C 3374

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Third Semester

Mechanical Engineering

ME 1206 — APPLIED ENGINEERING MECHANICS

(Common to Aeronautical Engineering/Automobile Engineering/Mechatronics Engineering/ Marine Engineering/Metallurgical Engineering and Production Engineering for candidates admitted in 2006 only)

(Regulation 2004)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1.   State Parallelogram law of forces. How can it be extended for more than two forces?

2.   A force $F = (100\,i + 50\,j + 20\,k)$N acts at a point P whose coordinates are (2, 4, 5) m. Find the moment of the force about X, Y and Z axes.

3.   Show how a given force could be resolved into a force and a couple.

4.   State the conditions for a rigid body to be in equilibrium under non coplanar forces.

5.   Define polar moment of inertia. What is its value for a square lamina of 100 mm side?

6.   Write the expressions for the mass moment of inertia of
     (a)   a cylinder
     (b)   a rectangular prism about the longest axis.

7.   A wheel of 300 mm diameter supports a load of 10 kN. Determine the coefficient of rolling resistance if a horizontal force of 250 N is needed to roll on the horizontal surface.

8.   Define
     (a)   projectile and
     (b)   range of a projectile.

9. What are the types of rigid body motion?

10. A flywheel 500 mm in diameter is brought uniformly from rest up to a speed of 280 rpm in 15 seconds. What is the velocity of a point on the rim one second after starting from rest?

PART B — (5 × 16 = 80 marks)

11. (a) Five forces act on a particle as shown in Fig. 11(a). Determine the resultant force in magnitude and direction.
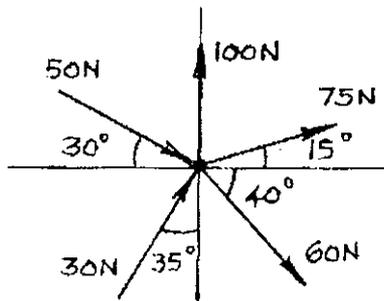

Fig. 11(a)

Or

(b) A force of magnitude 10 kN starts from a point A (2, 1, – 3) and passes through the point B (6, 3, 1). Represent the force in terms of unit vectors i, j and k. Also find the components of the force along the three directions and the angle made by the force with these directions.

12. (a) Two cylinders of diameter 50 mm and 25 mm weighing 150 N and 50 N respectively are placed as shown in Fig. 12(a). Assuming all contact surfaces to be smooth, find the reactions at A, B, C and D.
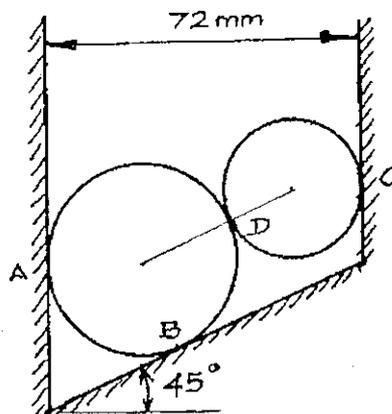

Fig. 12(a)

Or

C 3374

(b) For a hanging weight of 300 N at A as shown in Fig. 12(b), find the forces in the members AB, AC and AD of the wall bracket.
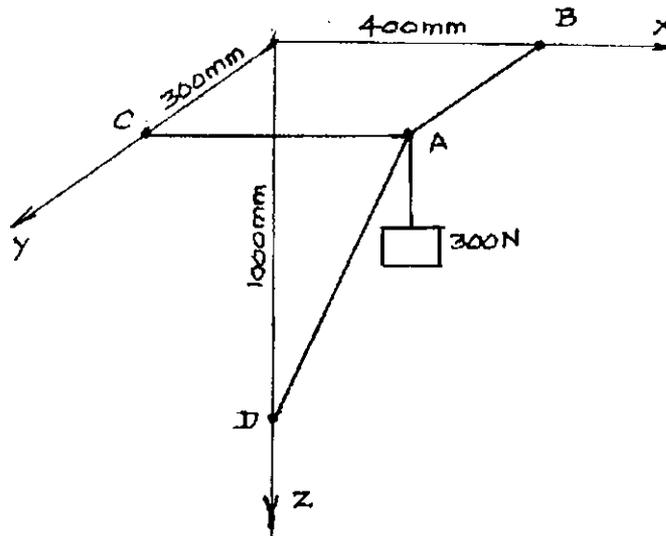

Fig. 12(b)

13. (a) For the plane section shown in Fig. 13 (a) determine the moment of inertia about its horizontal and vertical centrodial axes.
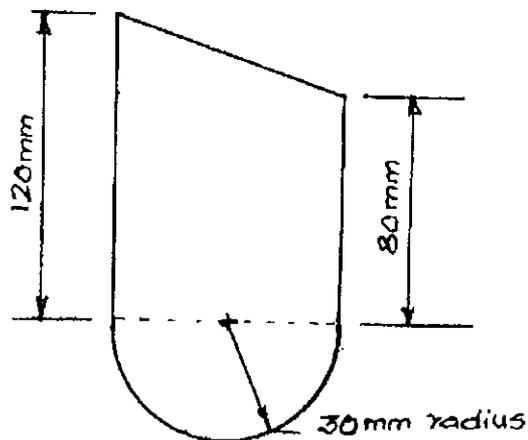

Fig. 13 (a)

Or

(b) From first principles derive the expressions for the mass moment of inertia of

(i) a thin circular plate about its polar axis and

(ii) a sphere.

14. (a) A body of weight 100 N is placed on a 30° inclined plane. Determine the minimum force to be applied on the block and parallel to the plane to

   (i) just move the body up the plane and

   (ii) just prevent the body from sliding down the inclined plane. Take the coefficient of friction as 0.2.

Or

   (b) A body A of mass 5 kg moving with an unknown speed hits centrally a stationary body B of mass 10 kg. The speed of the body B after impact is 8 m/sec. If the coefficient of restitution is 0.6, find the velocity of A before and after impact. Also find the kinetic energy lost during impact.

15. (a) The end A of the rod AB 1.8 m long shown in Fig. 15(a) moves with a velocity of 6 m/sec towards left. When $\theta = 25°$, determine the angular velocity of the rod and the velocity of the end B.
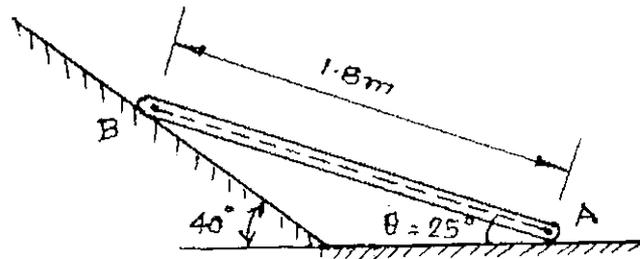

Fig. 15(a)

Or

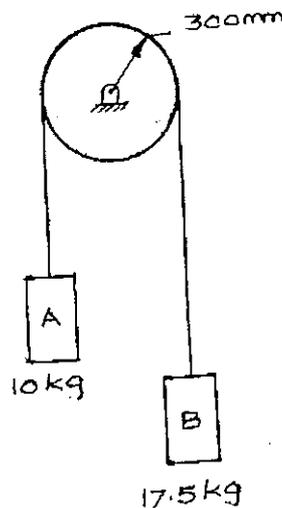   (b) What is the angular acceleration of the pulley shown in Fig. 15(b) if its mass moment of inertia is 20 kgm².

Fig. 15(b)

4   C 3374