

I B.Tech Semester Regular Examinations, June 2009

CLASSICAL MECHANICS

**(Common to Mechanical Engineering, Chemical Engineering, Mechatronics,
Production Engineering and Automobile Engineering)**

Time: 3 hours

Max Marks: 80

**Answer any FIVE Questions
All Questions carry equal marks**

1. A rigid bar is subjected to a system of parallel forces as shown in Figure 1. Reduce this system to
- (a) a single force
 - (b) a single force-moment system at A and
 - (c) a single force-moment system at B.
- [16]

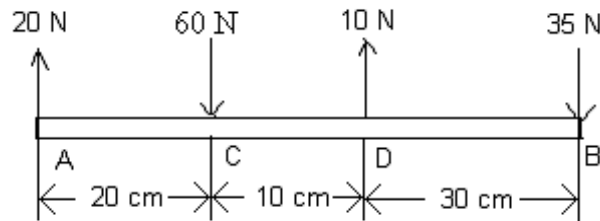


Figure 1

2. A force F with a magnitude of 150 N is applied at the origin O of the axes x , y and z as shown in Figure 2. The line of action of F passes through a point A whose co-ordinates are 2 m, 4 m and 6 m. Determine
- (a) the x , y , and z scalar components of F
 - (b) the projection of F on x - y plane, and
 - (c) the projection of F along the line OB .
- [16]

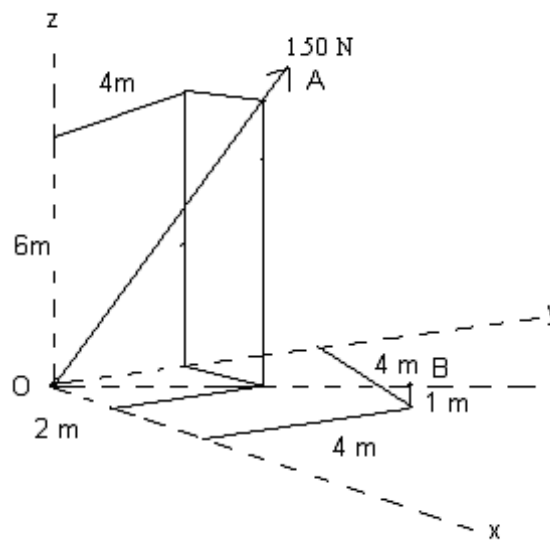


Figure 2

3. Find the centroid of the plane area shown in figure 3.

[16]

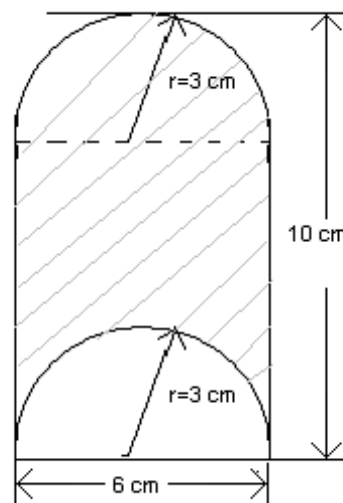


Figure 3

4. Find the moment of inertia about the centroidal axes XX and YY for the lamina shown in figure 4.

[16]

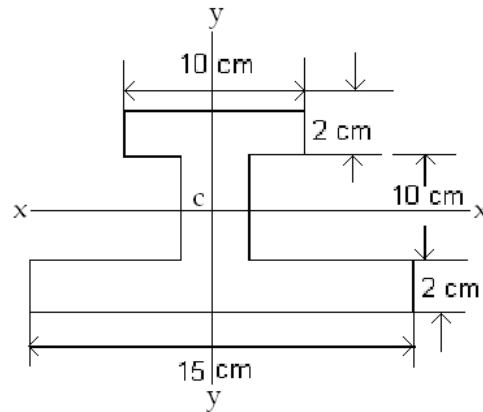


Figure 4

5. (a) Define Cantilever beam.
 (b) A braced support of 3m span is loaded as shown in figure 5b. Find the forces in the various members of the framed truss. [2+14]

