Exam.Code:1014
Sub. Code: 7442

2023

M.E. Mechanical Engineering

First Semester

MME-103 : Advanced Mechanics of Materials

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, selecting atleast two questions from each Unit. Use usual notations and symbols for derivations. Assume suitably missing data if any. All questions carry equal marks.

x-x-x

UNIT - I

1. The displacement field for the thin beam shown in Fig. 1.5-2 considering bending only is[†]

$$u(x, y) = \frac{Py}{6EI}(6Lx - 3x^2 - \nu y^2)$$

$$v(x, y) = -\frac{P}{6EI}[3Lx^2 - x^3 + 3\nu y^2(L - x)]$$

where

P = applied force
I = second-area moment about the bending axis
L = length of beam
E = Young's modulus

Determine (*a*) the vertical deflection and slope at the centroidal axis $y = 0$ and (*b*) the entire stress field.

2. Figure shows a round shaft of diameter 1.5 in loaded by a bending moment $M_z = 5000$ lb·in, a torque $T = 8000$ lb·in, and an axial tensile force $N = 6000$ lb. If the material is ductile with a yield strength $S_y = 40$ kpsi, determine the design factor corresponding to yield using (*a*) the Tresca theory and (*b*) the von Mises theory.

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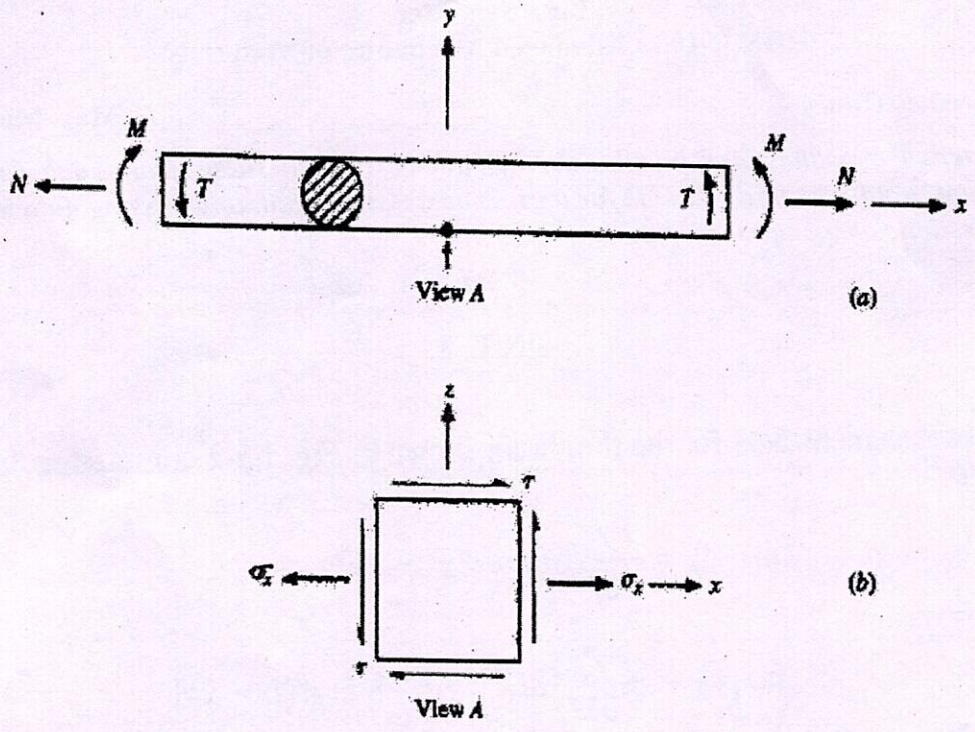

Figure Q.2

3. Estimate the shear stress and total angle of twist of the thin-walled circular cylinder shown in Fig. . The steel tube is 0.5 m long and is transmitting a torque of 1 kN·m. The material constants are E = 200 GPa and $\nu = 0.29$.

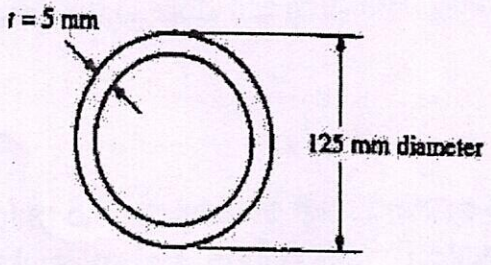

Figure Q.3

4. The channel section shown in Fig. is bending about the z axis and undergoes a net shear force V_y in the y direction. Determine (a) the shear flow throughout

the section, (*b*) the total shear force in each section, and (*c*) the shear center through which the plane of loading should intersect.

