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Question Paper Code : 90701

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Second/Third Semester

Aeronautical Engineering

GE 8292 — ENGINEERING MECHANICS

(Common to Aerospace Engineering/Agriculture Engineering/Automobile Engineering/Civil Engineering/Environmental Engineering/Industrial Engineering/Industrial Engineering and Management/Manufacturing Engineering Marine Engineering/Material Science and Engineering/Mechanical Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering Mechatronics Engineering/Petrochemical Engineering/Production Engineering/Robotics and Automation/Safety and Fire Engineering/Petrochemical Technology/Petroleum Engineering)

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A cart is pulled by two ropes as shown in Figure 1. The tension in rope PA is 2kN. The resultant acts along the axis of the cart. Determine the tension in rope PB and the magnitude of the resultant of the two forces.

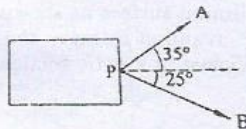


Figure - 1

2. Differentiate coplanar concurrent forces and non-coplanar concurrent forces.
3. A 4kN force acts as shown in Figure 2. Find the moment of the force about "A". Use vector method.

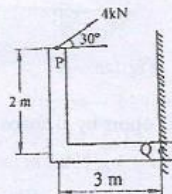


Figure - 2

4. Draw the free body diagram for the Figure 3.

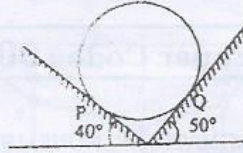
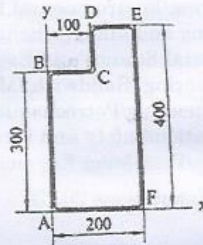


Figure - 3

5. Determine the centre of gravity of a thin homogeneous wire loop shown in Figure 4. All dimensions are in mm.



All dimensions are in mm

Figure - 4

6. How to determine the mass moment of inertia for rectangular prism.
7. A 20 kg block rests on horizontal surface as shown in Figure 5. Determine the magnitude of the force "P" required to move the block to the right with an acceleration of 3m/s^2 . Coefficient of kinetic friction between the block and the surface is 0.20.

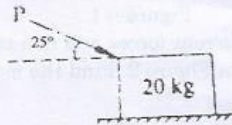


Figure - 5

8. A particle of mass 5kg is acted upon by a force $\vec{F} = 2t\vec{i} + (2-t)\vec{j} + t^2\vec{k}$. Velocity of the particle at $t=0$ is $\vec{v} = -6\vec{i} + 4\vec{j} - 16\vec{k} \text{ m/s}$. Determine the velocity of the particle at $t = 5\text{s}$.

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9. State law of sliding friction.
10. Draw the free body diagram for the Figure 7.

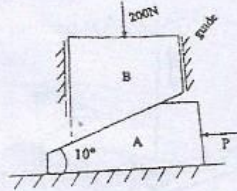


Figure - 7

PART B — (5 × 13 = 65 marks)

11. (a) A package is supported by three ropes as shown in Figure 11(a). Determine the weight "W" of the package if the tension in the rope "AD" is 4500 N.

Co-ordinates of "A" : (0,-1000,0)

Co-ordinates of "B" : (700,0,0)

Co-ordinates of "C" : (0,0,-600)

Co-ordinates of "D" : (-600,0,400)

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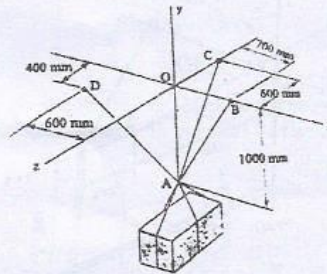


Figure - 11 (a)

Or

- (b) For the plate of shown in Figure 11(b), determine the tension in 10 cables "AB" and "AD" knowing that the tension of cable "AC" is 27kN and that the resultant of the forces exerted by the three cables at "A" must be vertical.

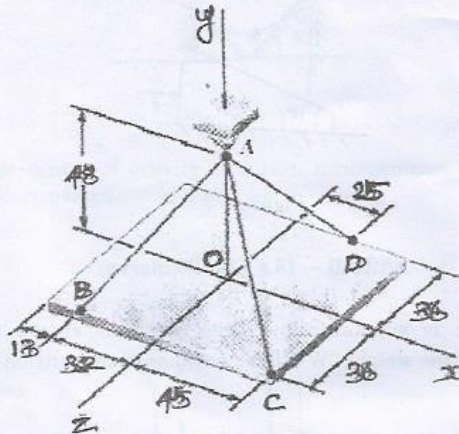


Figure - 11 (b)

12. (a) A 100 kg sign board of uniform density, measure 4m × 2m and is supported by a ball and socket at A and by two ropes as shown in Figure 12(a). Determine the tension in each rope and the reaction at "A"