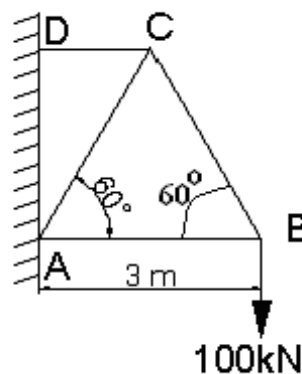


Figure 5b

6. The motion of a particle is defined by the position vector $\mathbf{r} = A (\cos t + t \sin t) \mathbf{i} + A (\sin t + t \cos t) \mathbf{j}$ where 't' is expressed in seconds. Determine the values of t for which the position vector and the acceleration vector are
 (a) perpendicular
 (b) parallel. [16]
7. The two step pulley in figure 7 has weight $w = 1800 \text{ N}$ and radius of gyration $i_0 = 175 \text{ mm}$. Develop a formula for the downward acceleration of the falling weight on the right if $W = 220 \text{ N}$, $r_1 = 250 \text{ mm}$ & $r_2 = 350 \text{ mm}$. [16]

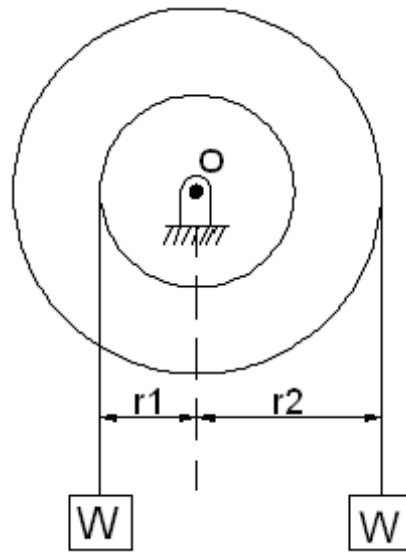


Figure 7

8. Derive an expression for the equation of motion of a simple pendulum employing the principle of conservation of energy. Also find the frequency and time period. [16]

I B.Tech Semester Regular Examinations, June 2009

CLASSICAL MECHANICS

(Common to Mechanical Engineering, Chemical Engineering, Mechatronics,
Production Engineering and Automobile Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. A rod AB shown in Figure 1 is held by a ball and socket joint at A and supports a mass C weighing 1200 N at end B. The rod is in x-y plane and is inclined to y axis at an angle of 15° . The rod is 10 m long and has negligible weight. Find the forces in the cables DF and EB. [16]

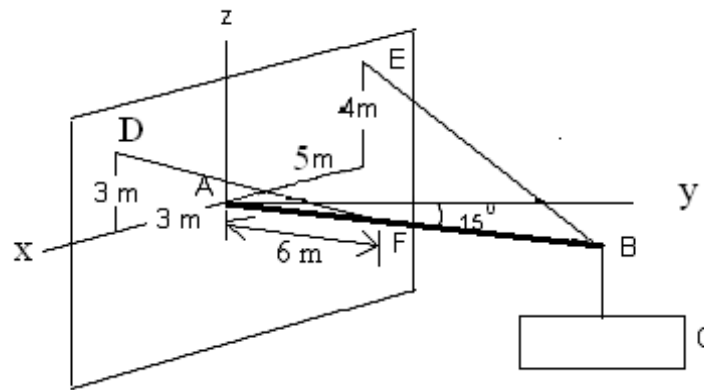


Figure 1

2. A force F with a magnitude of 150 N is applied at the origin O of the axes x, y and z as shown in Figure 2. The line of action of F passes through a point A whose co-ordinates are 2 m, 4 m and 6 m. Determine
- (a) the x, y, and z scalar components of F
 - (b) the projection of F on x-y plane, and
 - (c) the projection of F along the line OB.
- [16]

