41N0002/41N1101

Roll No. _____ Total No. of Pages:- 5

41N0002/ 41N1101

B.Tech. IV Sem Main Exam August-23

Aeronautical Engineering

(4AR4-02) - Mechanics of Solids
Commont to AR, MX

Time :3 Hours **Maximum Marks: 70**
Min. Passing Marks:

Instructions to Candidates:

Part – A: Short answer questions (up to 25 words) 10 * 2 marks = 20 marks. All ten questions are compulsory.

Part – B: Analytical/Problem Solving questions 5 * 4 marks = 20 marks. Candidates have to answer 5 questions out of 7.

Part – C: Descriptive/Analytical/Problem Solving questions 3 * 10 marks = 30 marks. Candidates have to answer 3 questions out of 5.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting materials is permitted during examination. (Mentioned in form No. 205)

1_____ 2_____

PART-A

1. Draw the stress-strain diagram of copper depicting all the main points.
2. Define Hooke's laws in shear?
3. Define Castiglione's theorem.
4. What is strain energy density?
5. Define factor of safety?
6. What are the built up beams?
7. Write the transformation equations for plane stress conditions.
8. Draw a line diagram for beam loaded with one concentrated load at centre, Uniform distributed load across the whole span and uniform varying load Across the whole span and couples acting at both ends of the beam. Assume beam length and intensity of loading?
9. Define Saint-Venant's principle.
10. Differentiate between hardness and toughness.

PART-B

1. A steel wire 2 m long and 3 mm in diameter is extended by 0.75 mm when a weight W is suspended from the wire. If the same weight is suspended from a brass wire, 2.54 m long and 2 mm in diameter, it is elongated by 4.64 mm. determine the modulus of elasticity of brass if that of steel be 2.0×10^5 N/mm^2.
2. Explain maximum principle strain theory in detail.
3. Derive the relationship for moment-curvature. What is its physical significance?
4. State and explain Hooke's law for plane stress.

5. A beam ABC with an overhang at one end supports a uniform load of intensity 12kN/m and a concentrated moment of magnitude 3kNm at C as shown in Figure 1. Draw the shear-force and bending moment diagrams for this beam. Find the values of V_{max} and M_{max}. Also locate the point of contra flexure, if any.

