

Code No: 131AE

**R16**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B.Tech I Year I Semester Examinations, December - 2016**

**ENGINEERING MECHANICS**

**(Common to CE, EEE, ME, ECE, CSE, EIE, IT, MCT, MMT, MIE, CEE, MSNT)**

**Time: 3 hours**

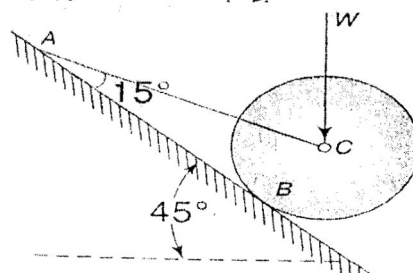
**Max. Marks: 75**

**Note:** This question paper contains two parts A and B.  
Part A is compulsory which carries 25 marks. Answer all questions in Part A.  
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

**PART - A**

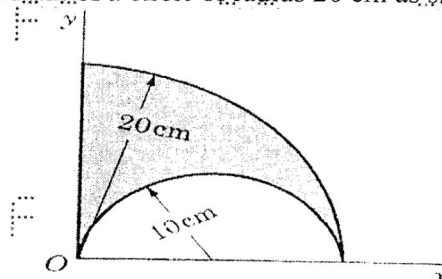
**(25 Marks)**

- 1.a) A force of 500 N inclined at angles of  $60^\circ$ ,  $45^\circ$  and  $120^\circ$  respectively with X, Y and Z axis. Write the force in vector form.
- b) Using Lami's equation, determine the tension in the string AC and reaction at point B, if the weight of the sphere is 4450 N for the figure 1. [2]  
[3]



**Figure: 1**

- c) Define the term "lead" and "pitch" of a screw. [2]
- d) A square threaded screw jack 75 mm mean diameter and 15 mm pitch is required to lift a load of 500 N. The coefficient of friction is 0.075. If lever arm is of 400 mm length, determine if the jack is self-locking or not. [3]
- e) The radius of gyration of a rectangular channel is 19 mm and its area is  $3500 \text{ mm}^2$ . Determine the moment of inertia of the channel. [2]
- f) Find the coordinates of the centroid of the area obtained after removing a semicircle of radius 10 cm from a quadrant of a circle of radius 20 cm as shown in the figure 2. [3]



**Figure: 2**

- g) State the principle of virtual work. [2]
- h) Determine the mass moment of inertia of a uniform rod of length L about the axis normal to its centroid. [3]
- i) State the principle of conservation of momentum. [2]
- j) With a sketch explain the difference between simple pendulum and compound pendulum. [3]

PART-B

(50 Marks)

- 2.a) The resultant of two forces one of which is 3 times the other is 300 N. When the direction of smaller force is reversed, the resultant is 200 N. Determine the two forces and the angle between them.
- b) A 12 m bar of negligible weight rests in a horizontal position on the smooth inclines as shown in the figure 3. Compute the distance  $x$  at which load  $T=100$  N should be placed from point B to keep the bar horizontal [4+6]

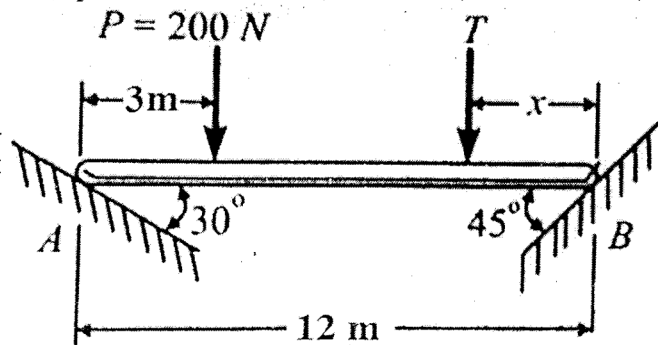


Figure: 3

OR

3. A block of 50 kg mass is suspended by two ropes attached to the wall at points A and B as shown in the figure 4. The block is held away from the wall by a horizontal strut CD. Determine the tensions in the two portions of the rope and the force in the strut. The coordinates of the points A, B, C and D are  $(-4, 3, 0)$ ,  $(3, 3, 0)$ ,  $(0, 0, 0)$  and  $(0, 0, 1)$  respectively. [10]

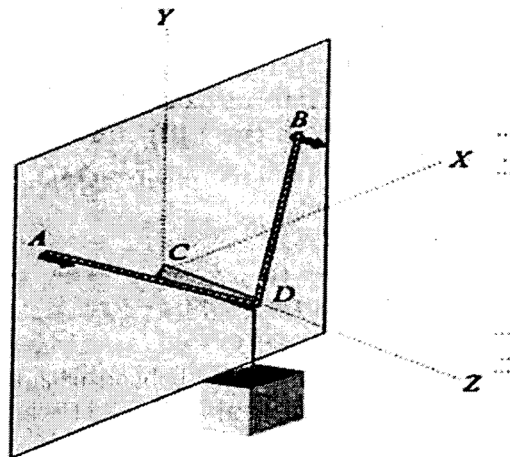


Figure: 4

4. A 7 m long ladder rests against a vertical wall, with which it makes an angle of  $45^\circ$  and it is on a floor. If a man, whose weight is one half of that of the ladder, climbs it, at what distance along the ladder will he be when the ladder is about to slip? The coefficient of friction between the ladder and the wall is  $1/3$  and coefficient of friction between the ladder and the floor is  $1/2$ . [10]