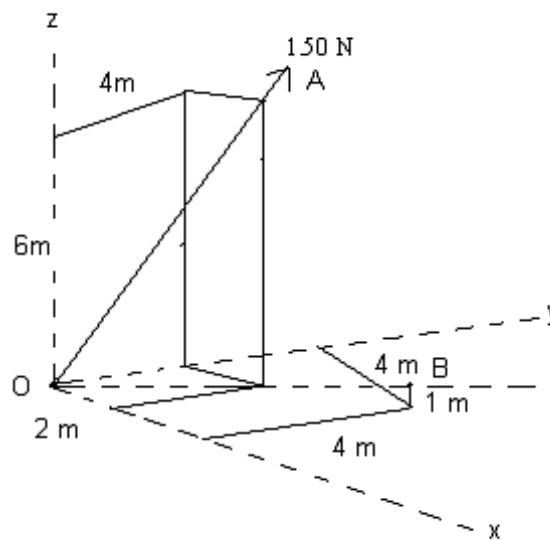


Figure 2

3. (a) Find the centroid of the inverted T section shown in Figure 3a.

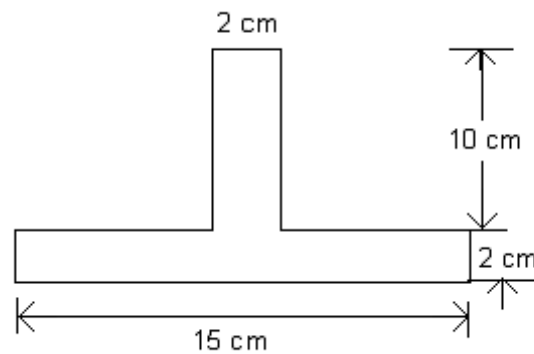


Figure 3a

- (b) Determine the centre of gravity of the composite body consisting of a cylinder of radius 'r' attached to a hemisphere of radius 'r' as shown in figure 3b. [8+8]

