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

Term-End Examination

December, 2016

01092

BME-016 : ENGINEERING MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any **five** questions. Use of scientific calculator is allowed. Assume suitable data, if missing.*

1. (a) Explain the Lami's theorem. *6*

(b) A wire rope is fixed at two points A and D as shown in Figure 1. Two weights, 20 kN and 30 kN, are attached to it at B and C, respectively. The weights rest with

portions AB and BC inclined at angles 30° and 50° respectively, to the vertical as shown in the figure. Find the tension in the wire in segments AB, BC and CD and also the inclination of the segment CD to the vertical. *8*

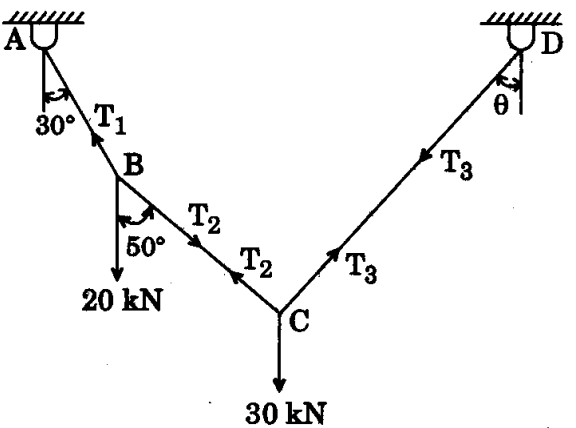

Figure 1

2. (a) A block weighing 800 N is raised up with the help of two 6° wedges B and C of negligible weights as shown in Figure 2. If the coefficient of static friction is 0·25 for all surfaces of contact, determine the smallest force 'P' to be applied to raise the block A. *8*

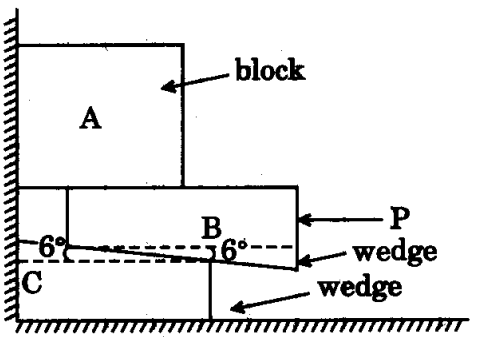

Figure 2

(b) Explain the laws of friction. *6*

3. (a) Explain the theorems of Pappu's 1 and 2. *6*

(b) Determine the centroid of the area shown in Figure 3, with respect to the axes as shown. *8*

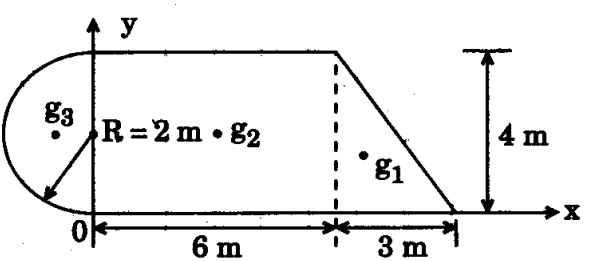

Figure 3

4. (a) Determine the centre of gravity of a right circular cone of height 'h' and base radius 'a'. 7

(b) Determine the moment of inertia of the L-section shown in Figure 4, about its centroidal axes parallel to the legs. Also find out the polar moment of inertia. 7

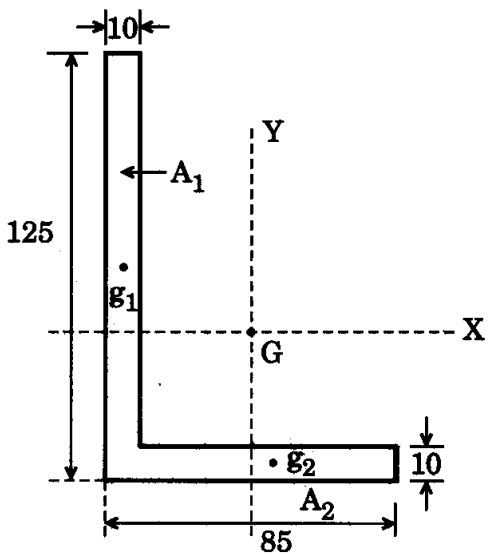

Figure 4

5. (a) Find the least initial velocity with which a projectile is to be projected so that it clears a wall 4 m high located at a distance of 5 m, and strikes the ground at a distance 4 m beyond the wall as shown in Figure 5. The point of projection is at the same level as the foot of the wall. 7

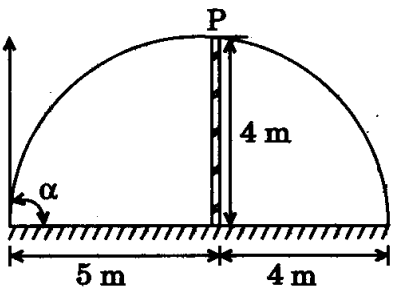

Figure 5

(b) A small steel ball is shot vertically upwards from the top of a building 25 m above the ground with an initial velocity of 18 m/sec.

(i) In what time, will it reach the maximum height ?

(ii) How high above the building will the ball rise ?

