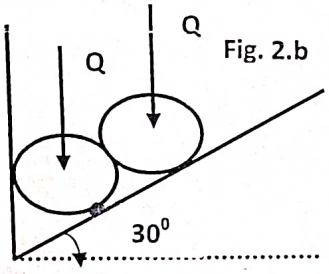
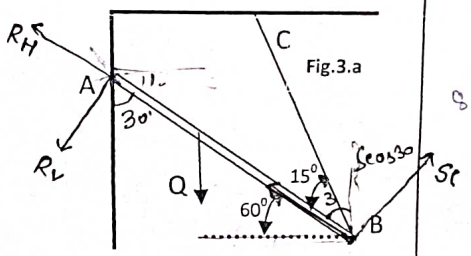
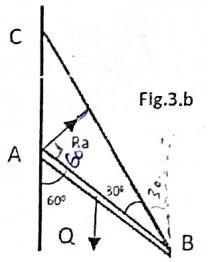
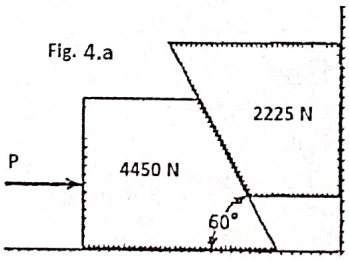
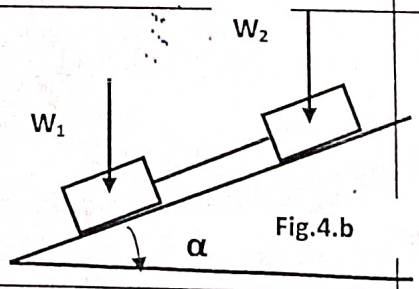
BRANCH NAME: ETC, IT,ME, MME, PE.

SUBJECT NAME: **Engineering Mechanics**

FULL MARKS: **30** | TIME: **90 Minutes**

Answer **All** Questions.

The figures in the right hand margin indicate Marks. *Symbols carry usual meaning.*

Q1.		Answer all Questions.	[2 × 3]
	a)	Describe Stable Equilibrium, Unstable Equilibrium and Neutral Equilibrium, with example.	- CO1
	b)	What do you mean by Principle of Superposition and Varignon Principle?	- CO2
	c)	Distinguish between Static Friction and Kinetic Friction. Which one is higher and why?	- CO3
Q2.			[8]
		a. Two smooth circular cylinders, each of weight W = 445 N and radius r = 152 mm, are connected at their centers by a string AB of length l = 406 mm and rest upon a horizontal plane, supporting above them a third cylinder of weight Q = 890 N and radius r = 152 mm (Fig. 2.a). Find the force S in the string and the pressures produced on the floor at the points of contact D, E.	- CO1
		OR	
		b. Two identical rollers each of weight Q = 445 N are supported by an inclined plane at a vertical wall as shown in the Fig. 2.b. Assuming the smooth surfaces, Find the reaction induced at the point of contacts.	- CO1
		Fig. 2.a  Fig. 2.b  	
Q3.			[8]
		a. A bar AB of length l is supported as shown in Fig.3.a. At any point along its length a vertical load Q can be applied. Determine the position of this load for which the tensile force S in the cable BC will be maximum and evaluate same if the various angles are as shown in the figure. In calculation, neglect the weights of the bar and the cable.	- CO2
		OR	
		A prismatic bar AB of weight Q=17.5 kN is hinged to a vertical wall at A and supported at B by a cable BC as shown in the Fig.3.b. Determine the magnitude and direction of the reaction Ra at the hinge A and the tensile force S in the cable BC. The direction of the bar and the cable are as shown in the figure.	- CO2
Q4.		Referring to the Fig. 4.a., the coefficient of friction are as follows: 0.25 at the floor, 0.30 at the wall, and 0.20 between blocks. Find the minimum value of a horizontal force P applied to the lower block that will hold the system in equilibrium	[8]
		Fig.3.b  Fig. 4.a   Fig.4.b	- CO3
		OR	
		b. Two identical blocks each of weight 22.5 N and are rest on a rough inclined plane and are connected by a short piece of string as shown in the Fig. 4.b, if the coefficient of friction are 0.2 and 0.3 respectively, Find the angle of inclination of the plane for which sliding will impend.	- CO3