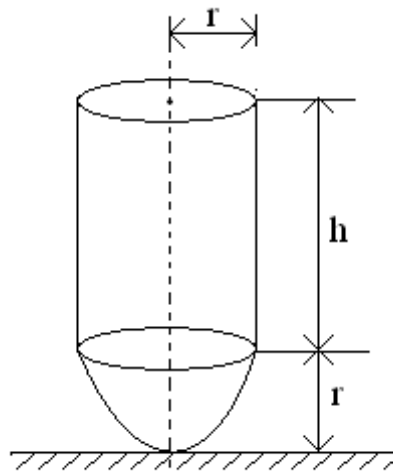


Figure 3b

4. Find the moment of inertia of the plane area shown in figure 4 about X and Y axes through its centroid. [16]

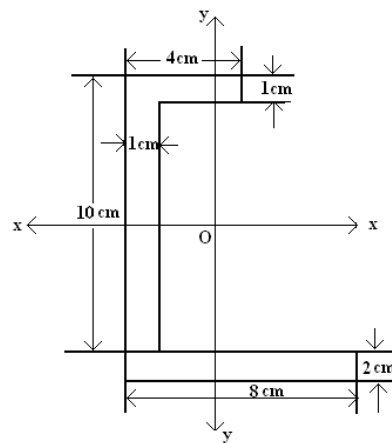


Figure 4

5. Find the axial forces in all the members of a truss shown in figure 5. [16]

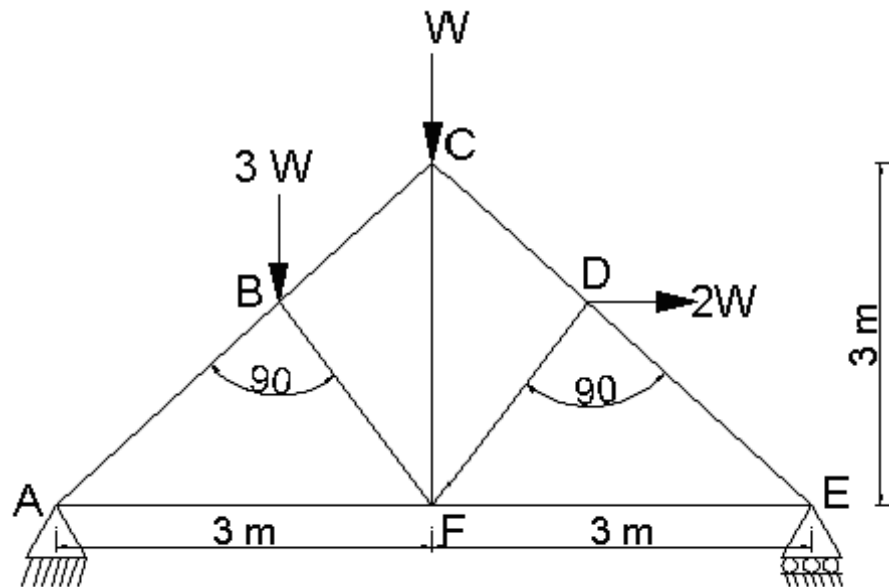


Figure 5

6. A projectile is fired from the edge of a 140m cliff with an initial velocity of 180 m/s at an angle of 30° with the horizontal. Neglecting air resistance, find
 - (a) the horizontal distance from the gun to the point where the projectile strikes the ground.
 - (b) the greatest elevation above the ground reached by the projectile. [16]
7. (a) A particle which moves in rectilinear translation is acted upon by a resultant force R.
 - i. Give the form of the impulse-momentum equation for the particle
 - ii. What is the linear momentum of the particle?
 - iii. What are the units of linear momentum?
 - iv. What is the graphical interpretation of an impulse?
- (b) Give the equation for the conservation of linear momentum of two particles which move in rectilinear translation. What is significant limitation of the equation. [8+8]
8. A 50 kg block is supported by the spring arrangement shown in figure 8. The block's moved vertically downward from its equation position and released. The amplitude of the resulting motion is 50 mm determine.

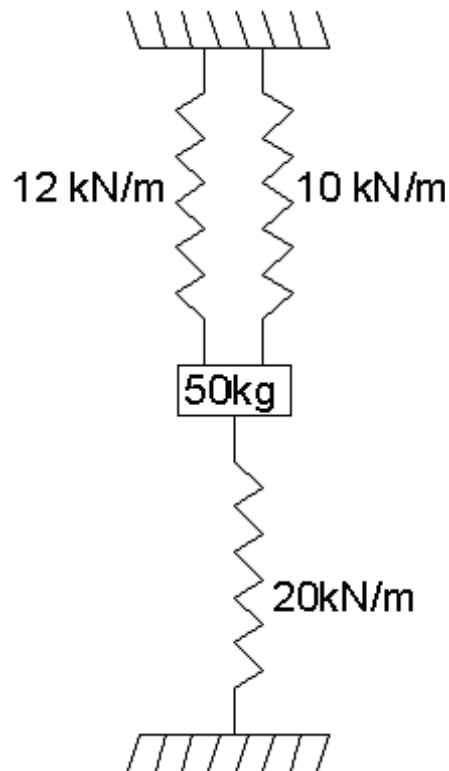


Figure 8

- (a) The period and frequent of the motion.
- (b) The maximum velocity and max acceleration of the block. [16]

I B.Tech Semester Regular Examinations, June 2009

CLASSICAL MECHANICS

(Common to Mechanical Engineering, Chemical Engineering, Mechatronics,
Production Engineering and Automobile Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. Determine the magnitude and direction of a single force which keeps the system in equilibrium. The system of forces acting is shown in Figure 1. [16]

