



Name : .....  
Roll No. : .....  
Invigilator's Signature : .....

**CS/B.TECH(NEW)/SEM-1/ME-101/2012**

**2012**

**ENGINEERING MECHANICS**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct answers of the following :  $10 \times 1 = 10$ 
  - i) For stable equilibrium the potential energy will be
    - a) maximum
    - b) minimum
    - c) zero
    - d) none of these.
  - ii) Lami's theorem is applicable for
    - a) three collinear forces
    - b) three coplanar and concurrent forces
    - c) three parallel forces
    - d) all of these.
  - iii)  $\bar{A} \cdot (\bar{A} \times \bar{B})$  is equal to (when,  $\bar{A}$  and  $\bar{B}$  are vector)
    - a) zero
    - b)  $A^2B$
    - c) 1
    - d) none of these.





viii) If a momentum of a body is doubled, its kinetic energy will,

- a) increase by two times
- b) increase by four times
- c) reduced by four times.
- d) reduced by two times.

ix) If the velocity of projection is  $u$  m/sec and the angle of inclination is  $\alpha^\circ$ , the maximum height of the projectile on a horizontal plane is,

- a)  $\frac{u^2 \cos^2 \alpha}{2g}$
- b)  $\frac{u^2 \sin^2 \alpha}{2g}$
- c)  $\frac{u^2 \tan^2 \alpha}{2g}$
- d)  $\frac{u \sin \alpha}{2g}$ .

x) Material having same elastic properties in all directions are called

- a) ideal material
- b) uniform material
- c) elastic material
- d) isotropic material.



**GROUP – B**

**( Short Answer Type Questions )**

Answer any *three* of the following.  $3 \times 5 = 15$

2. A circular roller of weight 100 N and radius 10 cm hangs by a ties rod  $AB = 20$  cm and rests against a smooth vertical wall at  $C$  as shown in the Figure 1. Determine the force  $F$  in the rod and normal reaction at  $C$ .

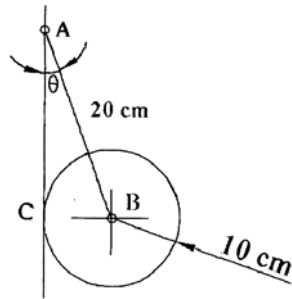


Figure : 1

3. Referring to Figure 2, where radius of roller is  $r = 12$  cm,  $h = 6$  cm and weight of the roller is 5000 N. find the magnitude of  $P$  required to start the roller over curb.

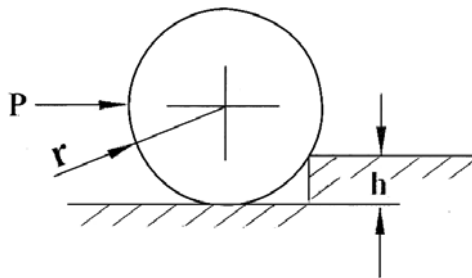


Figure : 2



4. A block of weight 1600 N is in contact with a plane inclined at  $30^\circ$  to the horizontal. A force ' $p$ ' parallel to the plane is applied on the body as shown in Figure 3. The coefficient of static friction between the contact surfaces is 0.20. Find the value of  $P$  to just cause the motion to impending up the plane.

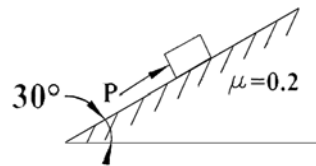


Figure : 3

5. State and explain D' Alembert's principle. What is the advantage of using the principle ? How does it differ from Newton's second law of motion ?
6. With a neat sketch explain stress-strain diagram for a ductile material.

