

R16

Code No: 131AE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech I Year I Semester Examinations, January/February - 2025

ENGINEERING MECHANICS

(Common to CE, EEE, ME, ECE, CSE, IT)

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) Define the basic concepts of mechanics and their importance in engineering. [2]
- b) How do you find the resultant of a system of coplanar concurrent forces? [3]
- c) Explain the laws of friction and their significance in engineering. [2]
- d) Differentiate between static and dynamic friction with examples. [3]
- e) What is the theorem of Pappus? [2]
- f) Describe the transfer theorem for moments of inertia and provide an example. [3]
- g) Describe the significance of mass moment of inertia in mechanical engineering. [2]
- h) Using the parallel axis theorem, determine the moment of inertia of a solid disk of mass m and radius r about an axis parallel to its central axis and passing through its edge. [3]
- i) How does D'Alembert's principle apply to the analysis of a particle in motion? [2]
- j) Explain the principle of work-energy for a rigid body in rotation. [3]

PART - B

(50 Marks)

- 2.a) Describe the process of resolving a force into its components. Provide an example with calculations.
- b) A ladder of length 10 meters and weight 200 N rests against a vertical wall. The ladder makes an angle of 60° with the ground. Determine the normal force and frictional force at the ground if the wall is frictionless. [5+5]

OR

- 3.a) Determine the resultant of the three forces originating at point (3, -3) and passing through the point indicated: 126 N through (8, 6), 183 N through (2, -5) and 269 N through (-6, 3). (Figure 1)

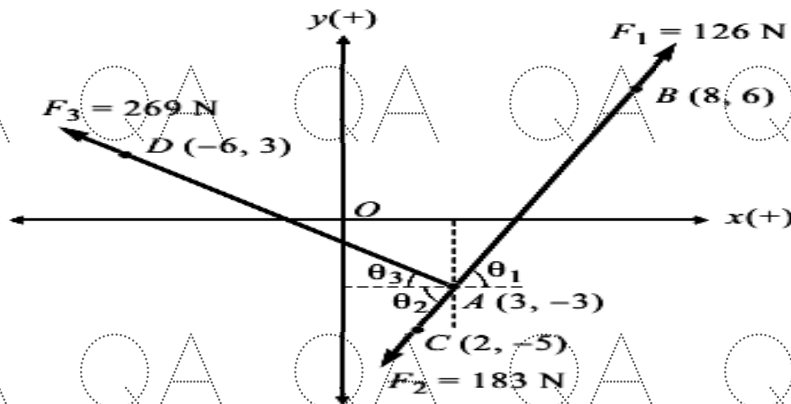


Figure 1

- b) Explain the concept of the equilibrium of forces. How are Free Body Diagrams (FBDs) used to solve problems related to the equilibrium of coplanar force systems? Illustrate with an example. [5+5]

- 4.a) A 100 N force acts, as shown in Figure.2, on a 30.6 kg block on a inclined plane. The coefficient of friction (static and kinetic) between the block and the plane are $\mu = 0.25$ and $\mu = 0.20$, respectively. Determine whether the block is in equilibrium and find the value of the friction force. Take $g = 9.81 \text{ m/sec.}^2$

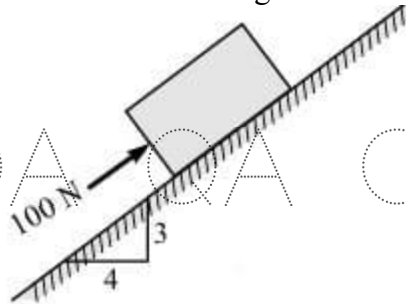


Figure 2

- b) The screw press, shown in Figure.3, is used in book binding. The screw has a mean radius of 10 mm and its pitch is 5 mm. The static coefficient of friction between the threads is 0.18. If a clamping force of 1000 N is applied to the book, determine (i) The torque that was applied to the handle of the press. (ii) The torque required to loosen the press. [5+5]

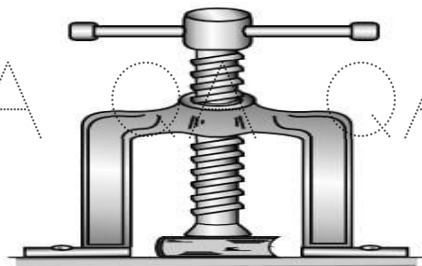


Figure 3

OR

- 5.a) Determine the force P to cause motion to impend. Take masses of blocks A and B as 9 kg and 4 kg respectively and the coefficient of sliding friction as 0.25. The force P and the rope are parallel to the inclined plane as shown in Figure. 4. Assume pulley to be frictionless.

