Code No: 111AC

R13

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD
B.Tech I Year Examinations, December-2014/January-2015
ENGINEERING MECHANICS
(Common to CE, ME, CHEM, MCT, MMT, AE, AME, MIE, PTE, CEE, MSNT, AGE)

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) Two forces 15 N and 12 N are acting at a point. The angle between the forces is 60^0. Find the magnitude and direction of the resultant. [2M]

b) The coordinates of initial and terminal points of a vector are (3, 1, -2) and (4, -7, 10), Specify the force vector, evaluate its magnitude and direction cosines. [3M]

c) State laws of friction and angle of friction. [2M]

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

e) Define the term centroid and centre of gravity. [2M]

f) Derive the expression of moment of inertia of rectangular area about their centroidal axes. [3M]

g) What is meant by rectilinear and curvilinear motion? How a uniform motion differs from a uniformly accelerated motion. [2M]

h) A stone dropped into a well is heard to strike the water in 4 seconds. Find the depth of the well, assuming the velocity of sound is 335 m/sec. [3M]

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

j) A bullet weighs 0.5 N and moving with a velocity of 400 m/sec hits centrally a 30 N block of wood moving away at 15 m/sec and gets embedded in it. Find the velocity of the bullet after the impact and amount of kinetic energy lost. [3M]

Part-B **(50 Marks)**

2.a) Referring to figure 1, find the magnitude and direction of the resultant and also find the point of action of the resultant.

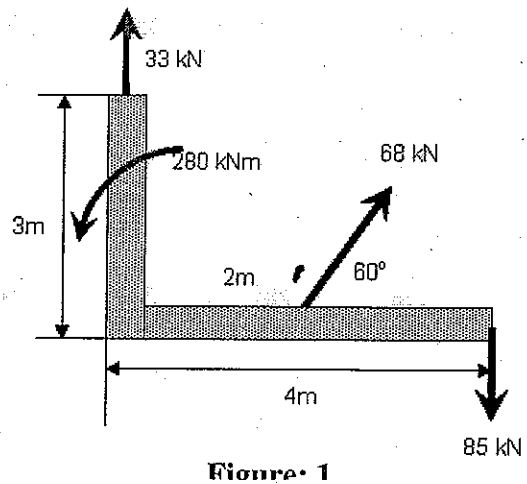

Figure: 1

b) Find the axial forces in the members of the tripod loaded in the figure 2, W = 25 kN.

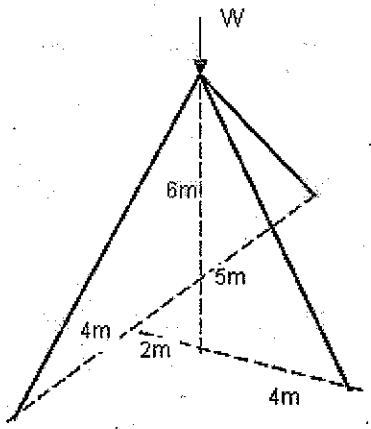

Figure: 2

OR

3.a) Find the reactions at supports A and B for the bracket loaded as shown in figure 3.

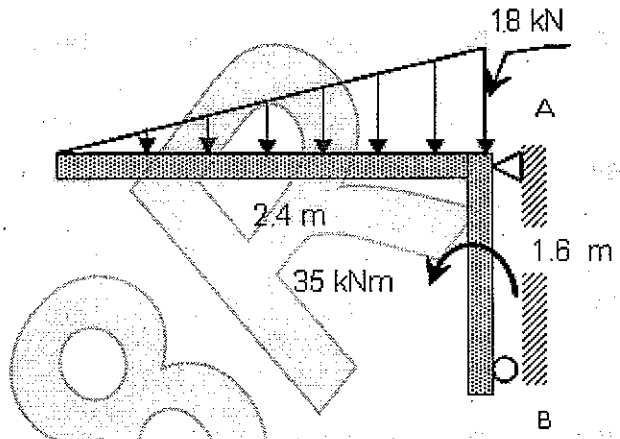

Figure: 3

b) A circular plate with a radius of 3 m is suspended by three identical cables AD, BE and CF as shown in figure 4. The plate is non homogeneous with a weight of 25 kN, which acts at a point G, at distance 1.5m from origin. What is the force in cable AD, BE and CF?

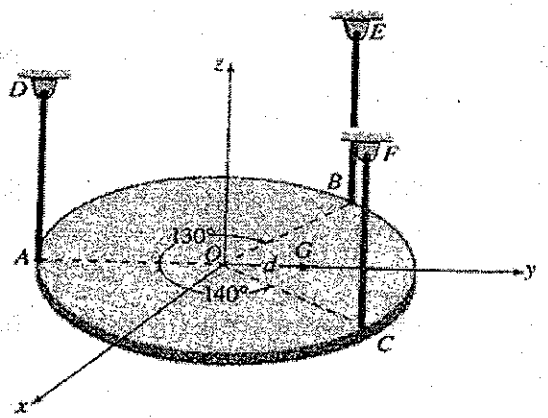

Figure: 4

4.a) Consider the system as shown in figure 5. If $\theta = 70^0$ and $\mu = 0.25$ at all surfaces of contact. What is the force (W) required to slide the wedge (A) in the downward direction?