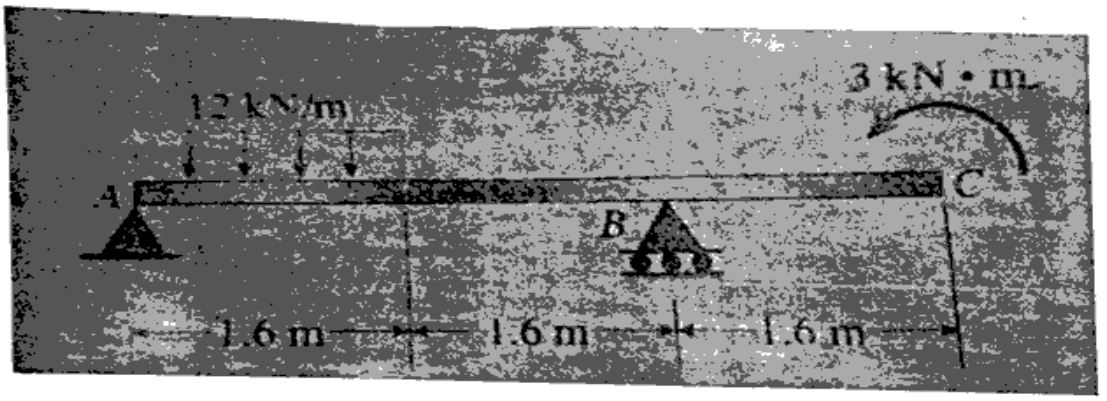


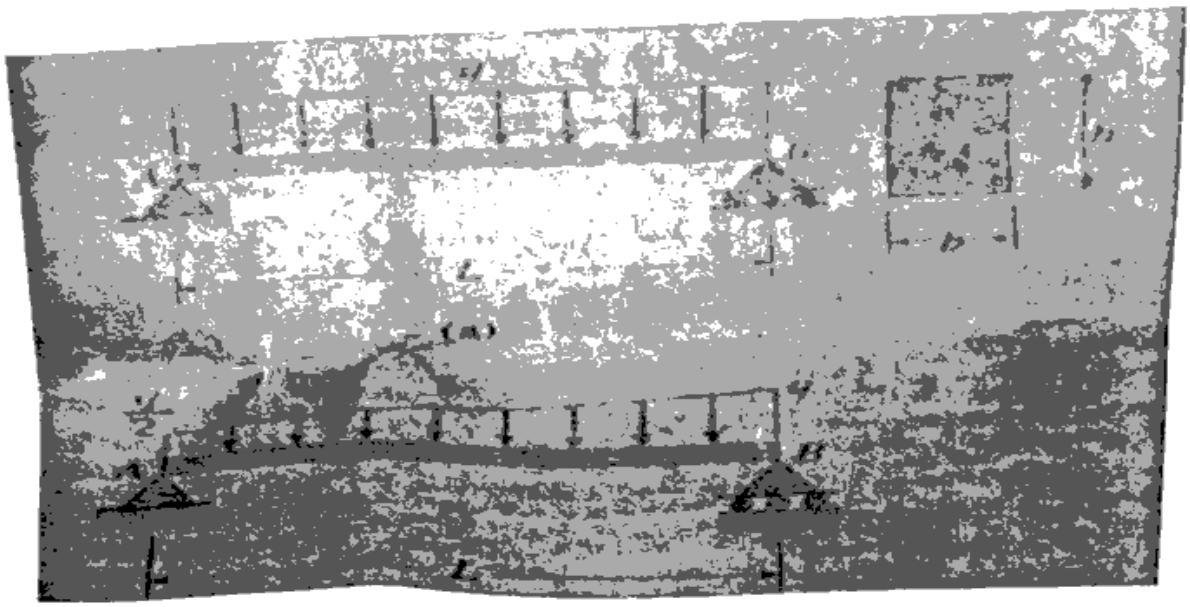
Figure 1

6. A bar of length 4 m when used as simply supported beam and subjected to a uniformly distributed load of 30 kN/m over the whole span, deflects 15 mm at the centre. Determine the crippling load when it is used as a column with following end conditions;
   a) One end fixed and other end hinged
   b) Both end fixed
   c) Both ends pin-joined

7. A thin cylinder of 100mm internal diameter and 5 mm thickness is subjected to an internal pressure of 10 MPa and a torque of 2000 Nm. Calculate the magnitudes of the principal stresses.

PART-C

1. A simply supported wood beam AB with span length L = 4 m carries a uniform load of intensity q = 5.8kN/m as shown in figure 2.
   a) Calculate the maximum bending stress σ_{max} due to the load q if the beam has a rectangular cross section with width b = 140 mm and height h = 240mm.
   b) Repeat (a) but use the trapezoidal distributed load shown in the figure part (b).



(b)

Figure 2

2. An element in plane stress is subjected to stresses σ_x = 50 MPa and τ_{xy} = 42 MPa as shown in figure 3. It is known that one of the principle stresses equals 33 MPA in tension.
   a) Determine the stress σ_y
   b) Determine the other principle stress and the orientation of the principal planes, then show the principal stresses on a sketch of a properly oriented element.

