**Code No: 131AE** **R16**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech I Year I Semester Examinations, September - 2023**

**ENGINEERING MECHANICS**

**(Common to CE, EEE, ME, ECE, CSE, EIE, IT, MCT, AE, MIE)**

**Time: 3 Hours** **Max. Marks: 75**

**Note:** i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

## PART – A

**(25 Marks)**

| | | |
|---|---|---|
| 1.a) | Explain superposition law and law of transmissibility? | [2] |
| b) | Define equilibrium of a body and give conditions of equilibrium when subjected to Forces? | [3] |
| c) | Differentiate between Static Friction and Kinetic Friction? | [2] |
| d) | State the Laws of Friction? | [3] |
| e) | What are the conditions under which the centre of gravity of a body becomes the same as its centroid? | [2] |
| f) | State the Parallel axis theorem? | [3] |
| g) | Differentiate between polar moment of inertia and product of inertia? | [2] |
| h) | Define radius of gyration and applications? | [3] |
| i) | A particle of mass m moves rectilinearly under the action of a force determine the displacement - time equation, assuming initial displacement and velocity are zeros? | [2] |
| j) | The maximum range of a projectile is 2000 m. What should be the angle of elevation so as to obtain a range of 1400 m if the initial velocity remains unchanged? | [3] |

## PART - B

**(50 Marks)**

| | | |
|---|---|---|
| 2.a) | State and Prove Lami's Theorem? | |
| b) | Two identical rollers, each of weight 100 N, are supported by an inclined plane and a vertical wall as shown in below Figure 1. Assuming smooth surfaces, find the reactions induced at the points of support A, B and C. | [5+5] |

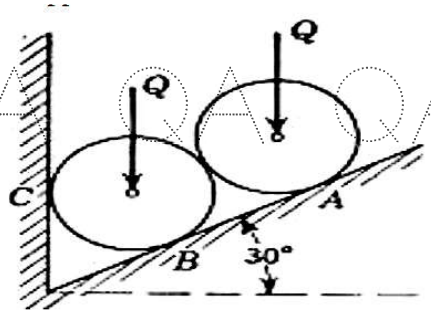


**Figure 1**

**OR**

3.a) The resultant of two concurrent forces is 3000N and the angle between the forces is $90^0$. The resultant makes an angle of $46^0$ with one of the forces. Find the magnitude of each force?

b) Determine the resultant of the non-concurrent, non-parallel system of forces shown in the figure 2. Assume that the coordinates are shown in meters? [5+5]

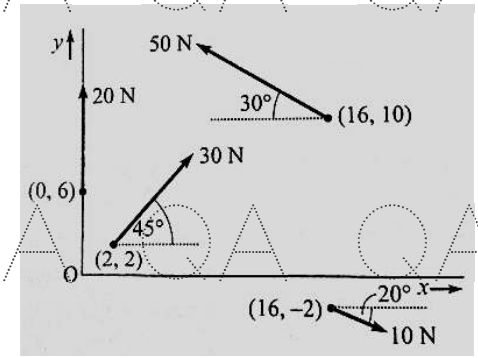


**Figure 2**

4. A 108 N block is held on a $40^0$ incline by a bar attached to a 150 N block on a horizontal plane shown in Figure 3. The bar which is fastened by smooth pins at each end is inclined $20^0$ to the horizontal. The coefficient of friction between each block and its plane is 0.325. For what horizontal force P, applied to 150 N block will motion to the right be impending? [10]

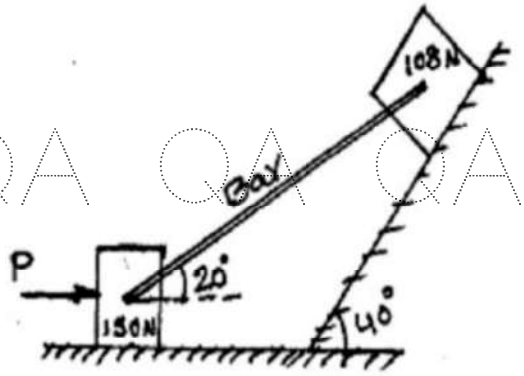


**Figure 3**

**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 4. 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]

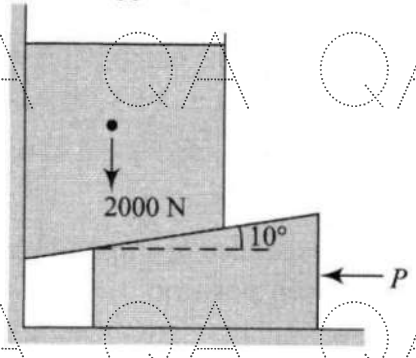


**Figure 4**

6. Determine the first moment with respect to the x and y axis and location of the centroid of given figure 5? [10]

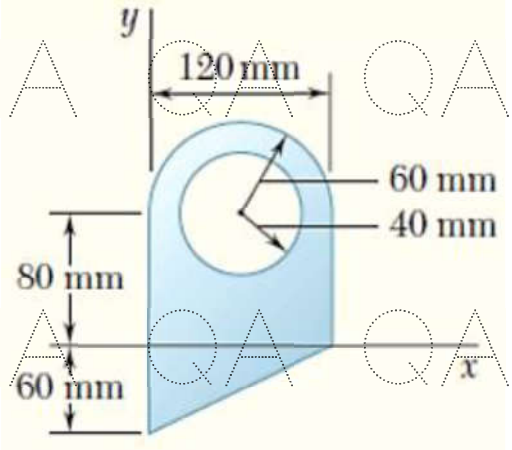


**Figure 5**

**OR**

7. Find the moment of inertia of the shaded plate about its centrode axis of given figure 6? [10]

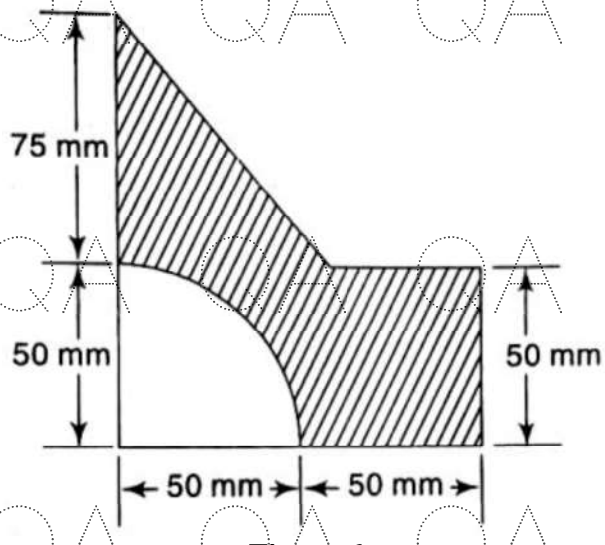


**Figure 6**

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 brass cone with base diameter of 400 mm and height of 300 mm is placed on a vertical aluminum cylinder of height 300 mm and diameter 400 mm. Density of brass = 85 kN/m$^3$ and density of aluminium = 30kN/m$^3$. Determine the mass moment of inertia of the composite body about the vertical geometrical axis? [10]

10. A car has an initial speed of 25m/s and a constant deceleration of $3m/s^2$. Determine the velocity of the car when t = 4s. What is the displacement of the car during the 4s time interval? How much time is needed to stop the car? [10]

**OR**

11. A projectile is fired with an initial velocity of 250m/s at a target located at a horizontal distance of 4km and vertical distance of 700 m above the gun. Determine the value of firing angle to hit the target. Neglect air resistance? [10]

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