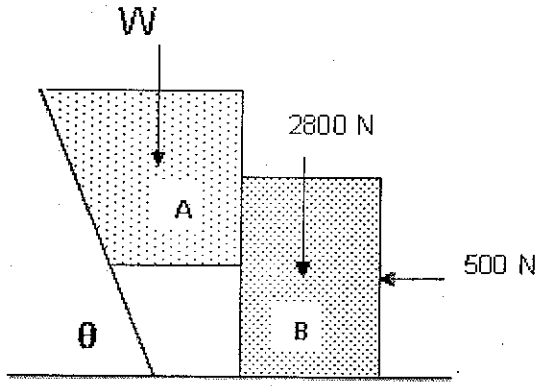

Figure: 5

b) For the system shown in figure 6, if it is required to move the block of weight 1500 N to the right, Find the tension in the string and also find the reaction between the blocks. Take $\mu = 0.25$ at all contacting surfaces.

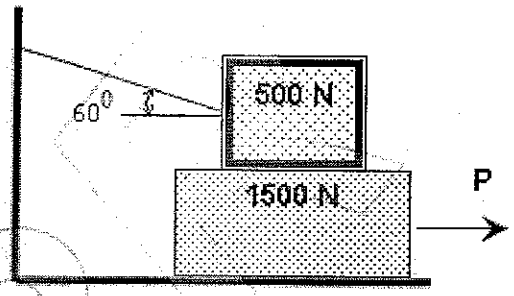

Figure: 6

OR

5.a) What is the value of P in the system as shown in figure 7 to cause the motion to impend? Assume the pulley is smooth and the coefficient of friction for all contact surfaces is 0.2.

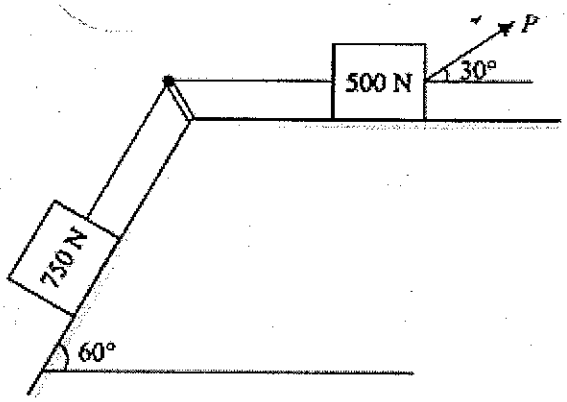

Figure: 7

b) Blocks A and B are placed on an inclined surface as shown in figure 8. The mass of A is 13.5 kg and that of B is 40 kg. The coefficient of friction at all surfaces of contact is 0.3. Determine the angle (θ) of the surface at which the motion impends and also find the tension in the string.

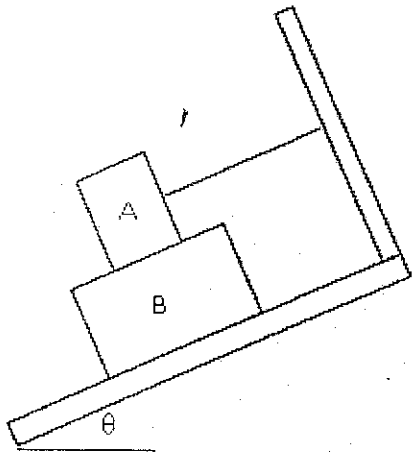

Figure: 8

6.a) A semicircular area is removed from the trapezoid shown in figure 9. Determine the Y coordinate of the centroid and the areal moment of inertia with respect to centroidal X axis for the shaded area.

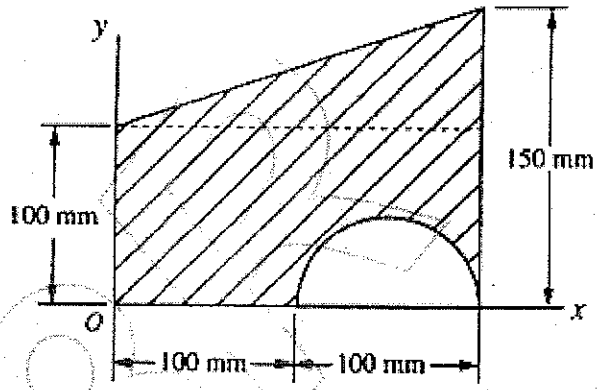

Figure: 9

b) Find the coordinate of the centroid and the areal moment of Inertia about the Centroidal axes parallel to the base for the shaded part of the figure 10.

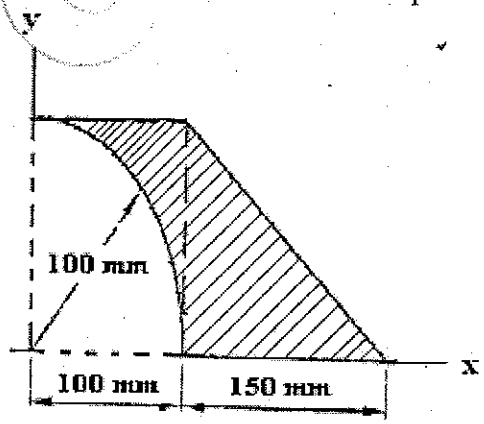

Figure: 10

OR

7.a) Determine the Y coordinate of the centroid and find areal moment of inertia of the shaded area about the centroidal X axis for the composite figure shown in figure 11.