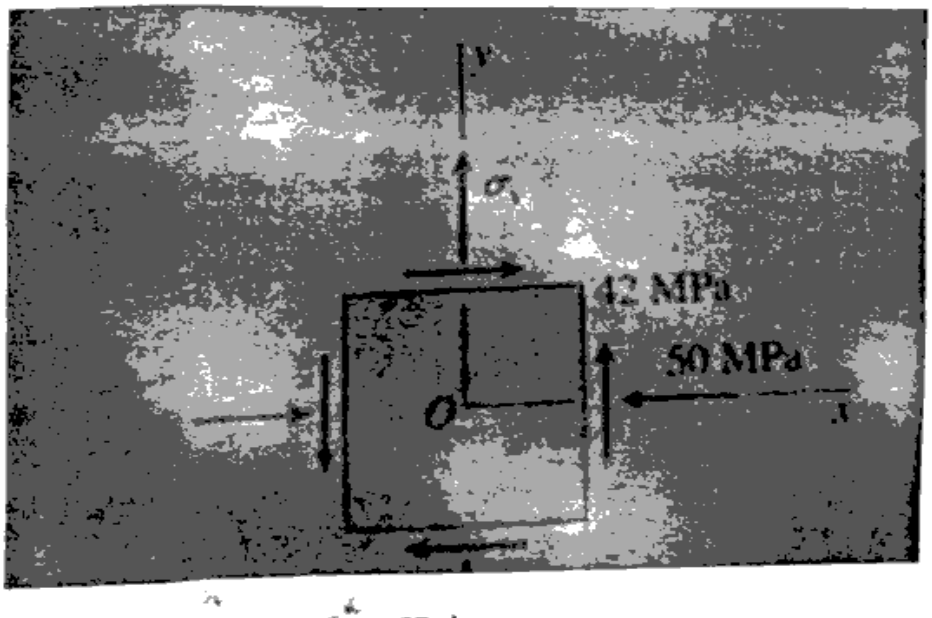


Figure 3

3. A copper bar 50 mm in diameter is placed within a steel tube 75mm external diameter and 50mm internal diameter of exactly the same length. The two pieces are rigidly fixed together by two pins 18 mm in diameter, one at each end passing through the bar and tube. Calculate the stresses induced in the copper bar, steel tube and pins if the temperature of the combination is raised by 50°C.

Take $E_{steel} = 210\ GN/m^2$

$E_{copper} = 105\ GN/m^2$

$\alpha_{steel} = 11.5 \times 10^{-6}$ per $°C$

$\alpha_{copper} = 17 \times 10^{-6}$ per $°C$

4. A beam having a T- shaped cross-sectional. (Figure 4) is subjected to a vertical shear for U= 45 kN. The cross section dimensions are b=100 mm, t=24 mm, h=200 mm and h_1 = 176 mm. Determine thew shaer stress at the top of the web (at level nn) and the maximum shear stress (Do not consider the areas of the fillets). Also 1 inch= 25 mm can be taken.

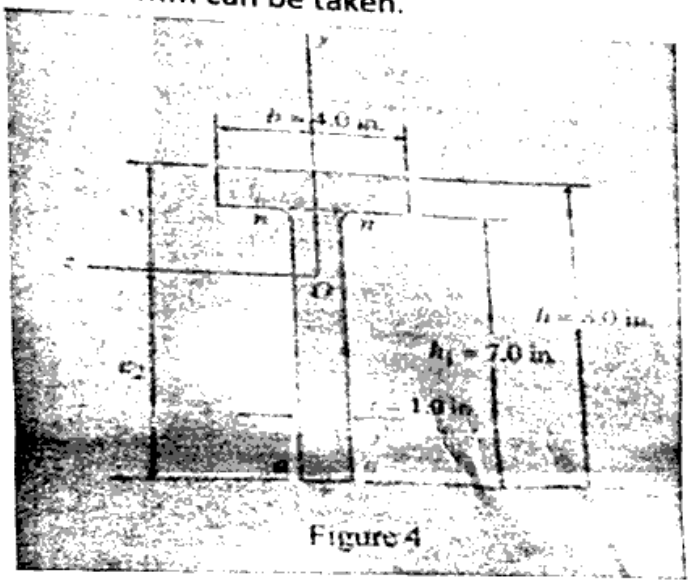
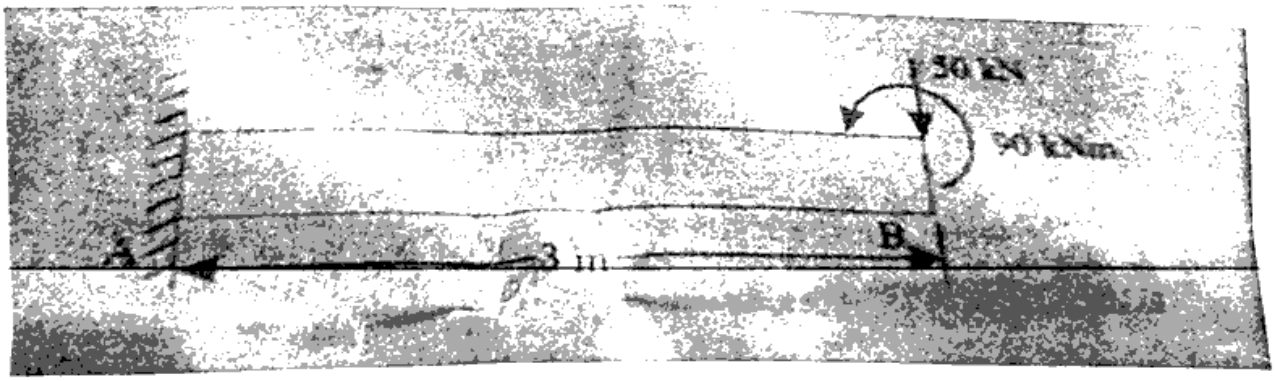


Figure 4

5. How do you find slope and deflection of a beam? Determine the slope and deflection at the end B of the prismatic cantilever beam when it is loaded as shown in figure 5, knowing that the flexural rigidity of the beam is EI = 10^4 kNm^2.



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