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BME-016

B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING) / B.Tech. AEROSPACE ENGINEERING (BTAE)

01450

Term-End Examination

June, 2016

BME-016 : ENGINEERING MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted.*

1. (a) Four forces are acting at O as shown in Figure 1. Find the resultant in magnitude and direction by using polygon law. 7

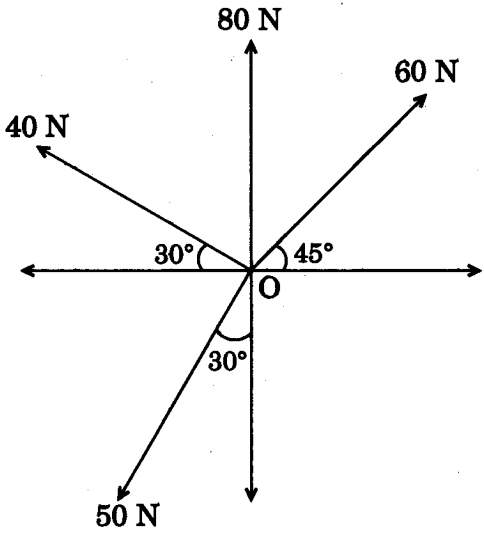

Figure 1

(b) A cantilever AB, 1·8 m long, is fixed at A and carries a uniformly distributed load of 20 kN/m over its entire length and a point load of 30 kN at the free end. Determine the reaction at A (Figure 2). 7

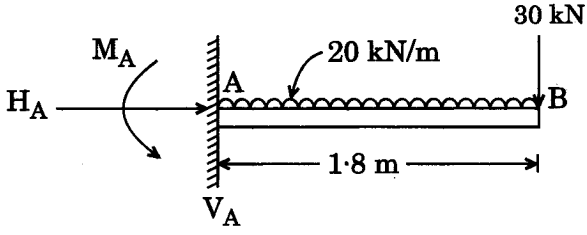

Figure 2

2. (a) The pitch of the thread of a screw jack is 5 mm and mean diameter is 60 mm. The coefficient of friction is 0·08. Find the force that should be applied at the end of a lever 200 mm long measured from the axis of the screw

(i) to raise the load of 20 kN,

(ii) to lower the same load. 7

(b) Determine the position of the centroid of a quadrant OAB of a circle, where arc AB subtends an angle of 90° at the centre O, and radius OA = a. 7

3. (a) Determine the moment of inertia of the semicircle about axis AT which is tangential to the circle as shown in Figure 3. 7

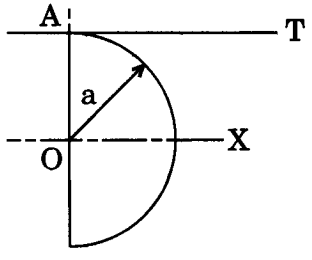

Figure 3

(b) The motion of a particle in XOY plane is defined by the equation

$$r(t) = 3t\,(i) + (4t - 3t^2)\,j.$$

The distances are in metres. Find its radius of curvature and its acceleration when it crosses the x axis again. 7

4. (a) An automobile of mass 1500 kg traverses a 500 m radius curve at a constant speed of 50 kmph. Assuming no banking of the curve, calculate the force exerted by the tyres on the road to maintain motion along the curve. 7

(b) A homogeneous sphere and a homogeneous cylinder are free to roll without slipping down the inclined plane as shown in Figure 4 from rest. Which body reaches the bottom first ? 7

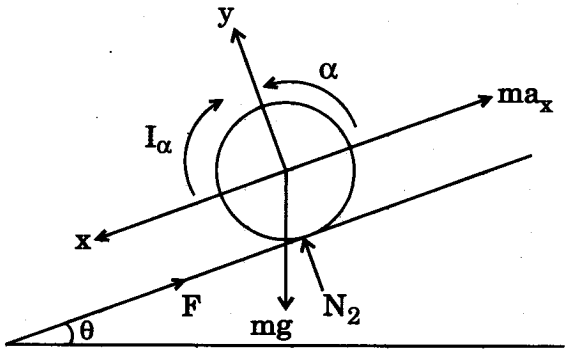

Figure 4

5. (a) A ball of mass 2 kg moving with a velocity of 12 m/s approaches another ball of mass 4 kg moving with a velocity of 4 m/s in the opposite direction. After collision both the balls move together with a common velocity. Determine the common velocity. 7

