R16

Code No: 131AE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech I Year I Semester Examinations, May/June - 2019
ENGINEERING MECHANICS
(Common to CE, EEE, ME, ECE, CSE, EIE, IT, MCT, ETM, MMT, AE, MIE, PTM, 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) State the necessary and sufficient conditions for equilibrium of rigid bodies in two dimensions. [2]

b) Calculate the magnitude of the moment about the point 'O' of the 600-N force as shown in figure 1. [3]

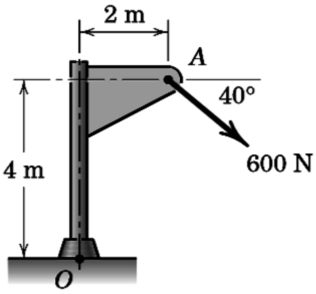

Figure: 1

c) What is the condition in terms of efficiency for a screw jack to be self-locking? [2]

d) State the laws of dry friction. [3]

e) Define polar moment of inertia. [2]

f) Derive an expression for a centroid of a triangle having base "b" and height "h". [3]

g) State and explain transfer formula for mass moment of inertia. [2]

h) Determine the mass moment of inertia of a slender rod of length 'L' and a mass 'm' with respect to an axis perpendicular to the rod and passing through one end of the rod. [3]

i) What is work-energy principle for rotation bodies? [2]

j) A train of weight 2000 kN is ascending a slope of 1 in 200 with a uniform velocity of 40 km/hr. Find the power exerted by the engine if the track resistance is 10 N/kN of the weight of train. [3]

PART-B

(50 Marks)

2.a) Three concurrent forces *P*, *T* and *F* having a resultant of 10 N directed forward and up to the right at $\theta_x = 60^0$, $\theta_y = 60^0$ and $\theta_z = 45^0$. P equal 21 N and passes from the origin through point (3, 2, 6). The value of T is 18 N and is directed from the origin toward point (-6, 6, -3). Determine the magnitude of the third force F and the angles it makes with the reference axes.

b) A man raises a 10 kg joist of 4 m length by pulling on a rope attached to the joist as shown in the figure 2. At this instant, find tension in the rope and reaction at end A of joist. [5+5]

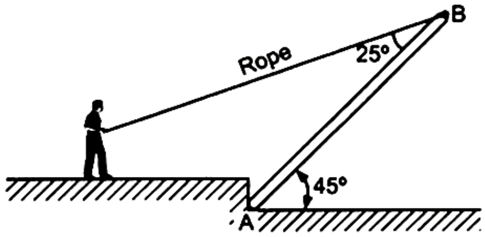

Figure: 2

OR

3.a) Determine and locate the resultant R of the two forces and one couple acting on the I-beam as shown in figure 3.

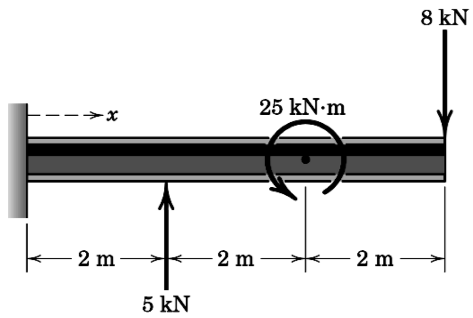

Figure: 3

b) Three bars pinned together at B and C and supported by hinges at A and D as shown in the figure 4 form a four link mechanism. Determine the value of P which is required to hold the system in equilibrium. [4+6]

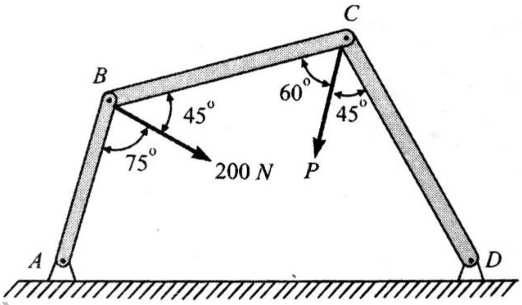

Figure: 4

4.a) What is a screw jack? Explain the principle of operation of a screw jack with a neat sketch.

b) Two block of weight W_1 = 50 N and W_2 = 50 N are resting on a rough inclined plane as shown in the figure 5. If μ = 0.3 for W_1 and plane and μ = 0.2 for W_2 and plane, find the inclination of the plane for which slipping will impend. [4+6]

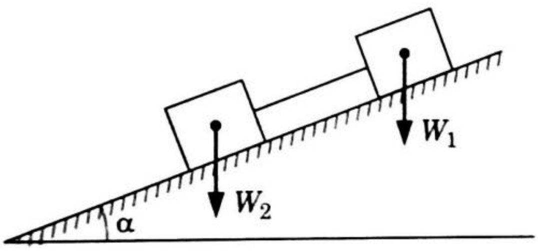

Figure: 5

OR

5.a) Prove that the angle of repose is equal to the angle of friction.