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY (VSSUT), ODISHA

Mid Semester (Odd) Examination for session 2022-23

COURSE NAME:B. Tech | SEMESTER:1st

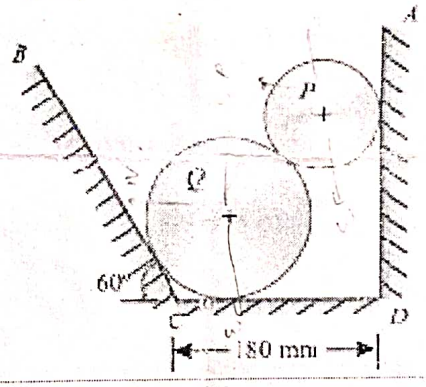
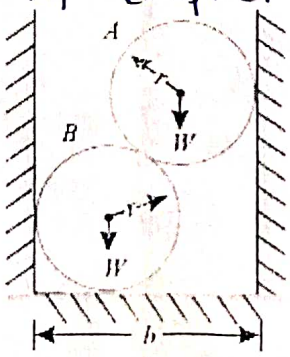
BRANCH NAME: (/Section: A, B. C. D. E. F) G

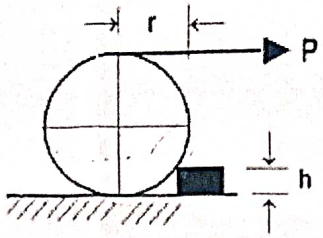
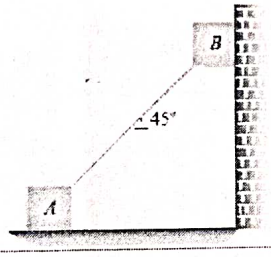
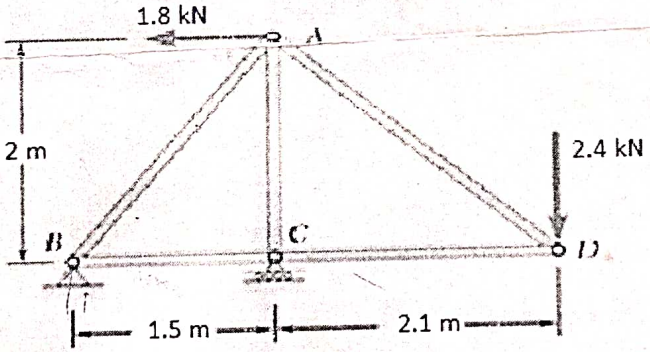
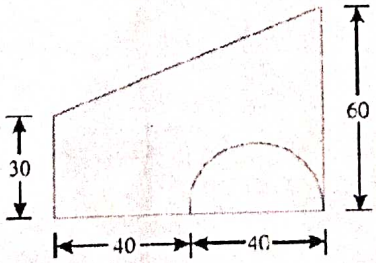
SUBJECT NAME: Engineering Mechanics

FULL MARKS: 30 | TIME: 90 Minutes

Answer All Questions.

The figures in the right hand margin indicate Marks. *Symbols carry usual meaning.*

Q1.		Answer all Questions.	2 × 3
	a)	Differentiate truss and frame.	
	b)	Define coefficient of friction and limiting friction.	
	c)	Describe the stable equilibrium, unstable equilibrium and neutral equilibrium.	
Q2.			
		Two cylinders P and Q rest in a channel as shown in Figure. The cylinder P has diameter of 100 mm and weighs 200 N, whereas the cylinder Q has diameter of 180 mm and weighs 500 N. Find out the reaction at contact surface. 	8
		OR	
		Two smooth spheres of weight W and radius r each are in equilibrium in a horizontal channel of A and B vertical sides as shown in Fig. Find the force exerted by each sphere on the other. Calculate these values, if r = 250 mm, b = 900 mm and W = 100 N. Find out the reaction at contact surface. 	8

