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**B. Tech**  
**BENG 1101**

**Second Semester Examination – 2007**

**MECHANICS**

**Full Marks – 70**

**Time – 3 Hours**

*Answer Question No. 1 which is compulsory  
and any five from the rest.*

*The figures in the right-hand margin  
indicate marks.*

1. Answer the following questions :  $2 \times 10$
- (a) Distinguish between truss and frame.
  - (b) Define a force system consisting of three forces will be in equilibrium.

**P.T.O.**

- (c) A force of 10 kN acting downward is to be resolved into a force of same magnitude and a couple at a point 100 m away from the force towards right. Determine the force and the couple at the mentioned point.
- (d) Explain cone of friction.
- (e) How can a system of parallel forces be in equilibrium ?
- (f) What is the second moment of area of a semicircular area of diameter about its diameter ?
- (g) Define the middle plane of a truss.
- (h) Define equation of dynamic equilibrium.
- (i) A bar always remaining on a vertical plane is in motion with it's one end on the vertical wall and the other end on the horizontal floor. What path will the mid point of the bar trace during the motion ?

(j) A 10N weight is suspended by a helical spring having constant  $k = 500 \text{ N/m}$ . Neglecting the mass of the spring find the time period for small amplitude of vertical vibration.

2. (a) What force  $Q$  combined with a vertical pull  $P = 10 \text{ N}$  will give a horizontal resultant  $R = 15 \text{ N}$ . 5

(b) A weight  $Q$  is suspended from a small ring  $C$ , supported by two cords  $AC$  and  $BC$  as shown in figure 2(b). The cord  $AC$  is fastened at  $A$  while the cord  $BC$  passes over a frictionless pulley at  $B$  and carries the weight  $P$ . If  $P = 20 \text{ N}$ ,  $Q = 30 \text{ N}$  and  $\alpha = 60^\circ$ , find the value of the angle  $\beta$ . 5

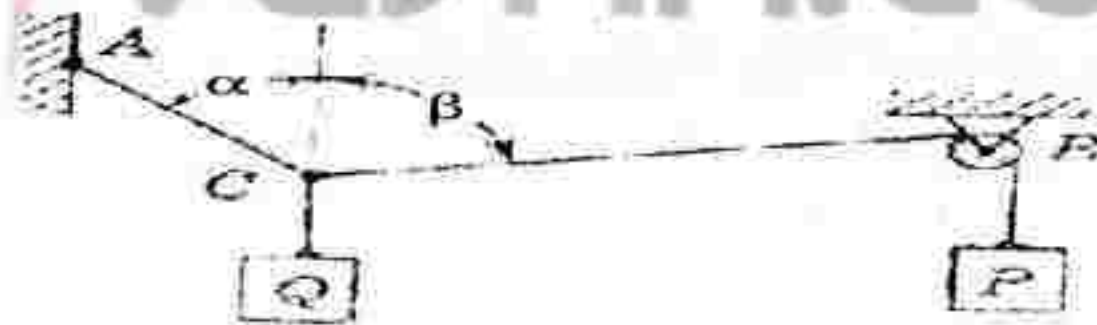


Figure 2(b)

3. Find the axial force in the bars of the truss shown in figure 3 using method of joints as well as method of sections. The lengths of each bar are equal and is 50 cm. 10