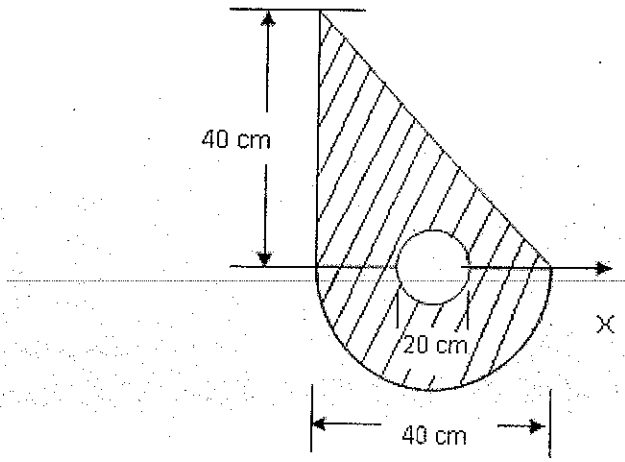

Figure: 11

b) Locate the Y coordinate of centroid and find areal moment of inertia about OY axis of the composite area shown in figure 12.

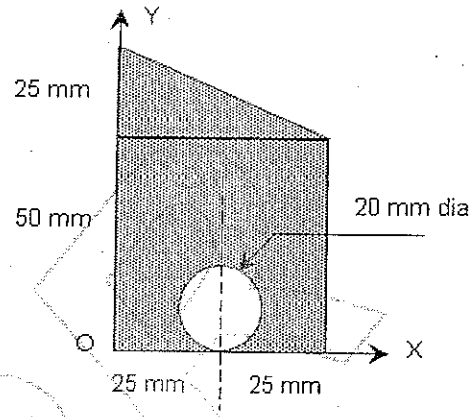

Figure: 12

8.a) A particle moves along a straight line with an acceleration prescribed by the relation $a = (4t^2 - 3t + 2)$. Where 'a' is in m/s^2 and t is in seconds. The particle has a

of the particle after 5 seconds.

b) An automobile enters a curved road at 30 km/hr and then leaves at 48 km/hr. The curved road is in the form of quarter of a circle and has a length 400 m. If the car travels at constant acceleration along the curve, calculate the resultant acceleration and its direction at both ends of the curve.

OR

9.a) A block of mass 5 kg resting on a 30^0 inclined plane is released. The block after traveling a distance of 0.5 m along the inclined plane hits a spring of stiffness 15 N/cm as shown in figure 13. Find the maximum compression of spring. Assume the coefficient of friction between the block and the inclined plane as 0.2.

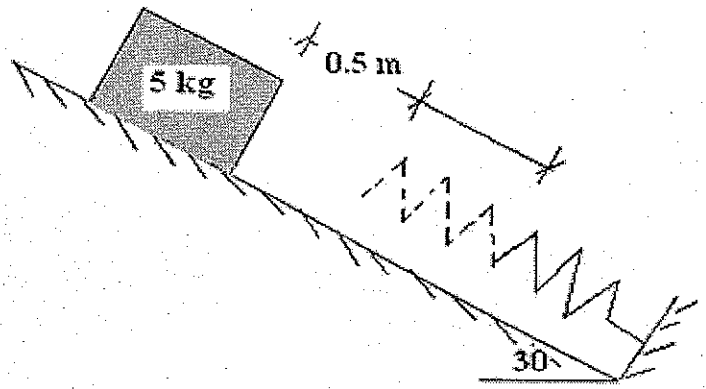

Figure: 13

b) A soldier fires a bullet with a velocity of 31.32 m/s at an angle α upwards from the horizontal from his position on a hill to strike a target which is 100m away and 50 m below his position. Find the angle of projection α. Find the velocity with which the bullet strikes the object.

10.a) A fly wheel 0.5 m in diameter accelerates uniformly from rest to 360 rpm in 12 seconds. Determine the velocity and acceleration of a point on the rim of the fly wheel 0.1 second after it has started from rest.

b) A body performing simple harmonic motion has amplitude of 5 m and periodic time 4 seconds. The body is to pass between two points which are at 4 m and 2m from the centre of the force and are on the same side of it. Determine the time the body will take to accomplish this task.

OR

11.a) A wheel rotating about a fixed axis at 20 revolutions per minute is uniformly accelerating for 70 seconds during which it makes 50 revolutions. Find the angular velocity at the end of this interval and time required for the velocity to reach 100 revolutions per minute.

b) A vertically mounted spring is found to deflect by 15 mm when a body of 30 N weight is suspended from it. How many oscillations are made by the body? Subsequently the body is displaced through a distance of 30 mm from the mean position and then released. Calculate the maximum force to which the spring would be subjected.

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