Programme(UG)/3rd Semester/UME 302
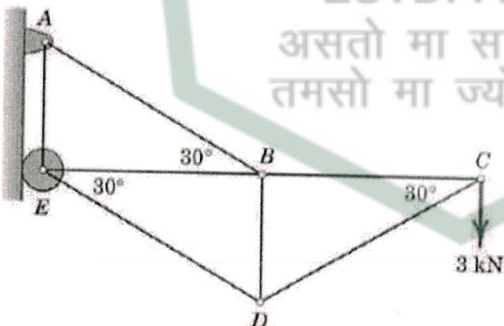
2023

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)	State the effects which a force may produce when it acts on a body	4
	b)	Enumerate the characteristics of a force.	3
	c)	Define the term free body diagram and state the importance of drawing such a diagram.	3
	d)	Outline the steps involved in the analytical method for the determination of resultant of coplanar force system.	3
	e)	Three coplanar forces acting at a point are stated to be in equilibrium. Show that each force is proportional to the sine of the angle between the other two forces.	7
2.	a)	The magnitude of two forces is such that when acting at right angles produce a resultant force of $\sqrt{20}$ N and when acting at 60 degree produce a resultant equal to $\sqrt{28}$ N. Work out the magnitude of the two forces.	6
	b)	The resultant of the two forces P and Q is at right angle to P. Show that the angle between the forces is $\cos^{-1}(-P/Q)$.	5
	c)	Determine the magnitude and direction of the resultant of the following set of forces acting on a body i. 200 N inclined 30° with east towards north ii. 250 N towards the north, iii. 300 N towards north west, and iv. 350 N inclined at 40° with west towards south.	7
	d)	Define the term resultant of a force system.	2
3.	a)	Three like parallel forces 20 N, 40 N, and 60 N are acting at points A, B, and C respectively on a straight line ABC. The distances are AB = 3 m, BC = 4 m. Find the resultant and also the distance of the resultant from point A	5

		on line ABC.	
	b)	Two men carry a weight of 2 kN by means of two ropes fixed to the weight. One rope is inclined at 45° and the other at 30° with their vertices. Find the tension in each rope.	5
	c)	Enunciate the principles of equilibrium.	4
	d)	Three forces of 20 N, 30 N and 40 N act along the three sides of an equilateral triangle of side 100 mm taken in order. Find the magnitude and position of the resultant force.	6
4.	a)	A body of weight 300 N is lying on a rough horizontal plane having a coefficient of friction as 0.3. Find the magnitude of the force, which can move the body, while acting at an angle of 25° with the horizontal.	5
	b)	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.	7
	c)	An effort of 200 N is required just to move a certain body up an inclined plane of angle 15° the force acting parallel to the plane. If the angle of inclination of the plane is made 20° the effort required, again applied parallel to the plane, is found to be 230 N. Find the weight of the body and the coefficient of friction.	8
5.	a)	What is a framed structure? List its applications.	2+3 =5
	b)	Determine the force in each member of the truss as shown in fig 1., and state if the members are in tension or compression.	15

Fig 1.

6.			
	a)	Find the Moment of Inertia of an I-section about the axis passing through the centre of gravity of the section with top flange 100 mm × 20 mm, web 200 mm × 30 mm and bottom flange 300 mm × 40 mm.	10
	b)	The motion of a particle is given by :	10

$$a = t^3 - 3t^2 + 5$$

where (a) is the acceleration in m/s^2 and (t) is the time in seconds. The velocity of the particle at t = 1 second is 6.25 m/sec and the displacement is 8.8 metres.

Calculate the displacement and velocity at t = 2 seconds.