Q3.	a)	State & prove Varignon's theorem.	2
	b)	A roller of weight 500 N has a radius of 120 mm and is pulled over a step of height 60 mm by a horizontal force P. Find magnitudes of P to just start the roller over the step. 	6
		OR	
		Two identical blocks of weight W are supported by a rod inclined at 45° with the horizontal as shown in Figure. If both the blocks are in limiting equilibrium, find the coefficient of friction, assuming it to be the same at floor as well as at wall. 	8
Q4.	a)	Explain the 'redundant constraints'	2
	b)	Determine the force in each member of the truss shown. State whether the member is in tension or compression. 	6
		OR	
	a)	A semicircular area is removed from a trapezium as shown in Figure. Find the centroid of remaining area.  (all dimensions are in mm)	5
	b)	Using Pappus theorem, find the surface area of the sphere.	3

END SEMESTER EXAMINATION

COURSE NAME: B.Tech.
BRANCH NAME: All

SEMESTER: 1st & 2nd

SUBJECT NAME: **Engineering Mechanics**

FULL MARKS: 50

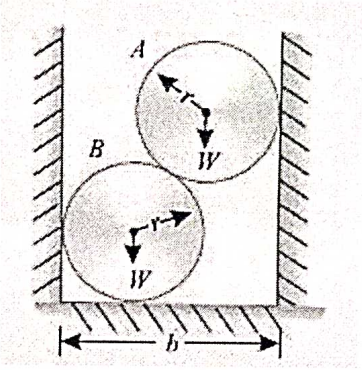
TIME: 2.30 Hours

Answer **All** Questions.
The figures in the right hand margin indicate Marks. *Symbols carry usual meaning.*
Any supplementary materials to be provided

Q1. Answer all Questions. [2×5]

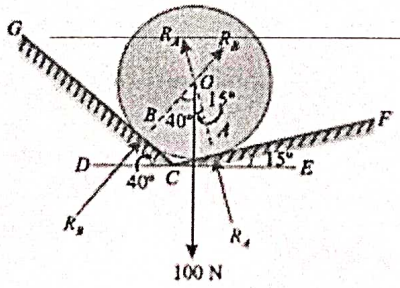
a) State Varignon's theorem.
b) What is a couple? What is the arm of a couple and its moment?
c) Define coefficient of friction and limiting friction.
d) A car is travelling on a level track of radius 50 m. Find the maximum speed, at which he can travel on the curved track, if the coefficient of friction between the tyres and track is 0.45. Take $g = 9{\cdot}8\ m/s^2$
e) State the principle of conservation of momentum.

Q2. Two smooth spheres of weight W and radius r each are in equilibrium in a horizontal channel of A and B vertical sides as shown in Fig. Find the force exerted by each sphere on the other. Calculate these values, if $r = 250$ mm, $b = 900$ mm and $W = 100$ N. [8]



OR

A smooth circular cylinder of radius 1.5 meter is lying in a triangular groove, one side of which makes 15° angle and the other 40° angle with the horizontal. Find the reactions at the surfaces of contact, if there is no friction and the cylinder weights 100 N. [8]



Q3. a) Describe the stable equilibrium, unstable equilibrium and neutral equilibrium [4]
b) A truss shown in figure is carrying a point load of 5 kN at E. Find the force in the members CE, CD and BD of the truss. [4]

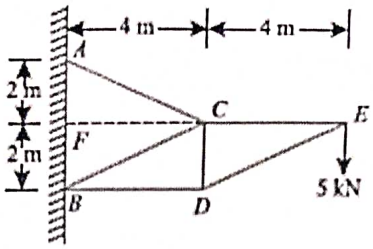


Figure 4

OR

Find the moment of inertia about the centroidal X-X and Y-Y axes of the angle section shown in figure. [8]