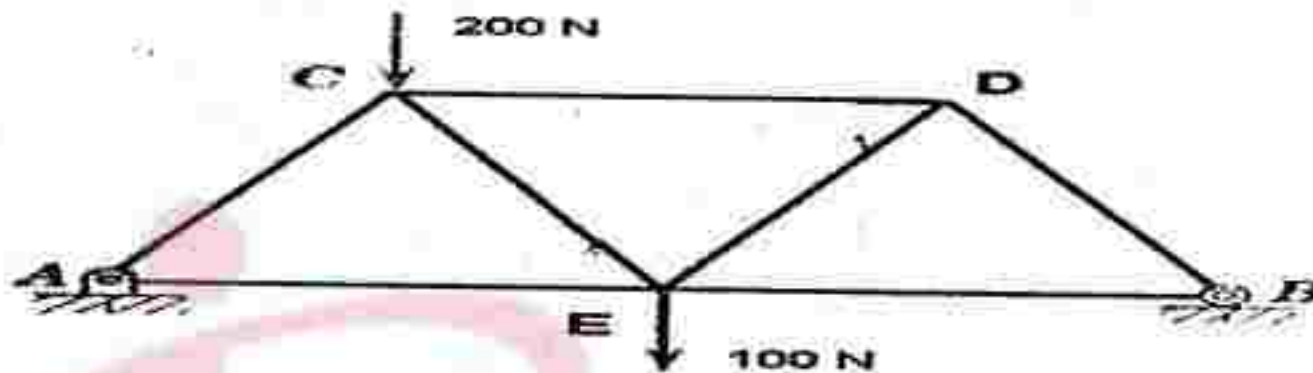


Figure 3

4. (a) Referring figure 4(a) locate the centroid of the length of the mean centre line of the stirrup with the dimensions shown. 3

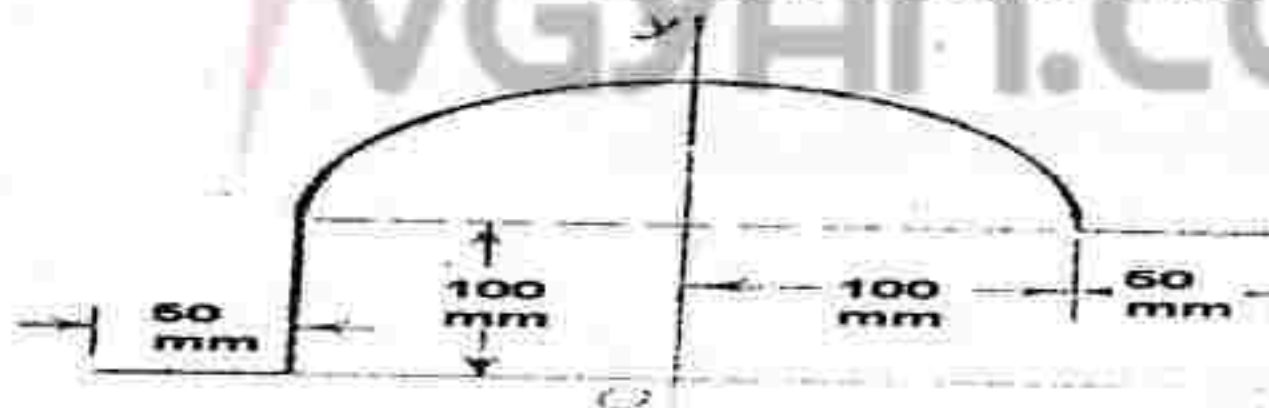


Figure 4(a)

- (b) Calculate the moment of inertia of the shaded area shown in figure 4(b) with respect to y-axis. 7

