

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 1118

Roll No.

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**B. Tech.**

(SEM. I) ODD SEMESTER THEORY  
EXAMINATION 2013-14  
**ENGG. MECHANICS**

Time : 3 Hours

Total Marks : 100

- Note :—(i) Attempt all the questions.  
(ii) Assume missing data suitably, if any.

**SECTION—A**

1. You are required to answer all the parts : (10×2=20)
- State and explain law of forces.
  - State Varignon's theorem.
  - What is perfect truss ? How it differ from an imperfect truss ?
  - Write down the statement of parallel axis theorem with figure.
  - State D'Alembert's principle.
  - What do you understand by relative velocity ?
  - Friction is desirable and undesirable both. Explain.
  - What is the equilibrium ? Write the equations of equilibrium for non concurrent force system.
  - Explain principle of transmissibility of forces.
  - A body of mass 100 kg is moving relative to a rough surface. Calculate the frictional resistance offered by the surface if  $\mu_s = 0.3$  and  $\mu_k = 0.2$ .

SECTION—B

2. Answer any three parts of the following : (3×10=30)

- (a) Find the unknown force  $F_3$  in the system of forces as shown in figure 1, if  $F_1 = 100\text{ N}$ ,  $F_2 = 150\text{ N}$  and the resultant of these three forces ( $F_1$ ,  $F_2$  and  $F_3$ ) is  $200\text{ N}$ .

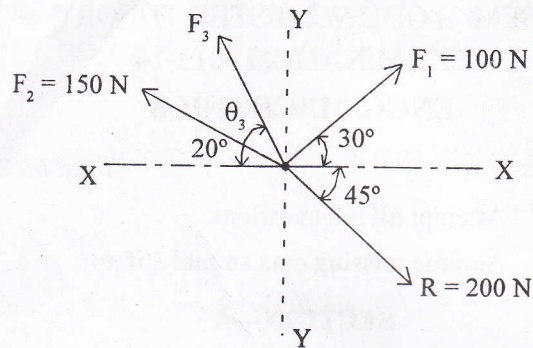


Fig. 1

- (b) An equilateral triangular plate of sides  $200\text{ mm}$  is acted upon by four forces as shown in figure-2. Determine the magnitude and direction of the resultant of this system of forces and its position from A.

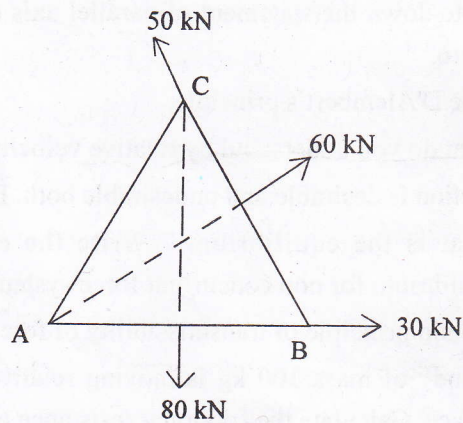


Fig. 2

- (c) For the shaded area shown in figure-3, find the moment of inertia about the line AB.

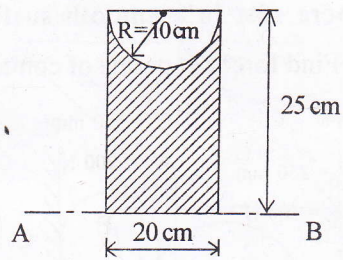


Fig. 3

- (d) The equation of motion of a particle moving in a straight line is given by :

$$S = 18t + 3t^2 - 2t^3$$

where  $S$  is the total distance covered from the starting point in meters at the end of  $t$  seconds. Find out :

- (i) velocity and acceleration at the start
  - (ii) the time when the particle reaches its maximum velocity.
- (e) Two bodies A and B are connected by a thread and move along a rough horizontal plane ( $\mu = 0.3$ ) under the action of a force 400 N applied to body B as shown in figure-4. Find the acceleration of the two bodies and tension in the thread using D'Alembert's principle.

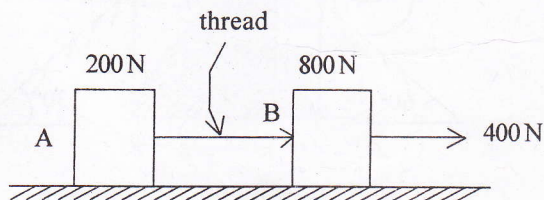


Fig. 4

SECTION—C

3. Attempt all the questions : (5×10=50)

(a) Two spheres rest in a smooth surface as shown in figure-5. Find forces at points of contacts.

