



PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY (PNGUOT)
MECHANICAL ENGINEERING

ME222: Solid Mechanics
Second Semester Examination, 2024
Second Year Mechanical Engineering
Friday, October 25th, 2024-8:20 A.M
Room No: M115

Time Allowed: 2 Hrs

Instructions:

1. *You have 10 minutes to read the paper. Do not write anything during this time.*
2. *Write your **name** clearly on the front-page using **Capital letters**.*
3. *There is **total five (5) questions**. Answer **any four (4) questions**.*
4. *All questions carry equal marks.*
5. *All questions must be answered only in the booklet provided.*
6. *Calculators are permitted in the examination room.*
7. *Any student found cheating will be disqualified.*



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Question 1: (25 Marks)

PART-A (5 Marks)

- A. Discuss the significance of the polar moment of inertia in torsional loading. How does it compare to the area moment of inertia used in bending?

PART-B (20 Marks)

- B. A hollow shaft with an outer diameter of 100 mm and an inner diameter of 60 mm is subjected to a torque of 1000 Nm. Derive the formula for the angle of twist over a length of 1 m and discuss how the dimensions of the shaft influence the angle of twist?

Question 2: (25 Marks)

PART-A (5 Marks)

- A. Define the terms "slope" and "deflection" in the context of beam theory. How are they related to the beam's stiffness?

PART-B (20 Marks)

- B. A beam is subjected to both bending and axial loads: $M=30$ kN and $P=20$ kN. Given the dimensions of a rectangular cross-section of 100 mm \times 200 , determine the maximum stress using superposition.

Question 3: (25 Marks)

- A. A beam of length 6 m is simply supported at its ends and carries two-point loads of 48 kN and 40 kN at 1 m and 3 m respectively from the left support find: i) Deflection under each load. ii) Maximum deflection iii) The point at which maximum deflection occurs. ($E = 2 \times 10^5$ N/mm² and $I = 85 \times 10^6$ mm⁴)

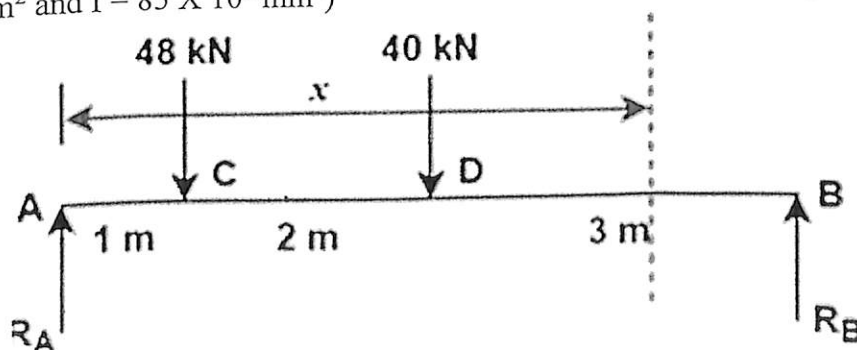


Fig. 2



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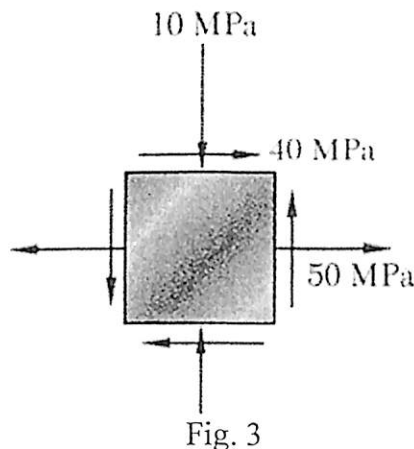
Question 4: (25 Marks)

PART-A (5 Marks)

- A. What are the advantages of using Mohr's Circle in stress analysis?

PART-B (20 Marks)

- B. A bar with the plane stress state is as shown in Fig. 3 below. Determine the normal and shearing stresses on a phase inclined at 30° to the CCW direction of loading and show them on a sketch of a properly oriented element. Solve by Mohr's circle method. Also find maximum shearing stress, the principal stresses and the principal plane.



Question 5: (25 Marks)

PART-A (5 Marks)

- A. Explain the concept of effective length in columns and how it influences the buckling load.

PART-B (20 Marks)

- B. An 8" diameter timber pole fixed in a large concrete footing at grade and pinned at the top. $E = 1.0 \times 10^6$ psi Find: Maximum height of the pole to support a 25-kip load.



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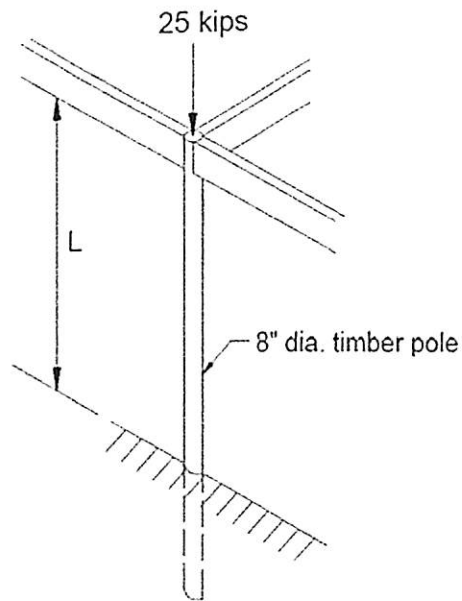


Fig. 4

Good luck!!!