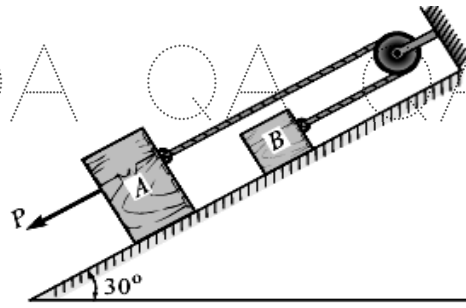


Figure 4

- b) A body of weight 120 N is at rest on a horizontal plane. A horizontal force of 75 N just causes the body to slide. Determine i) Limiting force of friction ii) Coefficient of friction. [5+5]

- 6.a) Find the centroid of the shaded area in Figure. 5.

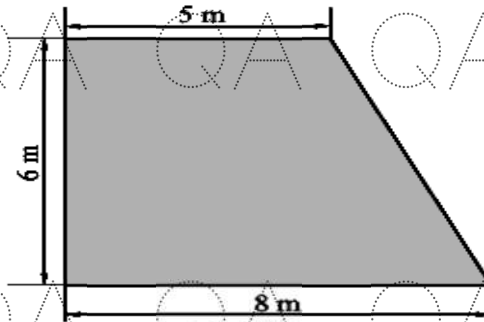
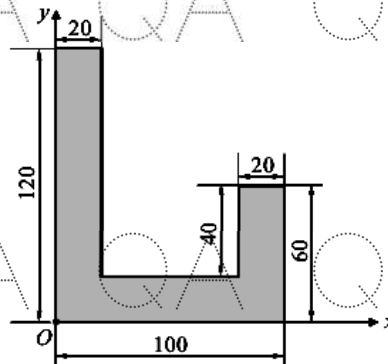


Figure 5

- b) For the given shaded area shown in Figure. 6. Find,
 i) Moment of Inertia about the reference axes (i.e., O_x and O_y axis).
 ii) Moment of Inertia about the centroidal axis.
 iii) Polar moment of inertia about the origin O .
 iv) Radius of gyration about reference axes.
 v) Radius of gyration about the centroidal axis. [5+5]



(All dimensions are in mm)

Figure 6

OR

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- 7.a) Find the centroid of the unequal I- section shown in Figure. 7 and calculate about the centroidal x and y axis. Also find about base.

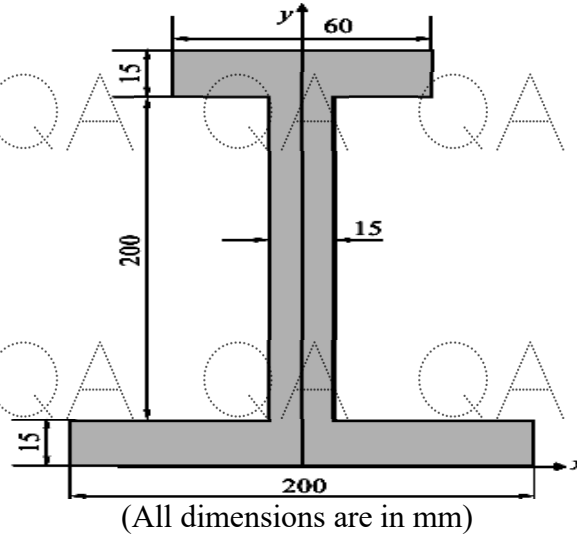


Figure 7

- b) Find the moment of inertia of shaded area shown in Figure.8 about OX and OY axis. Also find the centroid of the shaded area. [5+5]

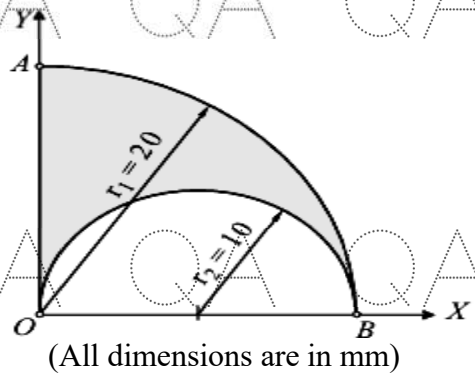


Figure 8

- 8.a) Define mass moment of inertia and explain its significance in rotational dynamics.
 b) A uniform rod of mass 10 kg is pinned at O and its ends are welded by sphere of mass 20 kg at upper end and circular disc of mass 15 kg at lower end, as shown in Figure.9. Find MI about pinned axis. [5+5]

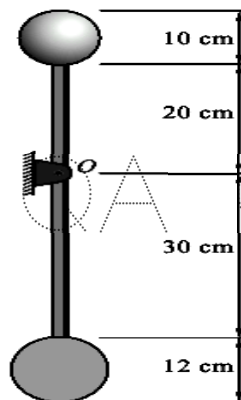


Figure 9

QA QA QA QA QA QA QA QA QA QA QA

