Code No: 131AE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech I Year I Semester Examinations, May/June - 2017
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) Define the term free body diagram and state the importance of drawing such diagram.
[2]

b) A force F = (10 i + 8 j – 5 k) N acts at point A (2, 5, 6) m. What is the moment of the force about the point B (3, 1, 4).
[3]

c) Define angle of friction and angle of repose.
[2]

d) The force required to pull a body of weight 100 N on a rough horizontal plane is 30 N. Determine the coefficient friction if the force applied is at an angle of 15^0 with the horizontal.
[3]

e) Find the centrodal coordinates of rectangular area of width w and depth d.
[2]

f) Determine the moment of inertia of an area of semi-circle of radius 2.5 cm about the centroidal x and y axes.
[3]

g) State parallel axis theorem as applied to mass moment of inertia.
[2]

h) Mention the forces which are generally omitted while applying the principle of virtual work.
[3]

i) Write the impulse-momentum equation and mention its application.
[2]

j) Show that when a particle moves with simple harmonic motion, it's time for complete oscillation is independent of the amplitude of its motion.
[3]

Part-B (50 Marks)

2.a) A bracket is constructed by attaching member ABC to wall CD with a frictionless hinge at C and a horizontal cable at A, as shown in Figure 1. A smooth cylinder of weight 1.2 kN is placed in the bracket as shown. Determine the force acting on the cylinder at contact points B and D and the tension in the cable and reactions at support C.
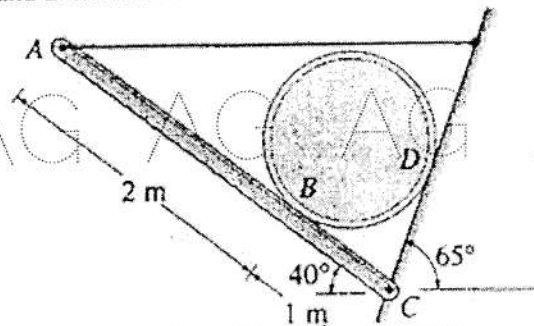

Figure: 1

b) Refer to figure 2. If the maximum allowable strength for each cable is 10.5 kN, determine the permissible weight of the homogeneous circular plate of diameter 4m.
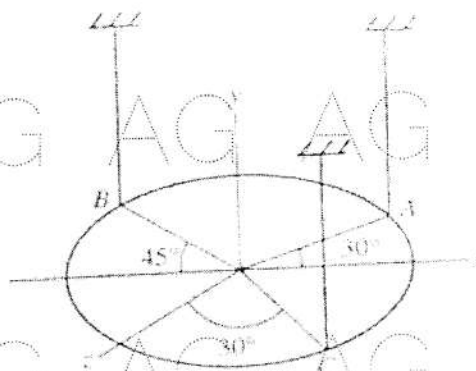
[5+5]

Figure: 2

OR

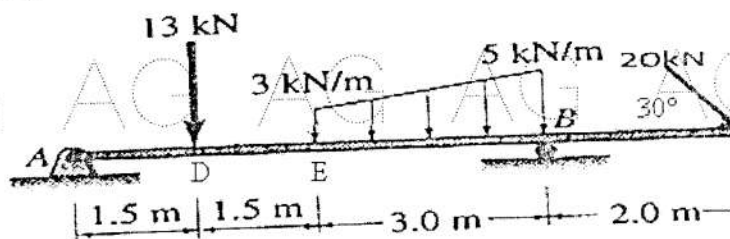3.a) Find the reactions at supports A and B for the force system acting on the beam as shown in Figure 3.

Figure: 3

b) A crate of weight W = 1.5 kN is supported as shown in figure 4, by members AO and AB and cable AC. Determine the force in the cable AC and in members AO and AB. [5+5]
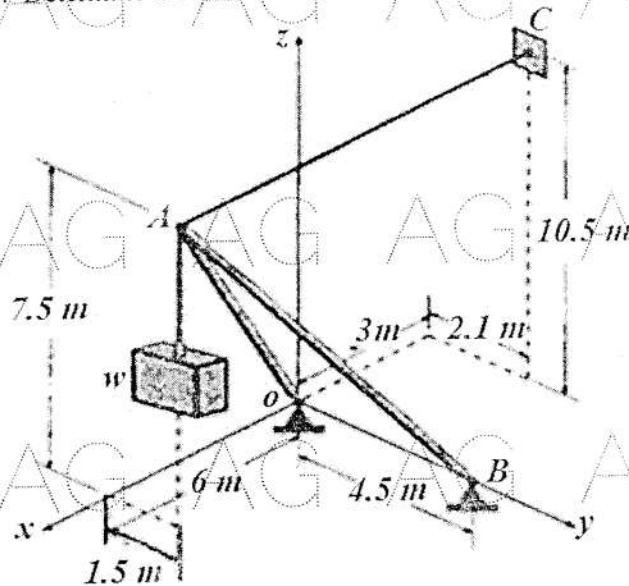

