B.Tech-1st

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

1. Answer *all* questions :　　　　　　　　　　2×5

　　(a) Define principle of transmissibility & Free Body Diagram (FBD) and draw FBD of Hinged, Fixed & Roller support.

　　(b) Explain the term 'redundant constraints'.

　　(c) What is the location of centroid of a cone height 'h' and radius 'r'?

(2)

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

(e) What is coefficient of restitution ?

2. Two roller of weights "P" = 222.5N and "Q" = 445N are connected by a rigid bar at its ends & supported inside a circular ring in a vertical plane as shown in figure. The length of the bar "AB" is such that radii "AC" and "BC" form right-angle at center of the circular ring "C". Neglecting friction and weight of the bar, find the compressive force in the bar "AB".   8
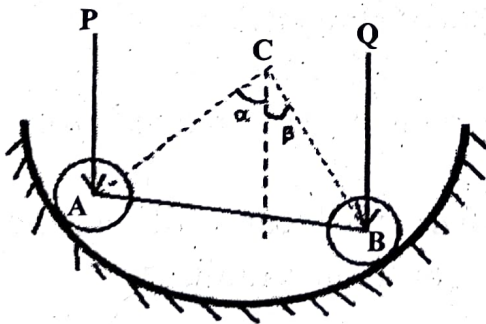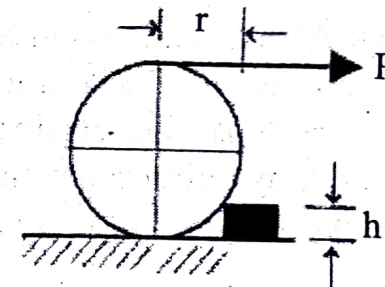
(3)

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.   5

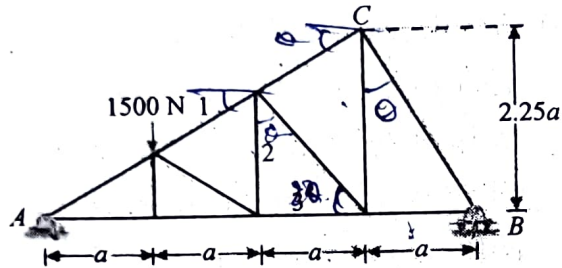

(b) Explain the stable, unstable and neutral equilibrium.   3

3. (a) A plane truss is shown in figure. Determine the nature and magnitude of the forces in the members 1, 2 and 3.   4

(Using method of section).

(b) 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.　　　　　　4

Or

A uniform ladder of 4 m length rests against a vertical wall with which it makes an angle of 45°. The coefficient of friction between the ladder and the wall is 0.4 and that between ladder and the floor is 0.5. If a man, whose weight is one-half of that of the ladder ascends it, how high will it be when the ladder slips ?　　　　8
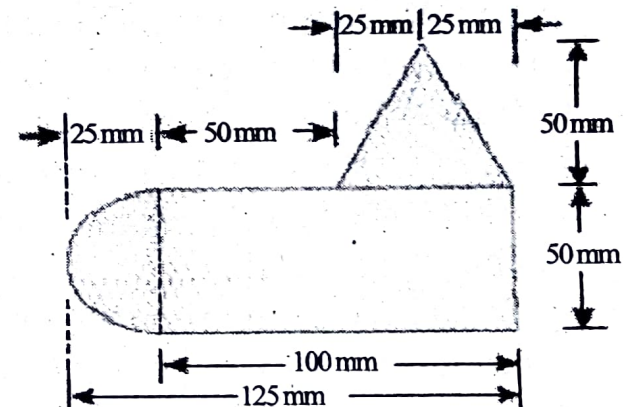
4. Find the moment of inertia of a T-section with flange as 150 mm × 50 mm and web as 150 mm × 50 mm about X-X and Y-Y axes through the centre of gravity of the section.　　　　8

Or

(a) A uniform lamina shown in Figure consists of a rectangle, a circle and a triangle. Determine the centre of gravity of the lamina. All dimensions are in mm.　　4

(b) Using Pappus theorem, find the volume of sphere.　　　　2

(c) Explain the parallel axis theorem. 2

5. A bullet is fired upward at an angle of 30° to the horizontal from a point P on the hill. It strikes the target, which is 80 m lower than P. The initial velocity of bullet is 100 m/sec. Calculate the actual velocity with which the bullet strikes the target. 8

Or

(a) Train A passes a certain station at velocity 72 kmph and move 20 km at this speed and then comes to rest at next station 24 km away from the first one. Train B, starts from the first station, in accelerate and then decelerate and finally reaches the second station. Time taken by B is twice of the time taken by A. Determine the maximum speed attained by B. 6

(b) What are impulse and momentum ? 2

6. A flywheel is made up of steel ring 40 mm thick and 200 mm wide plate with mean diameter of 2 metres. If initially the flywheel is rotating at 300 r.p.m., find the time taken by the wheel in coming to rest due to frictional couple of 100 N-m. Take mass density of the steel as 7900 kg/m³. Neglect the effect of the spokes. 8

Or

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. 8

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