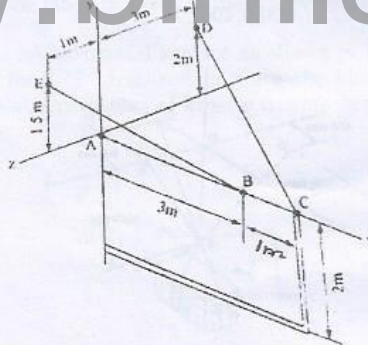


Figure - 12 (a)

Or

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(b) A force "F" of magnitude 2500 N acts on the frame at point "E" as shown in figure 12 (b). Determine the moment of "F" about

- (i) about "D" (6.5)
- (ii) about a line joining "O" and "D". (6.5)

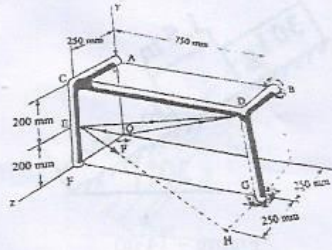


Figure - 12 (b)

13. (a) For the plane areas shown in figure 13(a). determine

- (i) The first moments with respect to x and y axis. (6.5)
- (ii) The location of the centroid. (6.5)

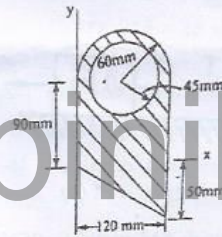


Figure - 13 (a)

Or

(b) For the area shown in figure 13(b), determine the moment of inertia with respect to the centroidal axis parallel to the X-axis.

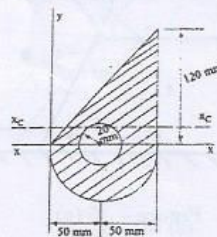


Figure - 13 (b)

14. (a) A 30 kg block starts sliding down from rest on an inclined plane shown in Figure 14(a). It strikes a spring and comes to rest. The coefficient of kinetic friction between the block and the plane is 0.2. Find the maximum compression of the spring. Also find the distance at which the block will move up the plane due to rebound. Take the spring constant as 2000N/m.

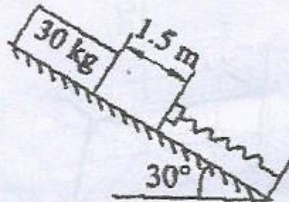


Figure - 14 (a)

Or

- (b) A system of 2 blocks of mass 20 kg and 40 kg are pulled by a force of 200N as shown in Figure 14(b). The coefficient of kinetic friction between the blocks and the plane is 0.25. Determine the tension in the cord and the velocity of after 4 seconds if it starts from rest. Use the principle of impulse and momentum.

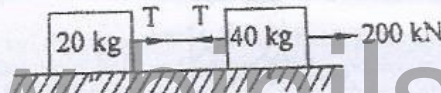


Figure - 14 (b)

15. (a) In the Figure 15(a), block "A" weights 25N and block "B" weights 20N. The coefficient of friction for all contacting surfaces is 0.2. Find the range of values of "P" for which the system will be in equilibrium.

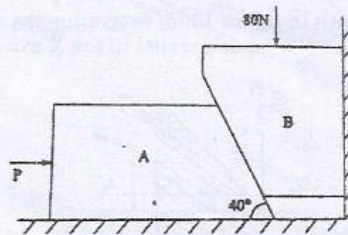


Figure - 15 (a)

Or

- (b) A 6m long ladder weighing 180N is placed at 60° to the ground and the is resting against a vertical wall. The man weights 700N. The coefficient of friction between the ladder and the ground is 0.4 and the between the ladder and the wall is 0.25. How far the man can climb so that the ladder does not slip.

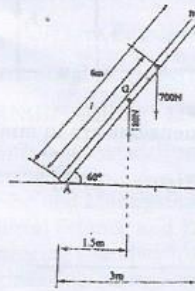


Figure - 15 (b)

PART C -- (1 x 15 = 15 marks)

16. (a) Cables "AB" and "AC" can sustain a maximum tension of 500N, and the pole can support a maximum compression of 300N. Determine the maximum weight of the lamp that can be supported in the position shown in Figure 16(a). The force in the pole acts along the axis of the pole.

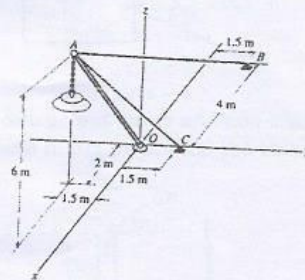


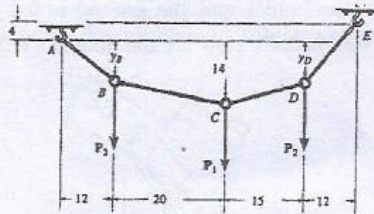
Figure - 16 (a)

Or

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- (b) The cable supports the three loads shown in figure 16(b). Determine the sags " y_B " and " y_D " of points "B" and "D". Take $P_1 = 400$ N, $P_2 = 250$ N.



All dimensions are in mm.

Figure - 16 (b)

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