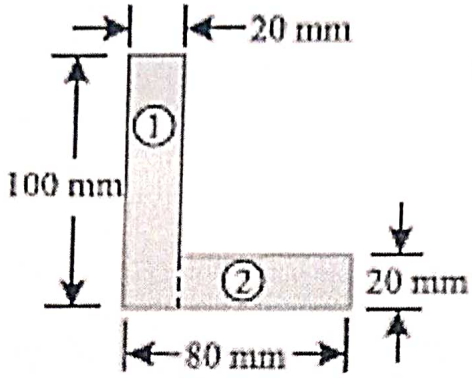


Figure 4

Q4. A ladder 5 meters long rests on a horizontal ground and leans against a smooth vertical wall at an angle 70° with the horizontal. The weight of the ladder is 900 N and acts at its middle. The ladder is at the point of sliding, when a man weighing 750N stands on a rung 1.5 metre from the bottom of the ladder. Calculate the coefficient of friction between the ladder and the floor. [8]

OR

A beam AB of span 5 metres is carrying a point load of 2 kN at a distance 2 metres from A. Determine the beam reactions, by using the principle of the virtual work. [8]

Q5. A bullet of mass 20 g is fired horizontally with a velocity of 300 m/s, from a gun carried in a carriage; which together with the gun has mass of 100 kg. The resistance to sliding of the carriage over the ice on which it rests is 20 N. Find (a) velocity, with which the gun will recoil, (b) distance, in which it comes to rest, and (c) time taken to do so. [8]

OR

a) Explain the principle of conservation of momentum in oblique impact bodies. [4]

b) A ball is dropped from a height $h_0 = 1$ m on a smooth floor. Knowing that the height of the first bounce is $h_1 = 81$cm, determine [4]
(a) coefficient of restitution, and
(b) Expected height h_2 after the second bounce.

Q6. A projectile fired from the edge of a 150 m high cliff with an initial velocity of 180 m/s at an angle of elevation of 30° with the horizontal. Neglecting air resistance find : [8]
i. The greatest elevation above the ground reached by the projectile ; and
ii. Horizontal distance from the gun to the point, where the projectile strikes the ground.

OR

A bullet of mass 30 gm is fired into a body of mass 10 kg, which is suspended by a string 0.8 m long. Due to this impact, the body swings through an angle 30°. Find the velocity of the bullet. [8]

Total Pages—7

Set-21(I)

B.Tech.-2nd (Sec-H to N)

Engineering Mechanics

Full Marks : 50

Time : $2\frac{1}{2}$ hours

Answer **all** questions

The figures in the right-hand margin indicate marks

Symbols carry usual meaning

Any supplementary materials to be provided

1. Answer *all* questions : 2×5

   (*a*) What do you mean by a Truss ? What is the relation between the number of joints and number of members for a truss to be designed as a perfect truss ? If this condition is not satisfied what will be the truss called ?

   (*b*) Define coefficient of friction and limiting friction.

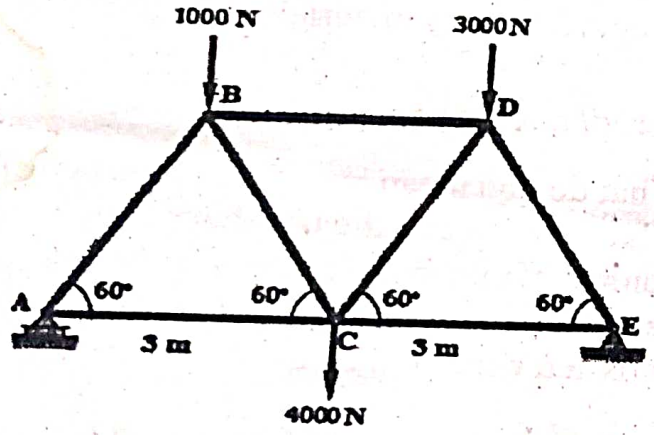
   (*c*) The moment of inertia of a triangular section of base (b) and height (h) about an axis

through its centroid and parallel to the base is given by .....

(*d*) Obtain an equation for the trajectory of a projectile and show that it is a parabola.

(*e*) What is D-Alembert Principle ?