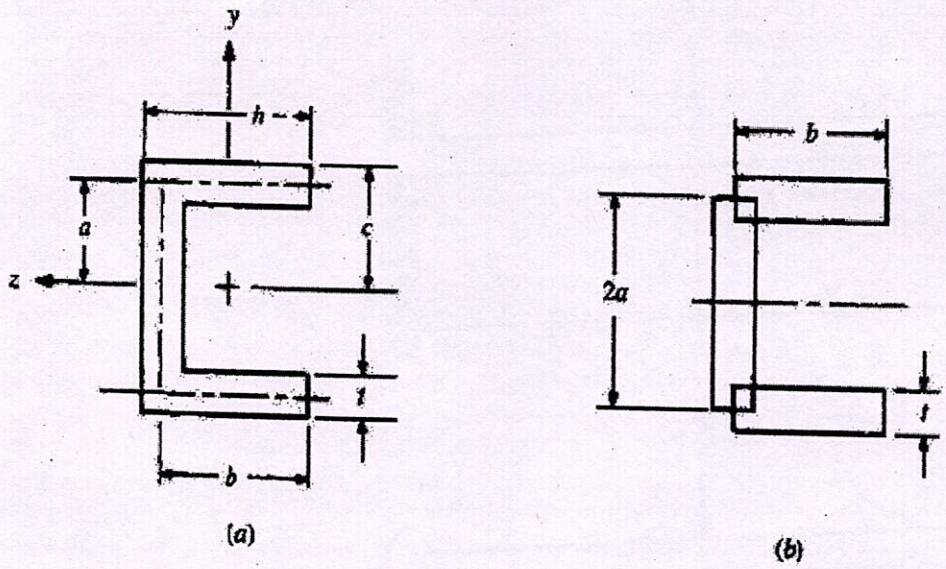

Figure Q.4

UNIT - II

5. An aluminum cylinder ($E_a = 70$ MPa, $\nu_a = 0.33$) with an outer diameter of 150 mm and inner diameter of 100 mm is to be press-fitted over a stainless-steel cylinder ($E_s = 190$ MPa, $\nu_s = 0.30$) with an outer diameter of 100.20 mm and inner diameter of 50 mm. Determine (*a*) the interface pressure p, and (*b*) the maximum stresses in the cylinders.

6. A long slender bar of rigidity EI and length L is pinned at each end to a very rigid foundation. If the coefficient of thermal expansion of the bar is α, determine the increase in temperature ΔT which will cause the bar to buckle.

7. Using Castigliano's theorem, determine the reactions at points A and B of the beam shown in Fig.

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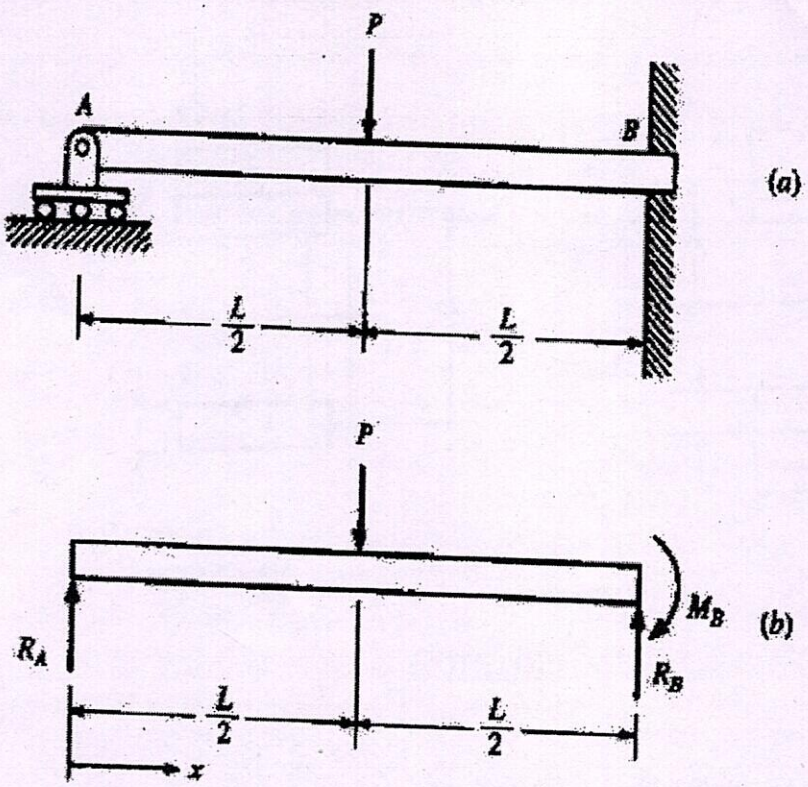

Figure Q.7

8. For a CST element in a finite element model the nodal coordinates for the i, j, and k nodes are (15, − 8) and (10, 5) and (2, 0) mm, respectively. The element is 2 mm thick and is of a material with properties $E = 70$ GPa and $\nu = 0.3$. Upon loading of the model the deflections of the given element were found to be $u_i = 100$ μm, $v_i = -50$ μm, $u_j = 75$ μm, $v_j = -40$ μm, $u_k = 80$ μm, and $v_k = -45$ μm. Determine (*a*) the element stiffness matrix, (*b*) the nodal force vector, and (*c*) the stress in the element.

x-x-x