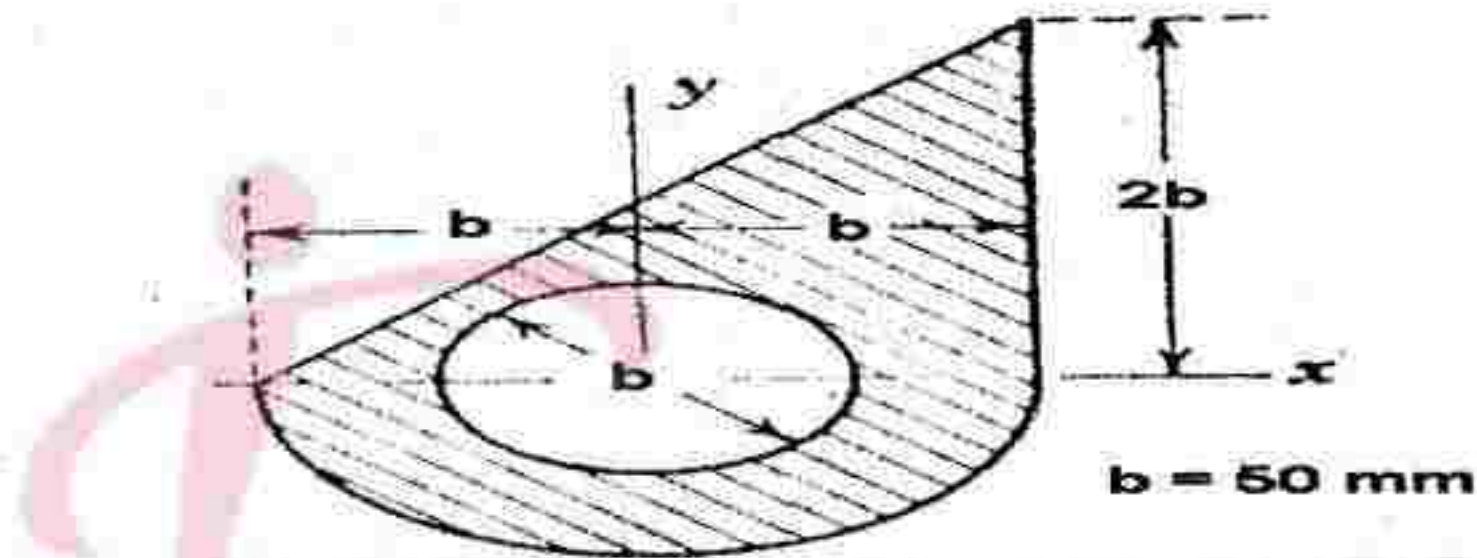


Figure 4(b)

5. (a) Two blocks of weight  $W_1 = W_2 = 100 \text{ N}$  rest on a rough inclined plane and are connected by a short piece of string as shown in figure 5(a). If the coefficient of friction are  $\mu_1 = 0.25$  and  $\mu_2 = 0.35$

respectively, find the angle of inclination of the plane for which sliding will impend. 5

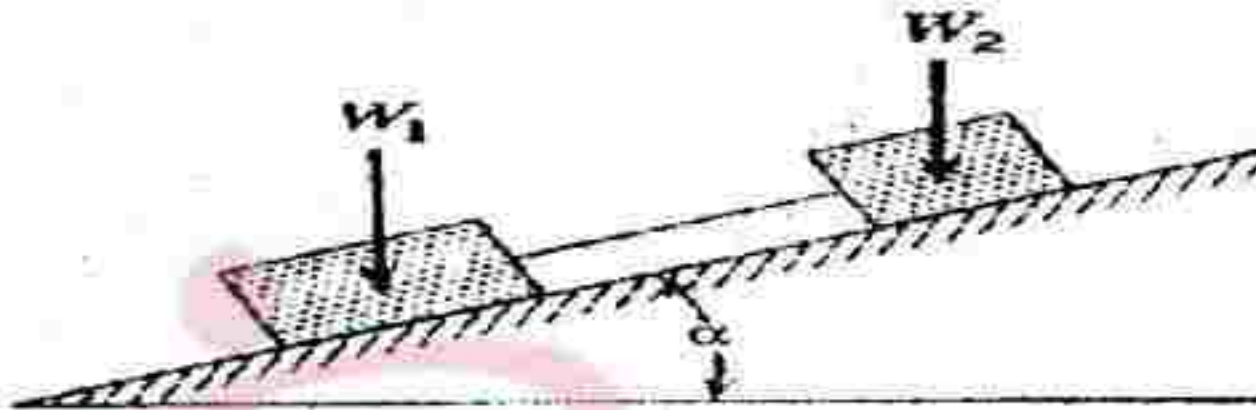


Figure 5(a)

