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NATIONAL INSTITUTE OF TECHNOLOGY CALICUT

ZZ1001 ENGINEERING MECHANICS

End Semester Exam - Winter semester 2013

Time: 3hrs **Maximum Marks: 50**

1. What are the supporting forces at A and E for the frame shown in Figure 1. Neglect all weights except the 100 N weight of the pulley at D. Also find the force transmitted from one bar to the other at joint C. Disregard friction. [6]

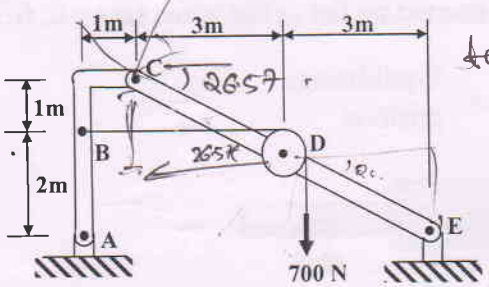

Figure 1.

2. Using the method of joints, determine the force in each member of the truss given in Figure 2. [5]

3. Find the principal second moments of area at the centroid of the L section given in Figure 3. [6]

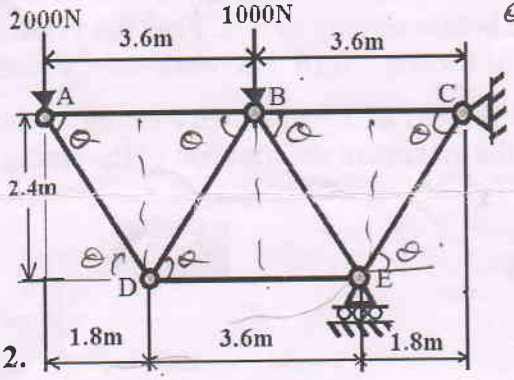

Figure 2.

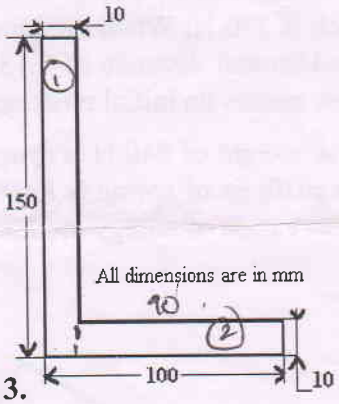

Figure 3.

4a. A projectile is fired at a speed of $V_0 = 500$m/s from the origin O. The ground has a parabolic profile as shown in Figure 4a. (i) If the angle of firing $\alpha = 45°$, determine the position (x,y) where the projectile will hit the ground? (ii) At what angle α should the projectile be fired to hit the point A which is at a horizontal distance of 3000m from the origin? [5]

4b. A circular platform is rotating with respect to the ground at an angular speed of 1.5rad/s and angular acceleration of 0.5rad/s^2. Point P is fixed to the platform at a distance $r = 0.6$m. The platform is being raised up at a speed of 0.25m/s with an acceleration of 0.1m/s^2. At the instant of interest the angle θ is 30°. Determine the velocity and acceleration of the point P. [2]

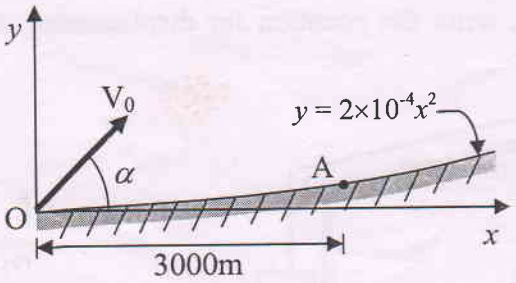

Figure 4a.

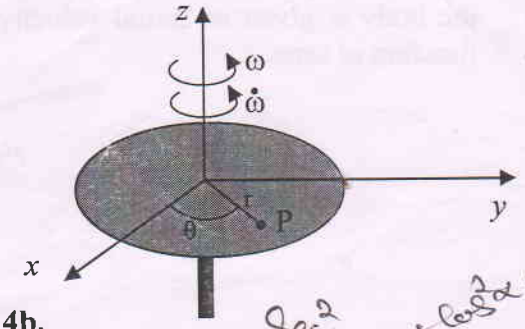

Figure 4b.

