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Question Paper Code : P 1409

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

Third Semester

Mechanical Engineering

ME 1206 — APPLIED ENGINEERING MECHANICS

(Common to Aeronautical Engineering/Automobile Engineering/Mechatronics Engineering/Marine Engineering/Metallurgical Engineering and Production Engineering)

(Regulation 2004)

Time : Three hours　　　　　　　　　　　　　　　　Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Two forces 50 kN and 10 kN act at a point 'O'. The included angle between them is 60°. Find the magnitude and the direction of the resultant.

2. State and prove Varignon's theorem.

3. State the general conditions of equilibrium of a rigid body in two dimensions.

4. Distinguish between statically determinate and indeterminate support reactions.

5. A right-angled triangle of base 3 m and height 4 m is revolved about its vertical edge. Compute the volume of the solid generated.

6. State parallel axis theorem as applied to moment of inertia of mass.

7. A rope is wrapped two and a half times around a pulley. Find the force exerted on the free end of the rope (tight side) that is required to support a 1.5 kN weight on the other end (slack side). The radius of the pulley is 200 mm and the coefficient of friction between cylinder and the rope is 0.25.

8.   The equation of motion of a particle moving in a straight line is given by $S = 18t + 3t^2 - 2t^3$, where S is in meters and t in seconds. Find the velocity and acceleration at start. Also find time when particle reaches its maximum velocity.

9.   A pelton wheel attains its operating speed of 800 rpm within 2 seconds after it is turned on. Determine the constant angular acceleration of the pelton wheel.

10. State D' Alembert's principle.

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PART B — (5 × 16 = 80 marks)

11. (a) A force acts at the origin of a coordinate system in a direction defined by the angles $\theta_x = 70.9°$ and $\theta_y = 144.9°$. Knowing that the z - component of the force is -52.0 N, determine,

     (i)   The angle θ_z (4)

     (ii) The magnitude of the force 'F'   (4)

     (iii) The component of the force F along x and y directions   (4)

     (iv) The component of the force F on a line through the origin and the point (1,- 2, 1).   (4)

Or

     (b) A couple of magnitude M = 300 Nm and three forces shown in Figure 1. are applied to an angle bracket.
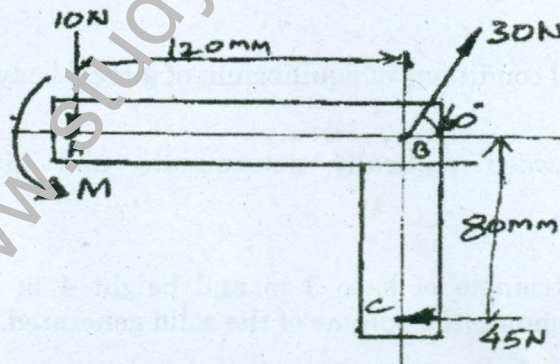

Fig. 1

     (i)   Find the resultant of the system of forces.   (4)

     (ii) Locate the points where the line of action of the resultant intersects Line AB and Line BC.   (12)

12. (a) A precast concrete post weighing 50 kg and of length 6 m is raised for placing it in position by pulling the rope attached to it as shown in Figure 2. Determine the tension in the rope and the reaction at A.
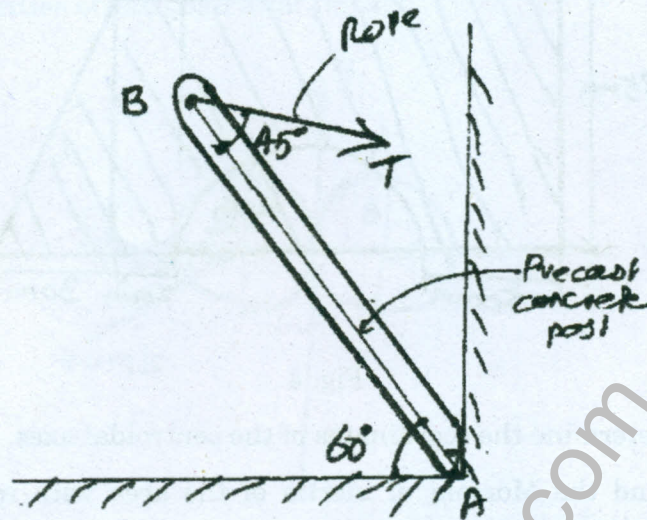

Fig 2.

Or

(b) The 6 m post shown in Figure 3. is acted upon by a 30 kN force at Q and is held by a ball and socket at P. Two cables AB and AC are connected as shown. Determine the tension in each cable and the reaction at support P.
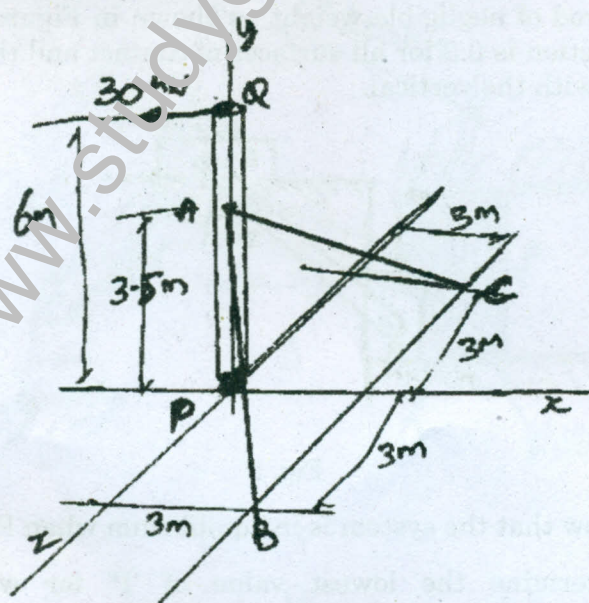

