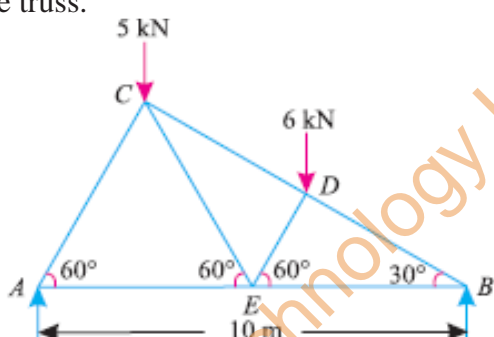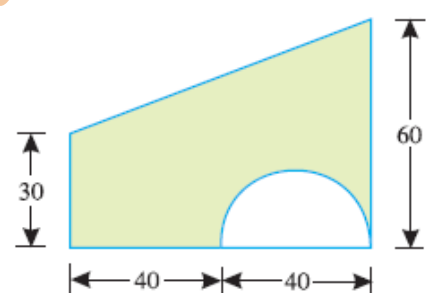**2022**

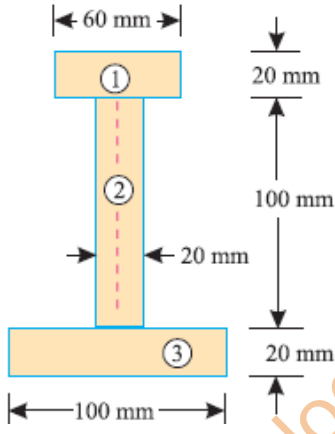**Engineering Mechanics**

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1.	a)	What do you mean by scalar and vector quantities?	3
	b)	Define the law of parallelogram of forces. What is the use of this law?	3
	c)	What is the effect of force and moment on a body?	3
	d)	Define parallel forces. What are the different types of parallel forces?	3
	d)	State and prove Lami's theorem	5
	e)	What is the physical meaning of moment of force? State Varignon's principle of moment.	1+2=3
2.			
	a)	The resultant of the two forces, when they act at an angle of 60° is 14 N. If the same forces are acting at right angles, their resultant is √136 N. Determine the magnitude of the two forces.	5
	b)	The following forces act at a point: (A) 50 N towards North-East. (B) 40 N towards East. (C) 25 N inclined at 30° West of North (D) 30 N inclined at 60° South of West Determine the magnitude and direction of the resultant force.	5
	c)	Three forces 20 N, 30 N and 40 N act along three sides of an equilateral triangle taken in order. Find the magnitude and direction of the resultant force. Assume the length of the sides of a triangle.	5
	d)	A beam *AB* 5 m long is supported at its ends *A* and *B* carries two point loads W_1 and W_2 of 3 kN and 5 kN which are 1 m apart. If the reaction at B is 2 kN more than that at A, find the distance between the support A and the load 3 kN.	5
3.	a)	State the laws of static friction.	4
	b)	Define the terms: co-efficient of friction and angle of friction	3

	c)	A body of weight W is placed on a rough inclined plane having inclination α to the horizontal. The force P is applied horizontally to drag the body. Find the minimum and maximum value of force P which will keep the body in equilibrium.	7
	d	A load of 1.5 kN, resting on an inclined rough plane, can be moved up the plane by a force of 2 kN applied horizontally or by a force 1.25 kN applied parallel to the plane. Find the inclination of the plane and the coefficient of friction.	6
4.	a)	What is a frame? Classify it	2+3
	b)	What do you mean by tensile stress and compressive stress?	3
	c)	A truss of span 10 meters is loaded as shown in figure-i. Find the forces in the members of the truss. fig.-i	12
5.	a)	Distinguish between the centre of gravity and centroid. How many centre of gravity a body has?	2+1=3
	b)	A semicircular area is removed from a trapezium as shown in figure-ii. Locate the co-ordinates of the centroid of the remaining area .All dimensions are mm. Fig.-ii	7
	c)	Find the centroid of an 'I' section of following dimension with neat diagram: Top flange = 100 mm x 20 mm Web = 20 mm x 120 mm Bottom flange = 200 mm x 20 mm.	10
6.			

	a)	Prove that moment of inertia of a triangular section about the base of the section $= \dfrac{bh^3}{12}$, Where b = base of triangular section, and h = height of triangular section.	10
	b)	Using parallel axis theorem, find the moment of inertia of the following figure-iii. Fig.-iii	10