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5a. A spring of constant k = 200 N/m is attached to both the support and the 2 kg cylinder as shown in Figure 5a. The cylinder slides freely on the horizontal guide. If a constant 10 N force is applied to the cylinder at time t = 0 s, when the spring is not deformed and the system is at rest, determine the velocity of the cylinder when x = 40 mm. Also determine the maximum displacement of the cylinder. Solve using Newton's law. [5]

5b. Rod OA rotates about O in a horizontal plane as shown in Figure 5b. The motion of the 300g collar B is defined by the relations $r = 300 + 100\cos(0.5\pi t)$ and $\theta = \pi(t^2 - 3t)$, where r is expressed in millimeters, t in seconds, and θ in radians. The angle θ is in the horizontal plane. Determine the radial and transverse components of the force exerted on the collar when (i) t = 0, (ii) t = 0.5 s. Solve using Newton's law. [5]

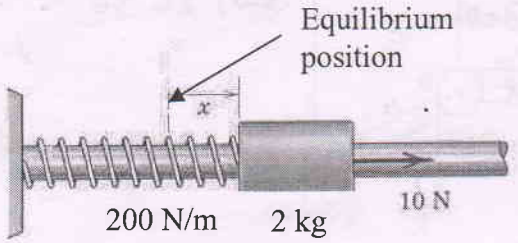

Figure 5a.

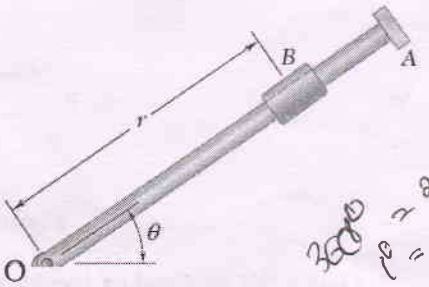

Figure 5b.

6a. A force of P=180 N is applied to the initially stationary block shown in Figure 6a. The weight of block is 270 N. When the block has covered a distance of 3 m, the force is removed and the block moves an additional distance of 0.132 m up the incline before coming to rest. Find the velocity with which the block passes its initial position. Take coefficient of friction = 0.16. Use work-energy method. [5]

6b. A weight of 540 N is dropped with an initial velocity of 1.5 m/sec on a spring as shown in Figure 6b. The stiffness of spring is K=90 N/cm. Compute the maximum deformation of the spring. Use principle of conservation of energy method. [3]

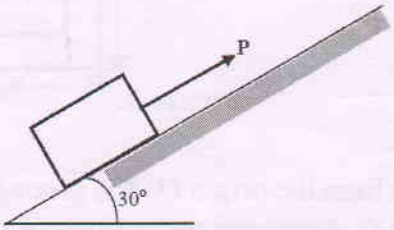

Figure 6a.

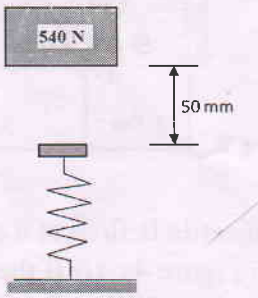

Figure 6b.

7a. Two bodies A and B are connected by inextensible and weightless chrd as shown in Figure 7. If the bodies start from rest, write the expression for velocity of the bodies at any time t before body A has reached the end of incline. Use impulse-momentum equation. Data: W_A = 350 kN, W_B = 200 kN, μ_d = 0.4 and $\alpha = 30^0$. [4]

7b. When a 100 N body is suspended from a linear spring, the spring is stretched a distance of 80 mm. Determine the natural frequency and period of vibration for a 50 N body attached to the same spring. If the body is given an initial velocity of 1.5 m/s, write the equation for displacement of the body as a function of time. [4]

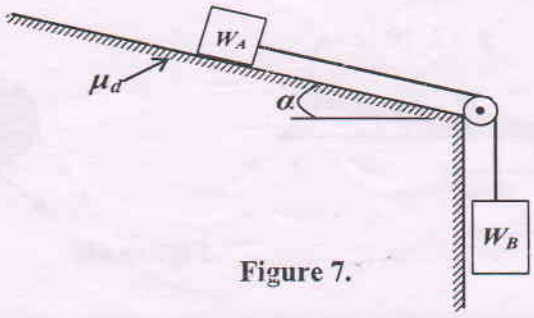

Figure 7.