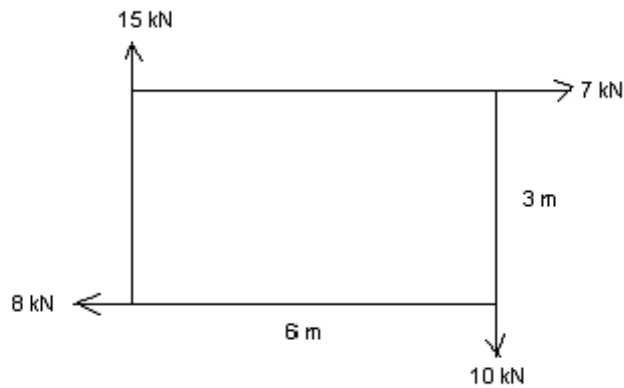


Figure 1

2. A force F with a magnitude of 150 N is applied at the origin O of the axes x , y and z as shown in Figure 2. The line of action of F passes through a point A whose co-ordinates are 2 m, 4 m and 6 m. Determine
- (a) the x , y , and z scalar components of F
 - (b) the projection of F on x - y plane, and
 - (c) the projection of F along the line OB .
- [16]

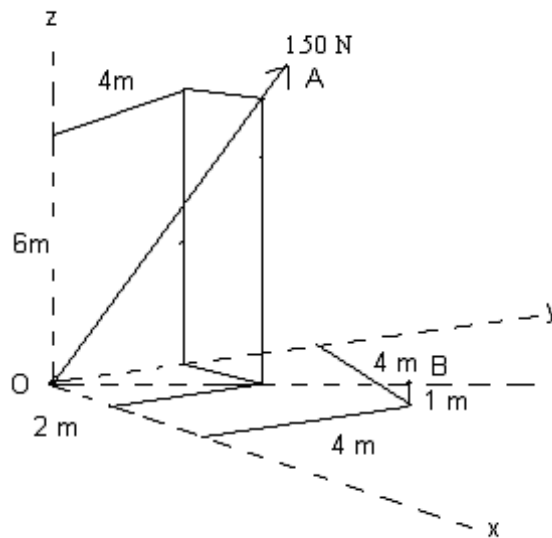


Figure 2

3. (a) Find the centroid of the L section shown in figure 3a.

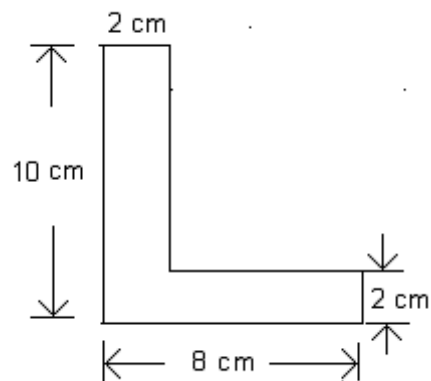


Figure 3a

- (b) Determine the Co-ordinates of the centroid of the shaded area OAB shown in figure 3b. [8+8]

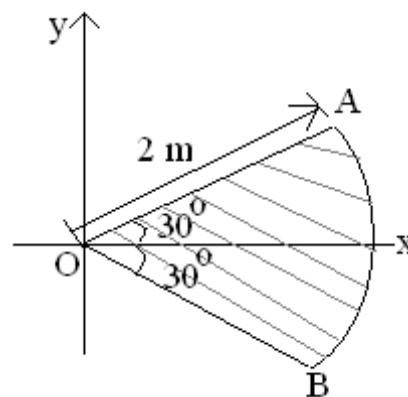


Figure 3b

4. Find the moment of inertia of the plane area shown in figure 4 about X and Y axes

through its centroid.

[16]

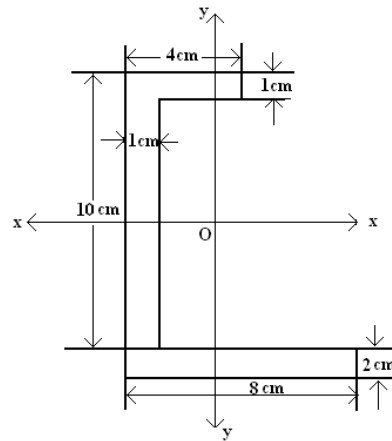


Figure 4

5. Find the axial forces in all the members of a truss shown in figure 5.

[16]

