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INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

M.Tech I Semester End Examinations (Regular) - February, 2017

Regulation: IARE-R16

ADVANCED MECHANICS OF SOLIDS (CAD/CAM)

Time: 3 Hours

Max Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT – I

1. (a) A cantilever beam of rectangular section is subjected to a load of 1000N which is inclined at an angle of 30° to the vertical. Determine the stress produced due to bending at point D. [7M]

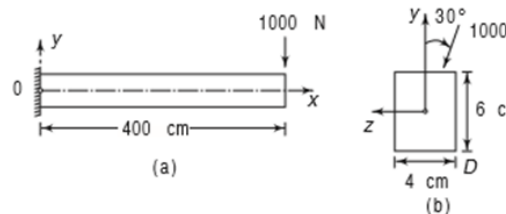


Figure 1

- (b) A beam of length 5 m and of uniform rectangular section is supported at its ends and carries uniformly distributed load over the entire length, calculate the depth of the section if the maximum permissible bending stress is 8 N/mm^2 and central deflection is not to exceed 10 mm. Take the value of $E = 1.2 \times 10^4 \text{ N/mm}^2$. [7M]
2. (a) Determine the shear stress distribution in a channel section of a cantilever beam subjected to a load F , as shown in figure 2. Also, locate the shear centre of the section. [7M]

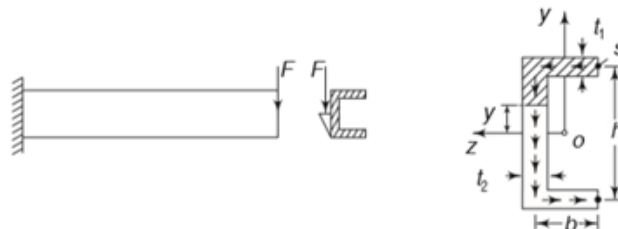


Figure 2

- (b) For a simply supported beam of length 5 m, which is carrying a point load of 5 kN at a distance of 3 m from the left end. Determine [7M]
- slope at the left support,
 - deflection under the load
 - maximum deflection Take $E = 2 \times 10^5 \text{ N/mm}^2$ and $I = 1 \times 10^8 \text{ mm}^4$

UNIT – II

3. (a) Determine the maximum tensile and maximum compressive stresses across the sec. AA of the member loaded, as shown in figure 3 load $P = 19620 \text{ N}$ [7M]

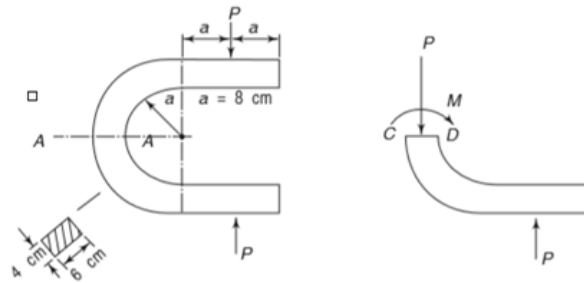


Figure 3

- (b) Determine the stress at point D of a hook having a trapezoidal section with following dimensions: $b_1 = 4 \text{ cm}$, $b_2 = 1 \text{ cm}$, $r_1 = 3 \text{ cm}$, $r_2 = 10 \text{ cm}$, $h = 7 \text{ cm}$, force $P = 29400 \text{ N}$. [7M]

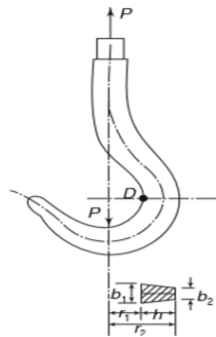


Figure 4

4. (a) The open link shown in Figure 5 below loaded by forces P, each of which is equal to 14700 N. Find the maximum tensile and compressive stresses in the curved end at section AB. [7M]

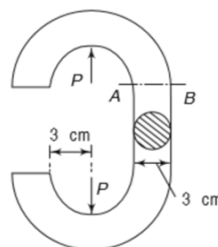


Figure 5

- (b) Derive an equation for the value of p^2 of a trapezoidal section. [7M]

UNIT – III

5. (a) Derive an expression for torque transmitted by a thin tubular section [7M]
- (b) The two tubular sections shown in figure 6 have the same wall thickness t and same circumference. Neglecting stress concentration, find the ratio of the shear stresses for 7M]
- i. Equal twisting moments in the two cases
 - ii. Equal angles of twist in the two cases
- [7M]

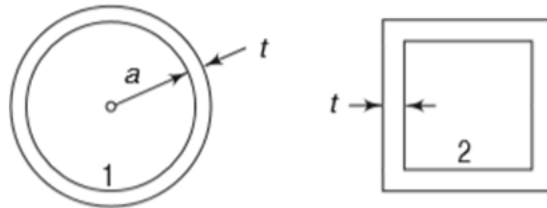


Figure 6

6. (a) For figure 7 given below a two cell tubular section whose wall thicknesses are as shown. If the member is subjected to a torque T , determine the shear flows and the angle of twist of the member per unit length. [10M]

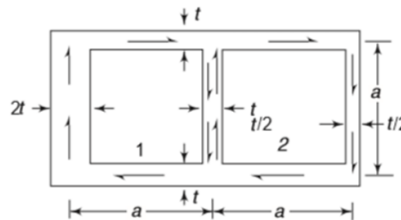


Figure 7

- (b) A thin walled rectangular tube $30 \times 60\text{mm}$ is subjected to torque of 10Nm . The thickness of all wall is 2mm . Determine the angle of twist per metre. Take $G=80\text{GPa}$ [4M]

UNIT – IV

7. (a) A solid flat circular plate of 800mm diameter and 15mm thickness is acted upon by a concentrated load of 40kN at the centre of the plate. Determine the central deflection and maximum radial stresses at the edge. $E = 207\text{GPa}$, and $\nu = 0.292$ [7M]
- (b) A square door has a side of 1.8m and thickness 15mm . The plate is simply supported and subjected to uniform pressure. Determine the yield pressure. $E = 200\text{GPa}$, and $\nu = 0.29$ [7M]
8. A plate made of mild steel ($E = 200\text{GPa}$, $\nu = 0.29$, and Yield stress = 315MPa) has a thickness $h = 10\text{mm}$ and cover a circular opening having a diameter of 200mm . The plate is fixed at the edges and is subjected to a uniform pressure p . [14M]
- i. Determine the magnitude of the yield pressure P_y and deflection w_{max} at the centre of the plate when this pressure is applied.
 - ii. Determine a working pressure based on a factor of safety of $\text{SF} = 2.00$ relative to P_y

UNIT – V

9. (a) A 20 mm long cast iron rod of 25 mm diameter is pressed on to a thick copper plate with a force of 20N. Determine the width of the contact area, the maximum pressure at the centre of the contact area. The elastic constants for the materials are Cast iron $E = 41.4$ GPa, $\nu = 0.211$, Copper $E = 44.7$ GPa, $\nu = 0.326$ [7M]
- (b) Derive an expression for contact pressure of ball bearing [7M]
10. Carbon steel balls, each 25 mm in diameter is pressed by a flat carbon plate force $F = 18$ N at the centre of the area of contact. For carbon steel $E = 207$ GPa, and $\nu = 0.292$ [14M]
- Determine the values of the principal stresses
 - Determine the maximum shear stress. At what distance from the contact surface do they occur.