Figure: 4

4.a) As shown in figure 5, two blocks each weighing 20 kN and resting on a horizontal surface, are to be pushed apart by a 30^0 wedge. The angle of friction is 15^0 for all contact surfaces. What value of P is required to start movement of the blocks?

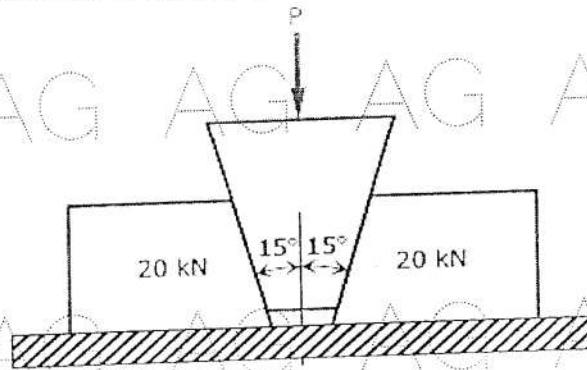20 kN 15^0 15^0 20 kN

Figure: 5

b) A screw jack has square threads of mean diameter 6 cm, of helix angle 10^0 and coefficient of friction 0.25. Determine the force that must be applied to the end of 50 cm lever to i) rise ii) lower a weight of 2500 N.   [5+5]

OR

5.a) A ladder 5 m long rests on a horizontal ground and leans against a smooth vertical wall at an angle of 70^0 with the horizontal. The weight of the ladder is 300 N. The ladder is on the verge of sliding when a man weighing 750 N stands on a rung 1.5 m along the ladder. Calculate the coefficient of friction between the ladder and the floor.

b) What should be the value of θ in figure 6 which will make the motion of 900 N block down the plane to impend? The coefficient of friction for all contact surfaces is 0.3. [5+5]
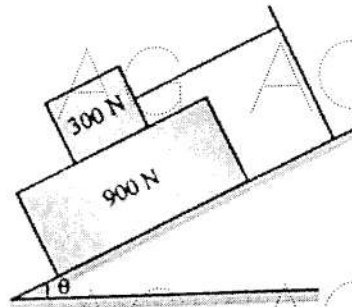

300 N

900 N

θ

Figure: 6

6.a) Find the centroidal coordinates of the area of the plane as shown in figure 7. Given a = 30 cm, b = 30 cm, c = 60 cm, d = 40 cm, and r = 20 cm.
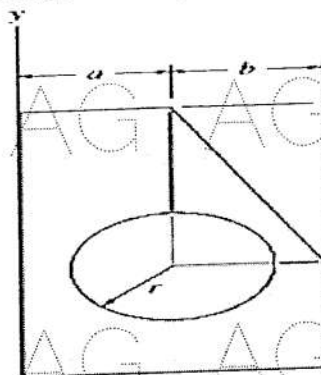

Figure: 7

b) For the shaded area as shown in figure 8, determine the Moment of Inertia of an area of plane figure about their centroidal axes. All units are in centimeters. [5+5]
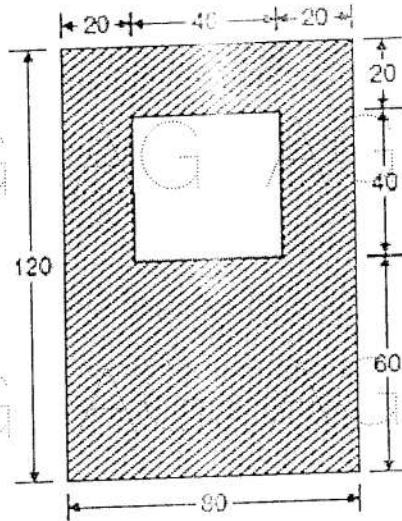