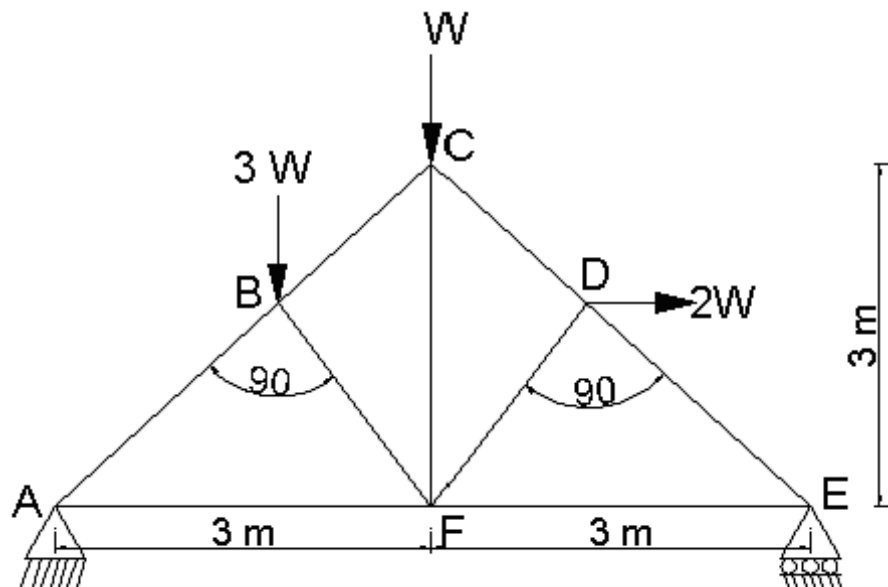


Figure 5

6. Bars AB and BE, each of weight 3.2 kg are welded together and are pin-jointed to two links AC and BD. The assembly is released from rest in the position shown in figure 6 and Neglecting the masses of the links determine

- the acceleration of the assembly
- the forces in the links.

[16]

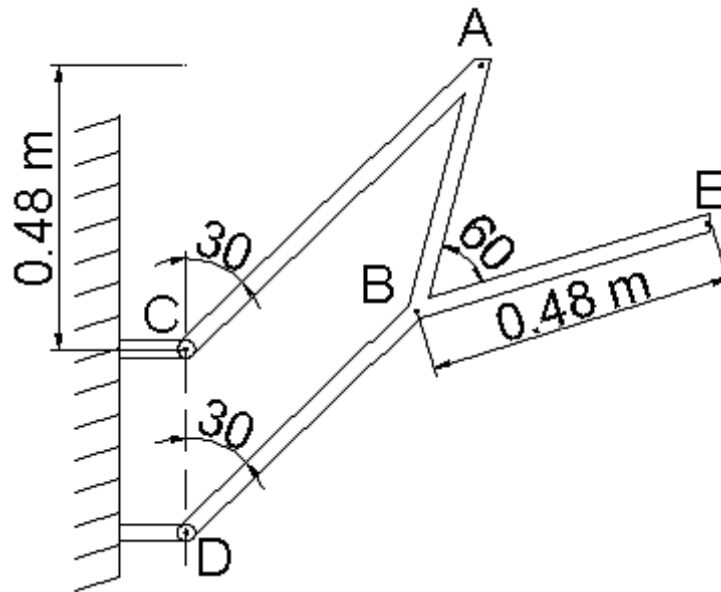


Figure 6

7. A 900 kg car starts from rest at 1 and moves without friction down the track shown in figure 7.
- Determine the force exerted by the track on the car at point 2, where the radius of curvature of the track is 5m
 - Determine the min. safe value at the radius of curvature at point 3. [16]

