

Code : 011101

B.Tech 1st Semester Exam., 2017

ENGINEERING MECHANICS

Time : 3 hours

Full Marks : 70

Instructions :

- (i) All questions carry equal marks.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Choose the correct alternative (any seven) :

- (a) A force acting on a body may
- (i) change its motion
  - (ii) balance the other forces acting on it
  - (iii) retard its motion
  - (iv) All of the above

(b) In a truss structure, load is applied

- (i) in the middle of the member
- (ii) anywhere on the member
- (iii) at the joints of the member
- (iv) None of the above

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(c) The angle of inclination of the plane at which the body begins to move down the plane, is called

- (i) angle of friction
- (ii) angle of repose
- (iii) angle of projection
- (iv) None of the above

(d) The unit of moment of inertia of an area is

- (i) ~~kg-m<sup>2</sup>~~
- (ii) m<sup>4</sup>
- (iii) kg/m<sup>2</sup>
- (iv) m<sup>3</sup>

(e) The term 'centroid' is

- (i) ~~the same as centre of gravity~~
- (ii) the point of suspension
- (iii) the point of application of the resultant of all the forces tending to cause a body to rotate about a certain axis
- (iv) None of the above

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( Continued )

- (f) Virtual work is the product of
- (i) displacement and force
  - (ii) virtual displacement and force
  - (iii) displacement and virtual force
  - (iv) None of the above
- (g) The magnitude of coefficient of restitution for perfectly elastic impact is
- (i) zero
  - (ii) one
  - (iii) negative
  - (iv) None of the above
- (h) Euler's equation is inapplicable
- (i) at a point fixed in space
  - (ii) at mass centre of the body
  - (iii) at a fixed point about which the body may rotate
  - (iv) None of the above

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- (i) The relationship  $v = u \pm at$  holds well for, a particle having
- (i) constant velocity
  - (ii) variable acceleration or deceleration
  - (iii) constant acceleration or deceleration
  - (iv) None of the above
- (j) When trying to turn a key into a lock, which of the following is applied?
- (i) Coplanar forces
  - (ii) Force and moment
  - (iii) Non-coplanar forces
  - (iv) Couple

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2. A ball is projected on the horizontal plane at an angle of  $45^\circ$  with initial velocity 120 m/s. Determine the (a) horizontal range, (b) maximum height attained by the particle, (c) total time of flight and (d) time taken to reach the highest position of its path.

3. Each of the two uniform hinged bars has mass  $m$  and length  $l$  is supported and loaded as shown in Fig. 1. For a given force  $P$ , determine the angle  $\theta$  for the equilibrium.

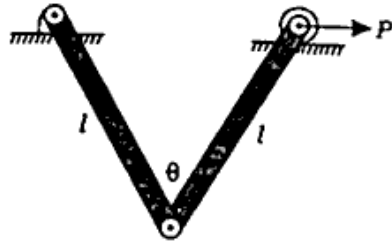


Fig. 1

4. Find out the expression for moment required to cause downward impending motion of square threaded screw and discuss the effect of friction on the screw motion.

5. Compute the force in each member of the loaded truss shown in Fig. 2.

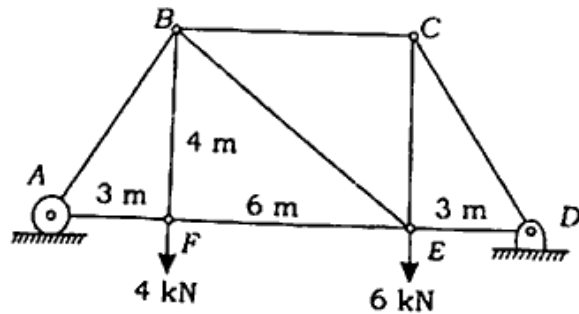


Fig. 2

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6. The 20-kg homogeneous smooth sphere rests on the two inclines as shown in Fig. 3. Determine the contact reactions at A and B.

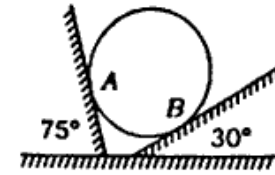


Fig. 3

7. Force  $P$  is applied to the 200 N crate (in Fig. 4), which is stationary before the force is applied. Determine the magnitude and direction of the frictional force  $F$  exerted by the horizontal surface on the crate, when (a)  $P = 85$  N and (b)  $P = 120$  N. The coefficient of friction,  $\mu_s = 0.50$ ,  $\mu_k = 0.40$ .

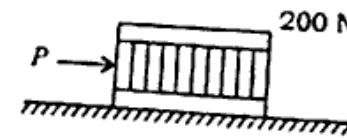


Fig. 4

8. Determine the moment of inertia of shaded area about  $x$ - and  $y$ -axes shown in Fig. 5.

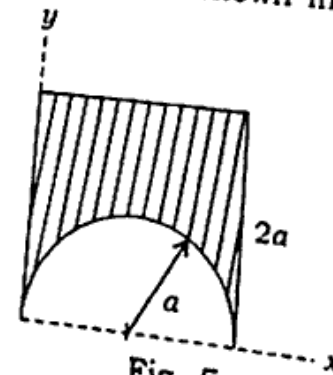


Fig. 5

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9. Explain the following :

(a) D'Alembert's principle

(b) Parallel axis theorem

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