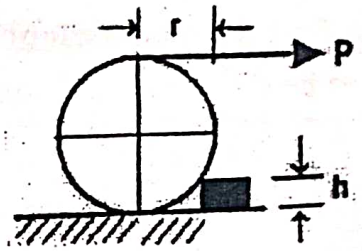
2. Using Method of Joint, determine the Axial forces in each member of the loaded truss as shown in the Figure.



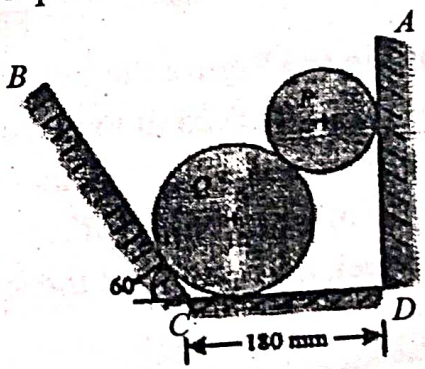
Or

(*a*) A roller of weight 500 N has a radius of 120 mm and is pulled over a step of height

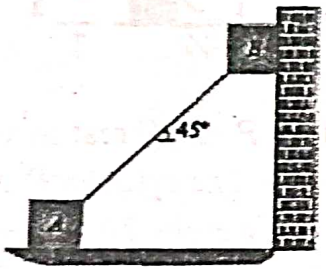
60 mm by a horizontal force P. Find magnitudes of *P* to just start the roller over the step. 4



(*b*) Two cylinders *P* and *Q* rest in a channel as shown in Figure. The cylinder *P* has diameter of 100 mm and weighs 200 N, whereas the cylinder *Q* has diameter of 180 mm and weighs 500 N. Find the support reactions developed at the points of contact. 4

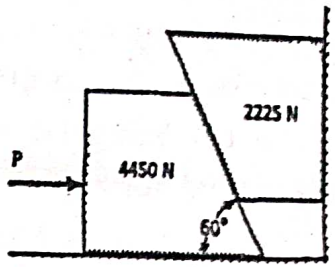


3. Two identical blocks of weight W are supported by a rod inclined at 45° with the horizontal as shown in Figure. If both the blocks are in limiting equilibrium, find the coefficient of friction, assuming it to be the same at floor as well as at wall. 8

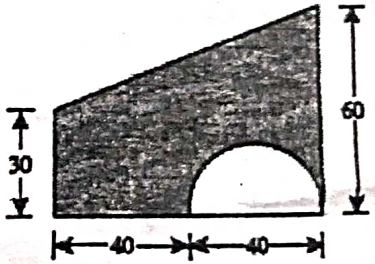


Or

Referring to the Figure the coefficient of friction is as follows : 0.25 at the floor, 0.30 at the wall, and 0.20 between blocks. Find the minimum value of a horizontal force P applied to the lower block that will hold the system in equilibrium. 8



4. A semicircular area is removed from a trapezium as shown in Figure. Determine the centroid of the remaining area (shown shaded). 8



Or

(*a*) Using Pappus theorem find the volume of the sphere. 4

(*b*) Using integration method find out the MI of a rectangular area about its centroidal axes. 4

5. A wooden block weighing 44.3 N rests on a rough horizontal plane, the co-efficient of friction between the two being 0.4. If a bullet weighing 0.23 N is fired horizontally in to the block with nuzzle velocity $V = 600$ m/sec, how far will the block be displaced from its initial position ? Assume that the bullet remains inside the block. 8

Or

(*a*) A hammer of mass 0.5 kg hits a nail of 25 g with a velocity of 5 m/s and drives it into a fixed wooden block by 25 mm. Find the resistance offered by the wooden block. 4

(*b*) A body of mass 200 kg is initially stationary on a 15° inclined plane. What distance along the incline must the body slide before it reaches a speed of 10 m/s ? Take coefficient of friction between the body and the plane as 0.1. 4

6. A flywheel of mass 10 tonnes starts from rest and gets up a speed of 200 rpm in 2 minutes. Find the average torque exerted on it, if the radius of gyration of the flywheel is 60 cm. 8

Or

A particle is thrown with a velocity of 5 m/s at an elevation of 60° to the horizontal. Find the velocity of another particle thrown at an elevation of 45° which will have (*a*) equal horizontal range, (*b*) equal maximum height, and (*c*) equal time of flight. 8

Set-14(1)

B.Tech-1st- (All Br.)