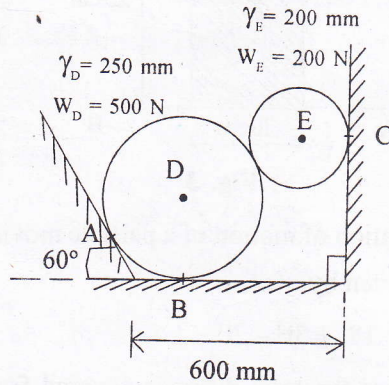


Fig. 5

OR

Two rollers of weights  $A = 60\text{ N}$  and  $B = 100\text{ N}$  are connected by a rod in figure-6. Find the tension induced in the rod and the angle that make with the horizontal when the system is in equilibrium.

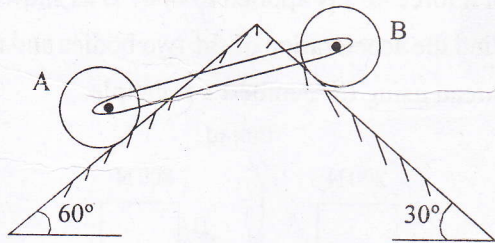


Fig. 6

- (b) Determine the forces in each member of the truss as shown in figure-7.

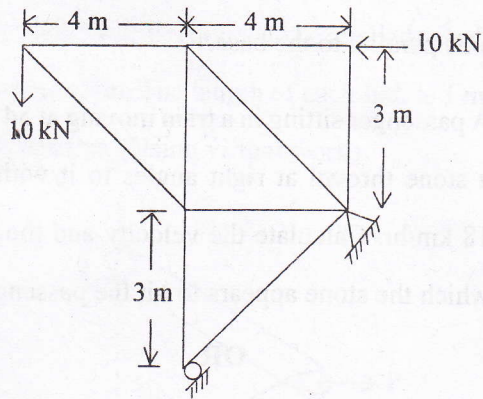


Fig. 7

OR

For a ladder of length 4 m, rest against a vertical wall making an angle of  $45^\circ$ . Determine the minimum horizontal force applied at A to prevent slipping.  $\mu = 0.2$  between the wall and ladder, and  $\mu = 0.3$  for floor and the ladder. The ladder weight 200 N and a man weight 600 N is at 3 m from A. (Point A is on floor)

- (c) Find the centroid of the shaded area with respect to x and y axis by direct integration method. (Ref. figure-8)

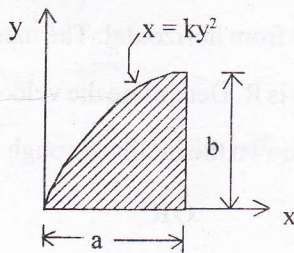


Fig. 8

OR

Find the mass M.I. (Moment of inertia) of a rectangular plate of mass  $m$ , base  $b$  and height  $h$  about the centroidal axis parallel to the base.

- (d) A passenger sitting in a train moving at 54 km/hr is hit by a stone thrown at right angles to it with a velocity of 18 km/hr. Calculate the velocity and the direction with which the stone appears to hit the passenger.

**OR**

A flywheel had an initial angular speed of 3000 rev/min in clockwise direction, when a constant turning moment was applied to the wheel, it got subjected to a uniform anticlockwise angular acceleration of 3 rev/sec<sup>2</sup>.

Determine the angular velocity of the wheel after 20 seconds, and the total number of revolutions made during this period.

- (e) A solid cylinder is released from rest on an inclined plane at an angle  $\theta$  from horizontal. The mass of the cylinder is  $m$  and radius is  $R$ . Determine the velocity of cylinder after it has rolled down the incline through a distance  $S$ .

**OR**

In the mechanism shown in figure-9, determine the horizontal force  $P$  required to hold the system in equilibrium. The length of each link is 1 m and weight is  $W$  newton. (Using virtual work)

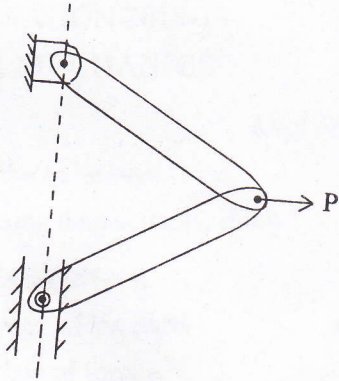


Fig. 9