(iii) Compute the velocity with which it will strike the ground and the total time it remains in motion. 7

6. (a) A homogeneous sphere having a mass of 100 kg is attached to a slender rod having a mass of 20 kg. In the horizontal position, shown in Figure 6, the angular speed of the system is 8 rad/sec. Determine the magnitude of the angular acceleration of the system and the reaction at 'O' on the rod. 8

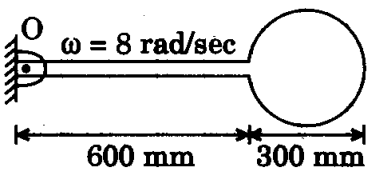

Figure 6

(b) Explain D'Alembert's principle. 6

7. (a) A flywheel of mass 15 kg and radius 20 cm is wound by a rope which carries a weight of mass 5 kg at its free end as shown in Figure 7. Determine the angular acceleration of the motion, assuming gravitational acceleration = 10 m/sec^2 for

the purpose of simplified calculations, and considering the following two cases : 7

(i) If friction at the bearing of flywheel-shaft is zero.

(ii) If frictional couple developed at the bearing of shaft is 2 N-m.

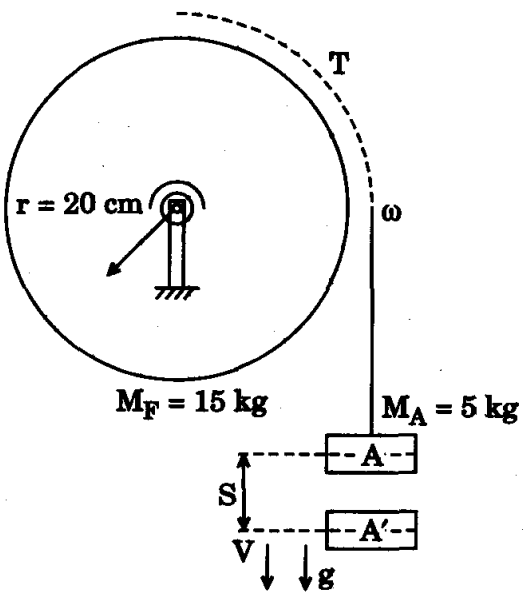

Figure 7

(b) Determine the constant force 'P' that will give the system of bodies shown in Figure 8 a velocity of 3m/sec after moving 4·5 m from rest. Coefficient of friction between the blocks and plane is 0·3. Pulleys are smooth. 7

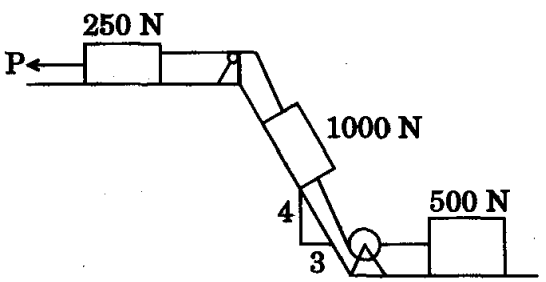

Figure 8

8. (a) The ladder shown in Figure 9 is 6 m long and is supported by a horizontal floor and a vertical wall. The coefficient of friction between the floor and the ladder is 0·4 and between the wall and the ladder is 0·25. The weight of the ladder is 200 N. The ladder also supports a vertical load of 900 N at C which is at a distance of 1 m

from B. Determine the least value of θ for which the ladder may be placed without slipping. Determine the reaction at this stage. 7

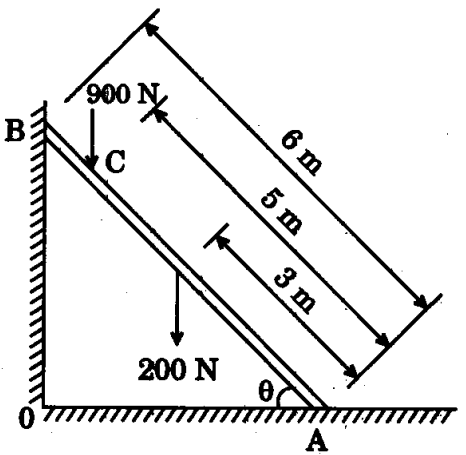

Figure 9

(b) Explain work-energy principle. 7

9. (a) Explain the procedure of method of joints. 7

(b) Determine the forces in all the members of the truss shown in Figure 10 and indicate the magnitude and nature of forces on the diagram of the truss. All inclined members are at 60° to horizontal and the length of each member is 2 m. 7

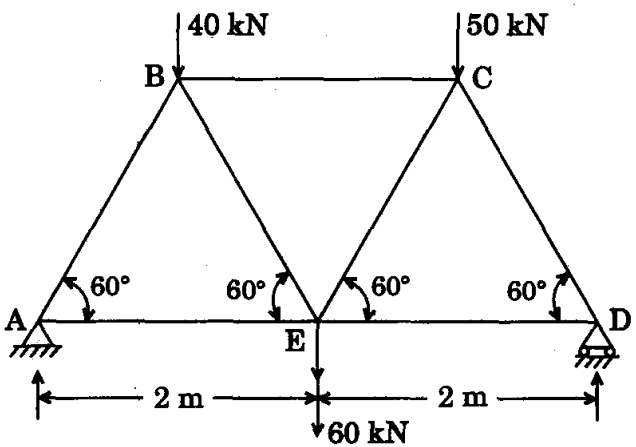

Figure 10