Fig. 3

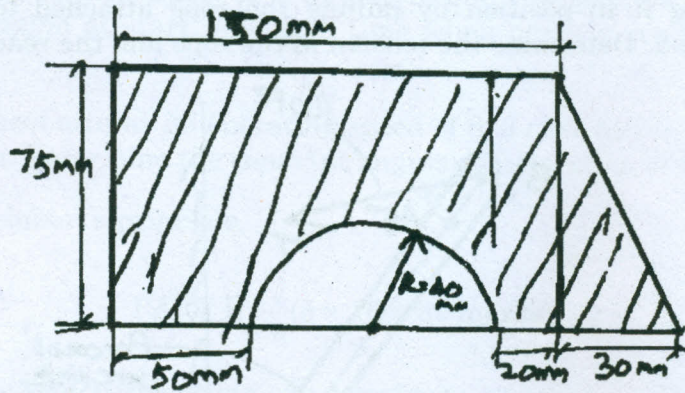13. (a) For the shaded area shown in Figure 4.

Fig. 4

(i) Determine the coordinates of the centroidal axes. (6)

(ii) Find the Moment of inertia of the area with respect to both the centroidal axes. (10)

Or

(b) Determine the mass moment of inertia of the following :

(i) A solid cylinder of radius 'R' and length 'L'. Let density of the material be ρ. (8)

(ii) A rectangular prism of length 'L'. width 'b', depth 'd' and density ρ. (8)

14. (a) Two blocks A and B each having a weight of 10 N are connected by a slender rod of negligible weight as shown in Figure 5. The coefficient of static friction is 0.3 for all surfaces of contact and the rod forms an angle $\theta = 30°$ with the vertical.
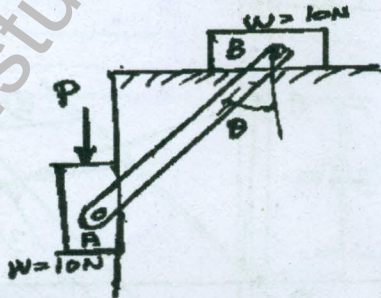

Fig. 5

(i) Show that the system is in equilibrium when P = 0 (6)

(ii) Determine the lowest value of 'P' for which equilibrium is maintained. (10)

Or

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(b) The magnitude and direction of the velocities of two identical smooth balls before they strike each other are shown in Figure 6. Assuming the coefficient of restitution, e = 0.6, determine the magnitude and direction of velocities of each ball after impact.
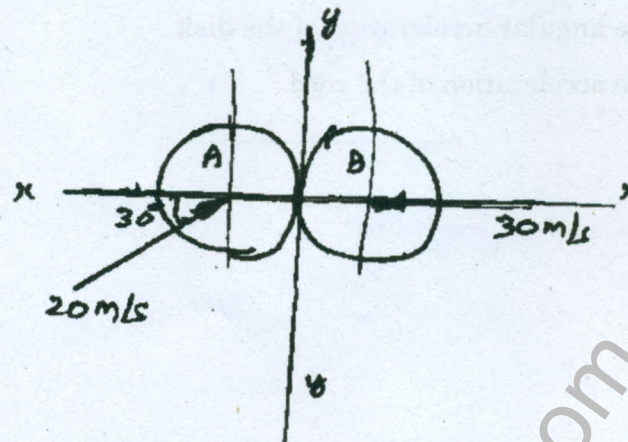

Fig. 6

15. (a) In the engine system shown in Figure 7, the crank AB has a constant angular velocity of 2000 rpm. For the crank position indicated determine,

   (i) The angular velocity of the connecting rod AB (8)

   (ii) The acceleration of the piston P (8)

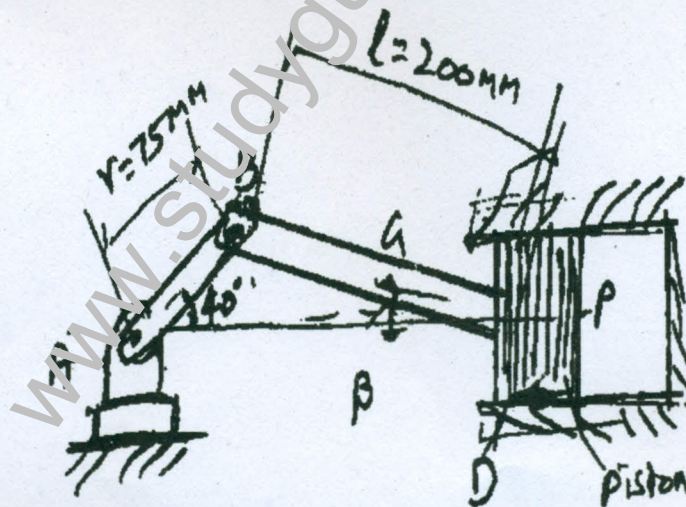Fig. 7

Or

(b) A cord is wrapped around a homogenous disk of radius r = 0.6 m and mass m = 20 kg. If the cord is pulled upward with a force 'T' of magnitude 200 N, determine,

(i) The acceleration of the center of the disk (5)

(ii) The angular acceleration of the disk (5)

(iii) The acceleration of the cord (6)

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