OR

5. A wedge B of negligible weight is to be used to move a block of weight 2000 N as shown in the figure 5. The angle of friction of all surfaces is  $20^\circ$ . Determine the force P required to be applied. [10]

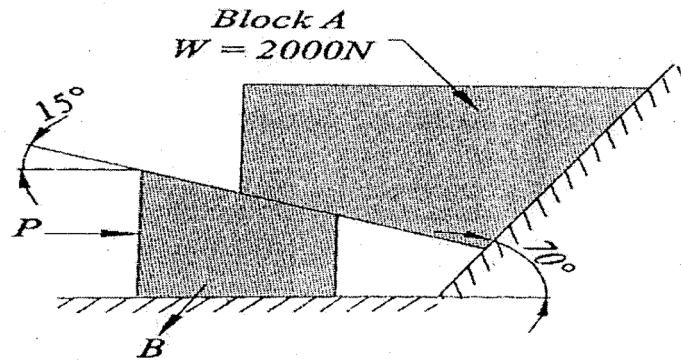


Figure: 5

- 6.a) Locate the centroid of the shaded area enclosed by the curve  $y^2 = ax$  and the straight line shown in the figure 6.

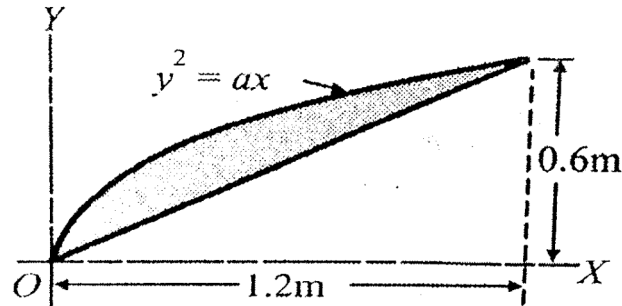


Figure: 6

- b) Find the coordinates of the centroid of the area left after removing a square area from the plate as shown in the figure 7. [5+5]

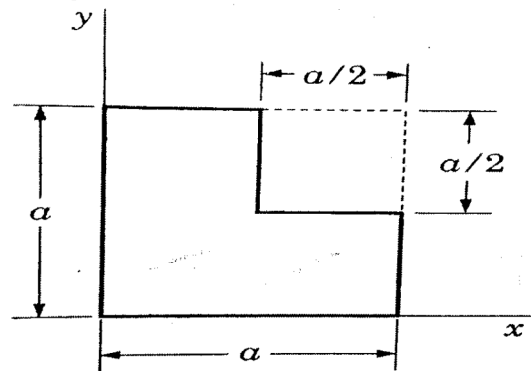


Figure: 7

OR

- 7.a) A circular hole of diameter 12 m is punched out from a circular plate of radius 12 m as shown in the figure 8. Find the moment of inertia of the shaded area about the centroidal x-axis and y-axis.

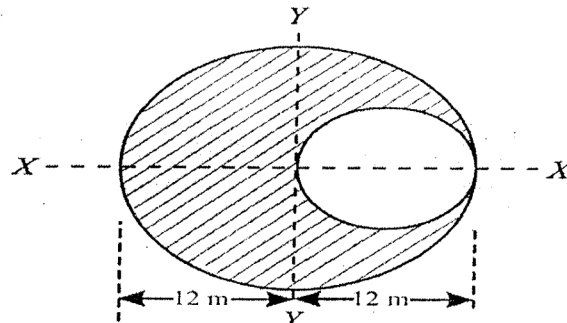


Figure: 8

- b) Determine the product of inertia for the given figure 9. All dimensions are in mm. [5+5]

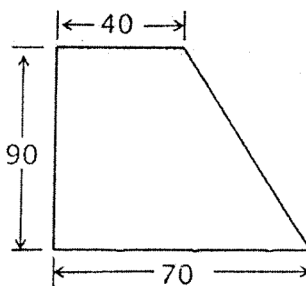


Figure: 9

- 8.a) Determine the mass moment of inertia of a rectangular plate of size "a" × "b" and thickness "t" about its centroidal axes.  
b) Find the mass moment of inertia of the solid cone of height 'h' and base radius 'R' about its axis of rotation. [5+5]

OR

- 9.a) Explain the term "virtual displacement" with an example.  
b) How can you apply principle of virtual work for investigating the configuration of equilibrium of body? [4+6]

- 10.a) Define the terms period, cycle, amplitude and frequency of vibration.

- b) A flywheel of mass 5000 kg having radius of gyration 1 m, losses its speed from 400 rpm to 280 rpm in 2 min. Calculate  
i) Retarding torque acting on it.  
ii) Change in kinetic energy during the above period.  
iii) Change in its angular momentum during the period. [4+6]

OR

- 11.a) A 20 kN car is moving at a speed of 70 kmph when the brakes are fully applied causing all four wheels to skid. Determine the time required to stop the car on concrete road for which  $\mu = 0.75$  and on ice for which  $\mu = 0.08$ .  
b) A body performing simple harmonic motion has a velocity of 12 m/sec when displacement is 50 mm and 3 m/sec when displacement is 100 mm, the displacement being measured from the mid-point. Calculate the frequency and amplitude of the motion. What is the acceleration when the displacement is 75 mm? [4+6]

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