Figure: 8

OR

7.a) Determine the centroidal coordinates of shade area with respect to x and y axes as shown in figure 9.
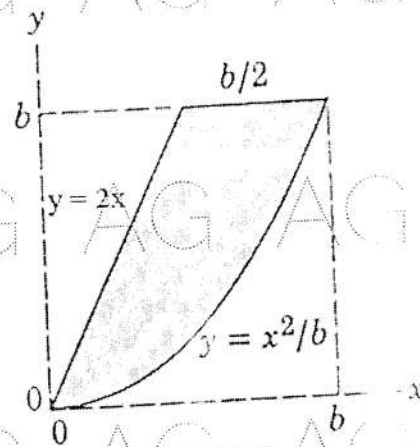

Figure: 9

b) Determine the moment of inertia an area of a triangle with a rectangular cut as shown in figure 10, about the base A-B and the centroidal axis parallel to AB. (All dimensions are in Centimetres). [5+5]
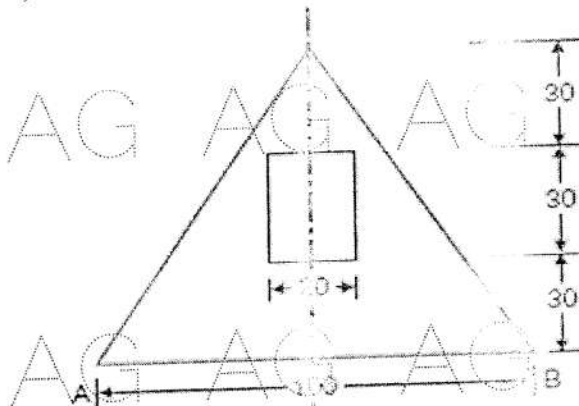

Figure: 10

8.a) Find the mass moment of inertia of a solid sphere of radius r and mass m about any axis.

b) The arrangement as shown in figure 11 is required to remain in state of equilibrium. Derive an expression for tension in the cable in terms of θ and W. Use method of virtual work. [5+5]
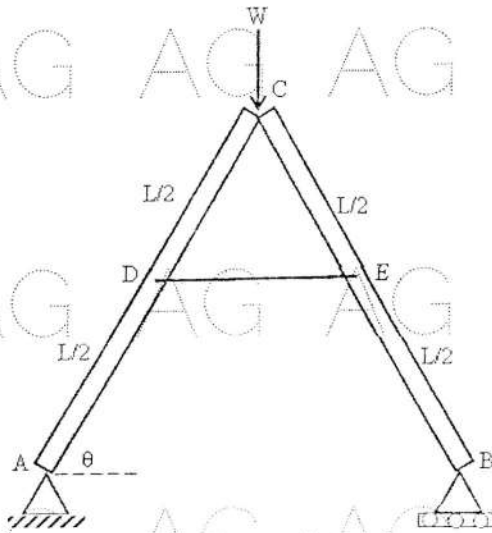

Figure: 11

OR

9.a) Find the mass moment of inertia of a solid cylinder of radius r, height h and mass m about centroidal x and y axes.

b) A uniform ladder of 200 N weights rests against a smooth vertical wall and a rough horizontal floor making an angle of 60^0 with the horizontal. Use the method of virtual work, find the frictional force between the foot of the ladder and the rough horizontal floor. [5+5]

10.a) An elevator gross weight 15 kN is moving in the upward direction, such that the displacement is given by $x = t^3 - 4t^2 + 6t + 7m$. Determine the tension in the cable supporting the elevator at t = 2 seconds.

b) A car starts from rest on a curved road of 250 m radius and accelerates at a constant tangential acceleration of 0.6 m/sec². Determine the distance and time for which that car travel before the magnitude of total acceleration attained it becomes 0.75 m/sec². [5+5]

OR

11.a) A body of mass 10 kg is suspended by a string of length 1m. It is struck by a bullet travelling horizontally with a velocity of 450 m/sec. The bullet weights 30 grams and gets embedded into the body after striking it. Determine the maximum angle through which the body swings.

b) A body moving with simple harmonic motion has amplitude of 1 m and a period of oscillation of 2 seconds. What will be its velocity and acceleration 0.4 seconds after passing an extreme position? [5+5]

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