### GROUP - C

#### ( Long Answer Type Questions )

Answer any *three* of the following.  $3 \times 15 = 45$

7. a) Two inclined rollers, each of weight 100 kgf are supported by an inclined plane and a vertical wall as shown in the Figure 4 below. Assuming smooth surfaces. find the reaction induced at the point A, B and C. 7

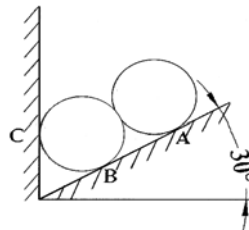


Figure : 4



- b) In the Figure 5 shown, find the minimum value of  $P$  applied on the lower block that will keep the system in equilibrium. Given coefficient of friction between lower block and floor = 0.25, between the upper block and the vertical wall = 0.30, between two blocks = 0.20. 8

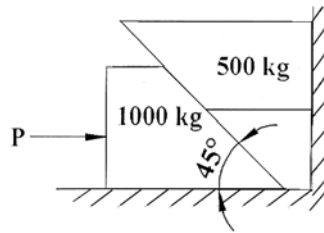


Figure : 5

8. a) Determine the forces exerted on the cylinder at  $B$  and  $C$  by the spanner wrench shown in the Figure 6. due to the vertical force of 250 N applied to the handle as shown. Neglect friction at  $B$ . 8

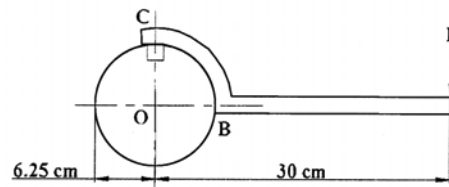


Figure : 6

- b) Determine the moment of inertia for the  $T$  section (as shown in Figure 7) with respect to a centroidal axis parallel to  $x$ -axis. 7

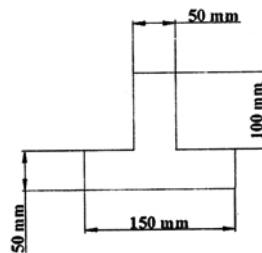


Figure : 7



9. a) A projectile is launched with an initial speed of 200 m/s at an angle  $60^\circ$  (shown in Figure 8.) with respect to horizontal. Compute the range  $R$  as measured up the incline. 7

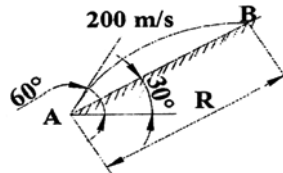


Figure : 8

- b) Find the acceleration of a falling weight  $W_1$  hanging over a pulley by a string connecting a block  $W_2$  as shown in Figure 9. the coefficient of friction between block  $W_2$  and the horizontal plane if slides, is  $\mu$ . Neglect the inertia of the pulley and friction on its axis. Where  $W_1 = 10\text{kgf}$   $W_2 = 12\text{ kgf}$ ,  $\mu = 0.5$ . 8

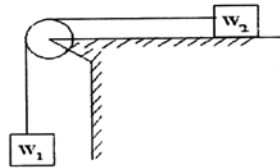


Figure 9

10. a) A system of weight and pulleys is arranged in a vertical plane as shown in Figure 10. Neglecting friction and the inertia of the pulleys. Find the acceleration of each weight if their magnitude are in the ratio  $W_a : W_b : W_c = 6:5:1$  10

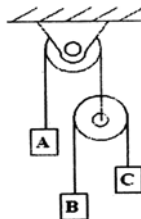


Figure 10

- b) State and prove Lami's theorem. 5



11. a) Locate the centroid of the quadrant of a circle of radius 'r', shown in the Figure 11.

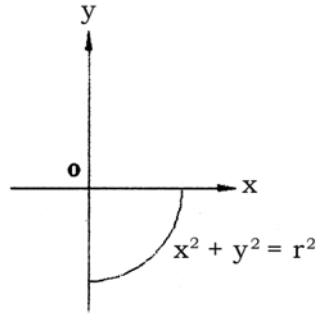


Figure : 11

- b) In Figure 12, a load of 5000 kg hang from a rod having different cross-section at the position 'a', 'b' and 'c'. The cross-sections are 500 mm<sup>2</sup>, 200 mm<sup>2</sup> and 100 mm<sup>2</sup> at the position 'a', 'b' and 'c' respectively; find the stress in each section. If the stress is not to exceed 700 N/mm<sup>2</sup>, what is the safe load ?

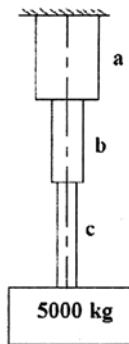


Figure : 12