b) A block overlaying a 10^0 wedge on a horizontal floor, leaning against a vertical wall, and weighing 2000 N is to be raised by applying a horizontal force to the wedge as shown in figure 6. Assuming coefficient of friction for all contact surfaces is 0.25, determine the minimum horizontal force to be applied to raise the block. [5+5]

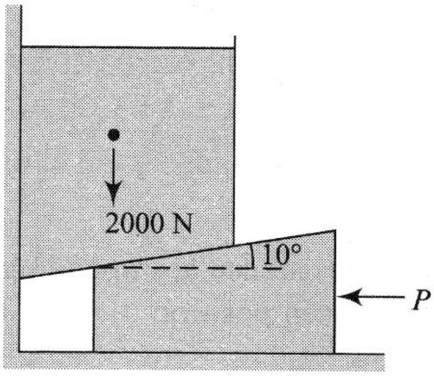

Figure: 6

6.a) Compute the moment of inertia of a regular hexagon of side "a" with respect to an axis passing through two opposite apexes.

b) Determine the co-ordinates of centroid of the shaded area enclosed by a parabola $4y = x^2$ and a straight line $x – y = 0$ as shown in figure 7. [5+5]

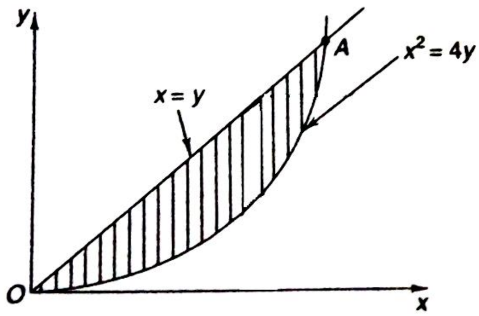

Figure: 7

OR

7.a) State and explain Pappus–Guldinus theorems for surface of revolution and volume of revolution.

b) Find the moment of inertia of the shaded area shown in the figure 8 about the edge AB. [5+5]

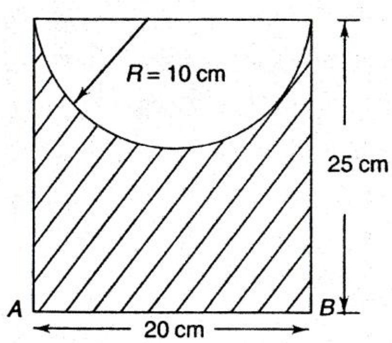

Figure: 8

8.a) Obtain an expression for mass moment of inertia of a solid cylinder about geometric axis.

b) Find the mass moment of inertia of the homogeneous parallelepiped with respect to centroidal axes parallel to the edges. [5+5]

OR

9.a) A Cube of side 400 mm has mass density of 2000kg/m^3. Find out the mass moment of inertia of the cube about its centroidal axis parallel to one of its sides.

b) A brass cone with base diameter of 400 mm and height of 225 mm is placed on a vertical aluminum cylinder of height 300 mm and diameter 400 mm. Density of brass = 85kN/m^3 and density of aluminium =25.6kN/m^3. Determine the mass moment of inertia of the composite body about the vertical geometrical axis. [4+6]

10.a) An elevator has an upward acceleration of 1 m/s^2. What pressure will be transmitted to the floor of the elevator by man weighing 600 N travelling in the elevator? What pressure will be transmitted if the elevator has a downward acceleration of 2 m/s^2?

b) The 3000 N block starting from rest as shown in the figure 9 slides down a 50^0 inclined plane. After moving 2 m it strikes spring whose modulus is 20 N/mm. If the coefficient of friction between the block and inclined plane is 0.2, determine the maximum deformation of the spring and the maximum velocity of the block. [4+6]

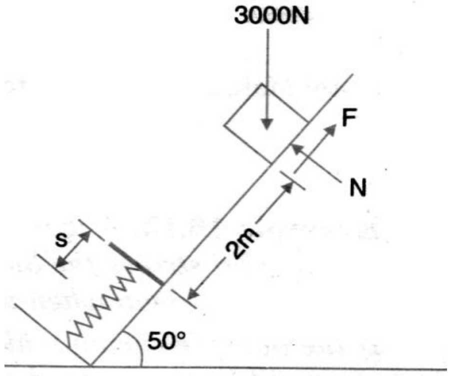

Figure: 9

OR

11.a) A stuntman drives a motor cycle around a circular vertical wall 30 m diameter. The coefficient of friction between tires and wall is 0.60. What is the minimum speed that will prevent his sliding down the wall? At what angle will the motorcycle be inclined to the horizontal? What is the effect of travelling at a greater speed?

b) After the block in the figure 10 has moved 3 m from rest, the constant force P is removed. Find the velocity of the block when it returns to its initial position. [5+5]

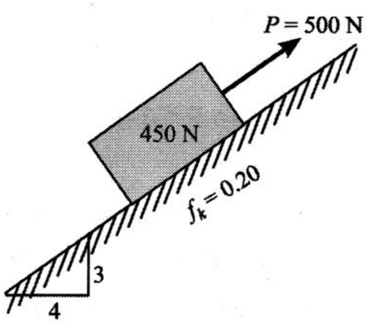

Figure: 10

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