Engineering Mechanics

Full Marks : 50

Time : 2.30 hours

Answer **all** questions.

The figures in the right-hand margin indicate marks.

Symbols carry usual meaning.

Any supplementary materials to be provided.

1. Answer *all* questions : 2×5

(*a*) State Varignon's principle. Explain by an example.

(*b*) State and explain principle of virtual work.

(*c*) What do you mean by radius of gyration ?

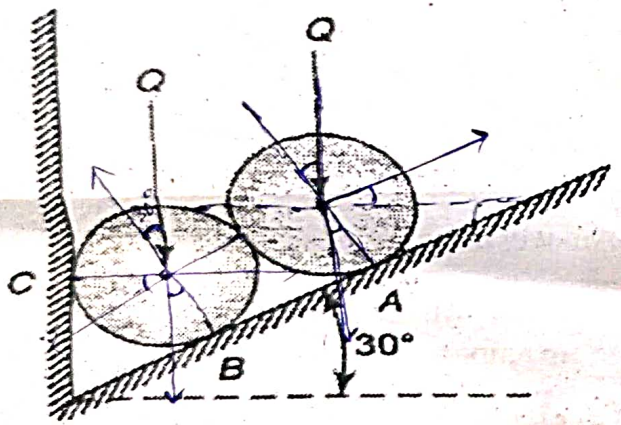
(*d*) Using Papus theorem calculate the centroid of a semicircular arc of radius *r*.

(*e*) Distiguish between Newton's 2nd law and motion and D' Alembert principle.

(Turn Over)

2. (*a*) State and explain Lamis theorem. 2

(*b*) Two identical rollers each of weight Q = 445 N are supported by an inclined plane at a vertical wall as shown in the figure. Assuming the smooth surfaces, find the reaction induced the point of support A, B and C. 6



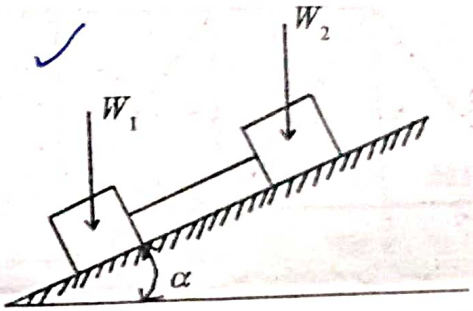
Or

(*a*) Distinguish between static friction and kinetic friction. Which one is higher and why ? 2

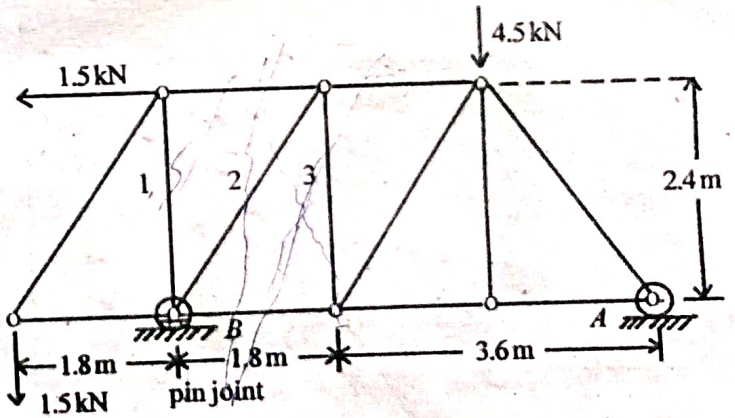
(*b*) Two blocks of weights and rest on a rough inclined plane and are connected by a short

(*Continued*)

piece of string as shown in Figure if the coefficients of friction are = 0.2 and = 0.3 respectively, find the angle of inclination of the plane for which sliding will impend. Assume = 22.25 N. 6