(b) A flywheel of mass 20 kg and radius 100 mm is made to rotate at 600 rpm. Determine the K.E. of the flywheel. If the frictional couple at its bearing is 10 Nm, determine the number of revolutions it will make before coming to rest. 7

6. (a) A mass of 10 kg moving with a velocity of 10 m/sec along x-direction follows another mass of 4 kg moving with 5 m/sec in the same direction. Determine the final velocities of the two masses after collision, if e = 0·6. 7

(b) Five weightless rods of equal length 'l' are joined together so as to form a rhombus ABCD with the diagonal BD. If a force P is applied to C downward and the system be suspended from A, show that the thrust in member BD is $\left(P/\sqrt{3}\right)$. 7

7. (a) Determine the forces in members DE and DC in the truss shown in Figure 5 below. The magnitude of the three applied forces are indicated in brackets. 7

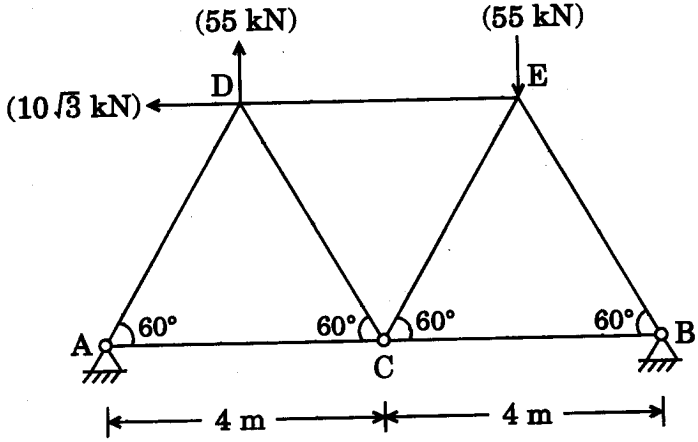

Figure 5

(b) Determine the forces in the member of the frame given in Figure 6. 7

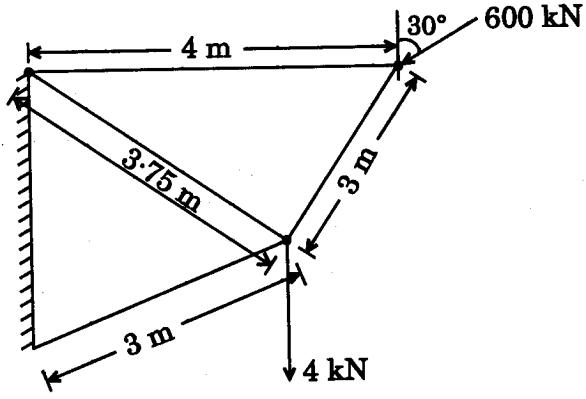

Figure 6

8. (a) Under which condition, will the mechanical advantage be equal to the velocity ratio ? 7

(b) A system of pulleys is given in Figure 7. Obtain the acceleration of the weights P and Q, if P = 300 N, Q = 200 N. Assume the pulleys to be weightless and frictionless, and the string to be inextensible. 7

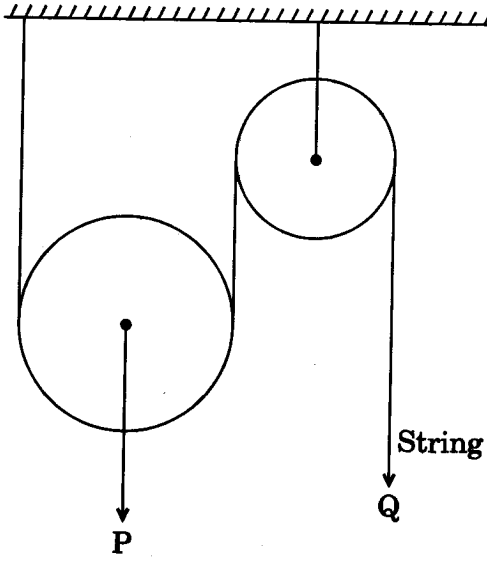

Figure 7