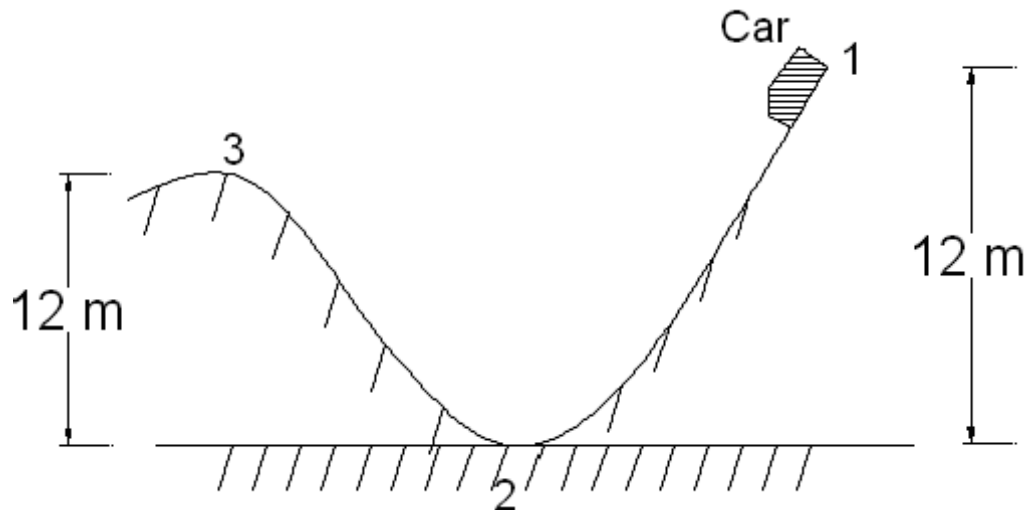


Figure 7

8. Show that the period of oscillation of a compound pendulum is equal to the period of a simple pendulum. [16]

I B.Tech Semester Regular Examinations, June 2009

CLASSICAL MECHANICS

(Common to Mechanical Engineering, Chemical Engineering, Mechatronics,
Production Engineering and Automobile Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. A rod AB shown in Figure 1 is held by a ball and socket joint at A and supports a mass C weighing 1200 N at end B. The rod is in x-y plane and is inclined to y axis at an angle of 15° . The rod is 10 m long and has negligible weight. Find the forces in the cables DF and EB. [16]

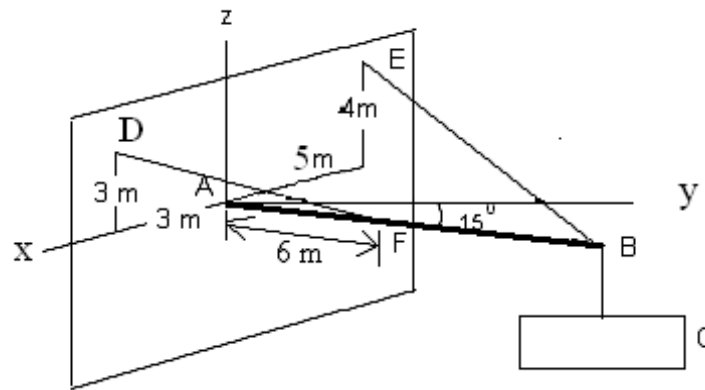


Figure 1

2. A force F with a magnitude of 150 N is applied at the origin O of the axes x, y and z as shown in Figure 2. The line of action of F passes through a point A whose co-ordinates are 2 m, 4 m and 6 m. Determine
- (a) the x, y, and z scalar components of F
 - (b) the projection of F on x-y plane, and
 - (c) the projection of F along the line OB.
- [16]

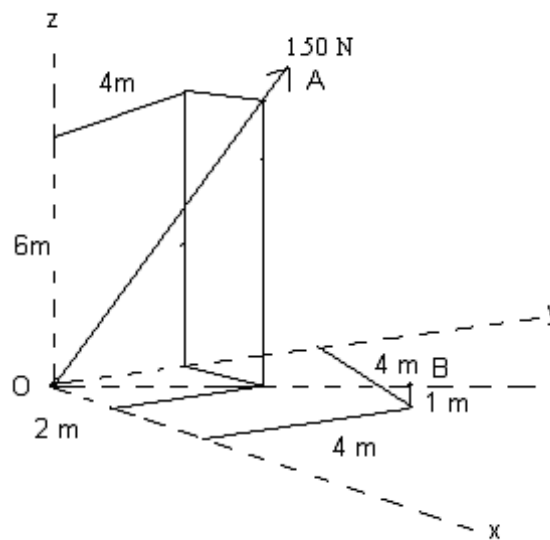


Figure 2

3. (a) Find the centroid of the plane area shown in figure 3a.