- (b) Two identical prismatic bars AB and CD are welded together in the form of a rigid T and suspended in a vertical plane as shown in figure 5(b). Calculate the angle  $\alpha$  that the bar CD will make with the vertical when a vertical load  $P = 50$  is applied at B. The weight of each bar is  $Q = 20$  N. 5

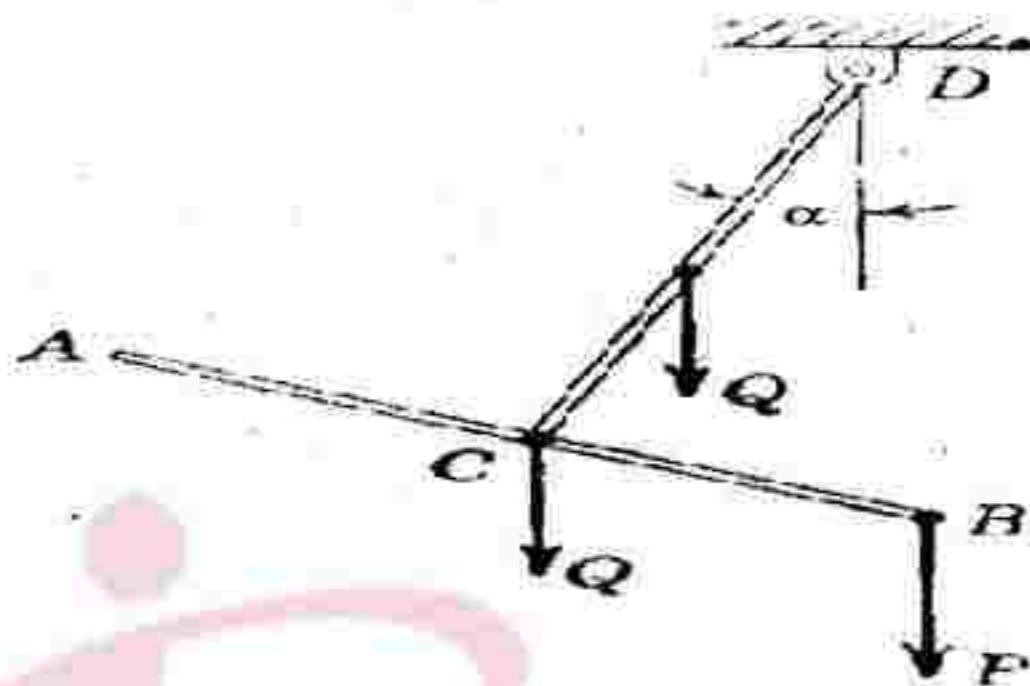


Figure 5(b)

6. (a) A man of height 1.7 m walks away from a lamp hanging at a height of 7 m above the ground level. If the man walks with a speed of 2 m/s, determine the speed of the tip of the man's shadow. 5
- (b) A particle freely falling under the action of gravity passes two points 10 m apart vertically in 0.2 s from what height above the higher point did it start to fall? 5

7. The displacement of a particle (in meter) is given by  $x = t^3 - 3t^2 - 9t + 10$ , where  $t$  is in second. Find the following : 10

- (i) Time at which the velocity of the particle is zero
- (ii) The position and the distance traveled by the particle at that time
- (iii) The acceleration of the particle at that time
- (iv) The distance traveled by the particle from  $t = 2\text{ s}$  to  $t = 4\text{ s}$ .

8. (a) A projectile is projected with a velocity of  $250\text{ m/s}$  at an angle of  $\alpha = 60^\circ$  to horizontal. Find the velocity and direction of motion of the particle after  $20\text{ s}$ . 3

(b) A string is wound around a pulley  $400\text{ mm}$  in diameter. One of its ends is fixed to the pulley while the other is fixed to a weight hanging freely. The weight describes a distance of  $8\text{ m}$  after starting from rest in  $4\text{ s}$ . Find the angular velocity of the pulley. Also determine the total distance moved by weight to make the pulley rotate at  $300\text{ rpm}$ . 7