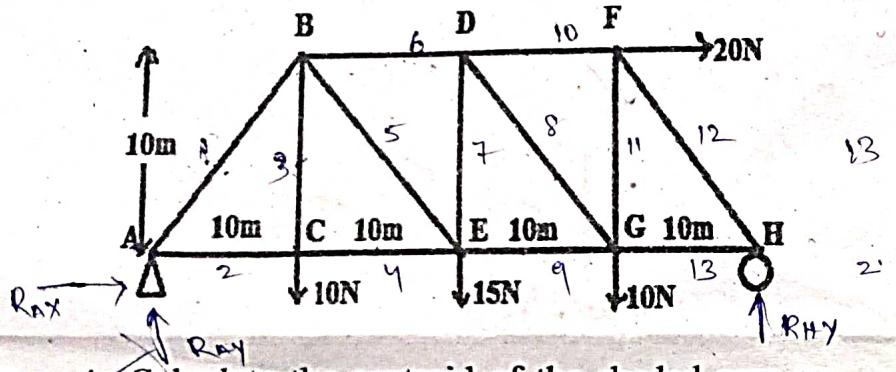
3. Determine the axial force in each of the bars 1, 2 and 3 of the plane truss shown in Figure. 8



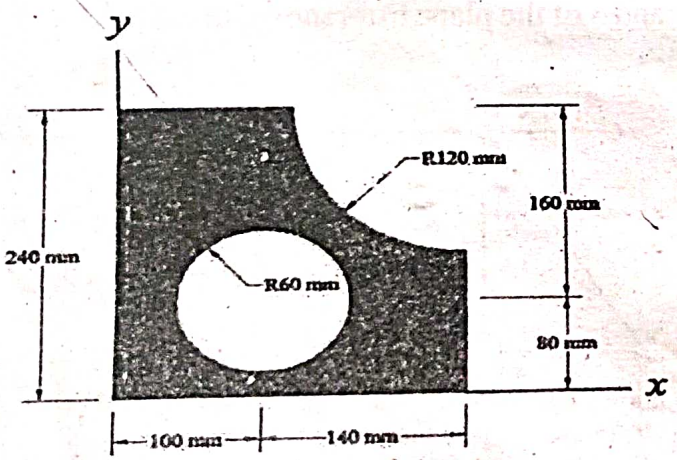
(*Turn Over*)

Or

Find the force in each member of the following truss. 8



4. Calculate the centroid of the shaded area as shown in Figure. 8



(Continued)

Or

Find the moment of inertia about the centroidal X-X and Y-Y axes of the I section whose top flange as 30 mm × 10 mm, bottom flange as 30 mm × 10 mm and web as 30 mm × 10 mm. 8

5. (*a*) Define impulse and momentum. Explain the law of conservation of momentum. 3

(*b*) Find the height from which a heavy elastic ball must be dropped on the floor so that after rebounding thrice it will reach a height of 16 meters ? Take $e = (0.5)^{1/3}$. 5

Or

(*a*) Find the proper super elevation *e* for a 7.2 m highway curve of radius $r = 600$ m in order to that a car travelling with a speed of 80 km /h will have no tendency to skid sidewise. 3

(*b*) A vehicle starts from rest at a point O and travels along a straight line with acceleration 2 m/s². Another vehicle starts from rest at the same point 4 seconds later and travels along the same path with an acceleration of 3 m/s². How far from O will be the location where the 2nd would overtake the first vehicle. 5

(Turn Over)

6. A particle is aimed at a mark on the horizontal plane through the point of projection. It falls 12 m short when the angle of projection is 15° while it overshoots the mark by 24 m when the angle of projection is 45°. Find the angle of projection to hit the mark. Assume no air resistance. 8

Or

A bullet of mass 20 gm is fired horizontally with a velocity of 300 m/s from a gun carried in a carriage, which together with the gun has a mass of 100 kg. The resistance to sliding of carriage over the ice on which it rest is 20N. Find 8

(*i*) Velocity, with which the gun will recoil

(*ii*) Distance, in which it comes to rest

(*iii*) Time taken to do so.