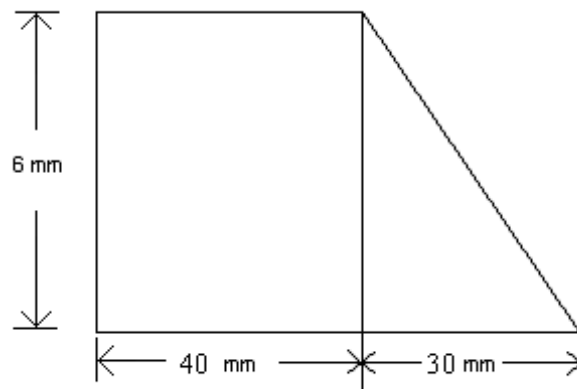


Figure 3a

- (b) Determine the centre of gravity of a homogeneous hemisphere of radius 'a' [8+8]
4. Determine the moment of inertia about the horizontal axis through the centre of gravity of the section shown in figure 4. [16]

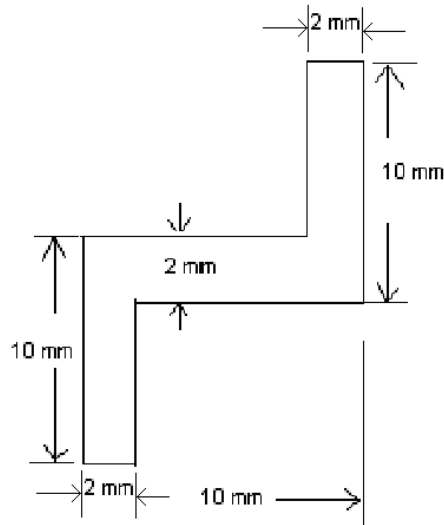


Figure 4

5. (a) Define and explain the terms: Perfect frame, imperfect frame and deficient frame.
- (b) Determine the support reactions and members forces in a structure shown in figure 5b. [4+12]

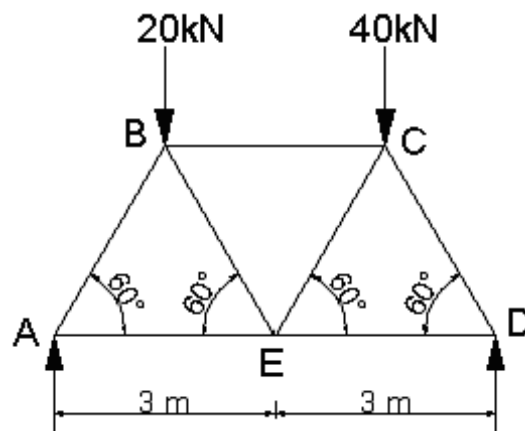


Figure 5b

6. (a) Explain the concept of coriolis acceleration.
- (b) Show that there are two directions in which a particle may be projected at the same velocity so that it passes through a given target. Establish the minimum velocity of projection requirement such that the particle does reach the target. [6+10]
7. (a) Under what circumstances is Newton's law of motion applicable?
- (b) When would you prefer the work-energy, impulse - momentum formulations?
- (c) A car weighing 18000N is driven down 10° incline at a speed of 94 km/hr. When the brakes are applied, causing a constant total braking force (applied by the road on tires) of 6680N, determine the distance traveled by the car before it comes to a rest. [3+3+10]

8. A 5 kg block, attached to the lower end of a spring whose upper end is fixed, vibrates with a period of 6.5s. The spring constant k is inversely proportional to its length, determine the period of a 2.5 kg block which is attached to the center of the same spring if the upper and lower end of the spring are fixed. [16]
