

B.Tech. Degree III Semester Examination, December 2006

ME 304 MECHANICS OF SOLIDS

(1999 Admission Onwards)

Time: 3 Hours

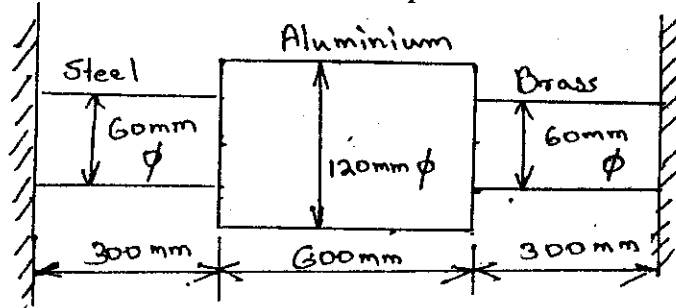
Maximum Marks: 100

- I. (a) Explain the construction of Mohr's circle of stress. (6)
 (b) Figure shows a composite bar which is rigidly fixed at the end supports. Temperature is raised by 70°C . Find the stresses in A,B,C if, supports are rigid.

For steel, $E = 200 \times 10^9 \text{ N/m}^2$ $\alpha = 12 \times 10^{-6} \text{ per } ^{\circ}\text{C}$

For Aluminium, $E = 88 \times 10^9 \text{ N/m}^2$ $\alpha = 20 \times 10^{-6} \text{ per } ^{\circ}\text{C}$

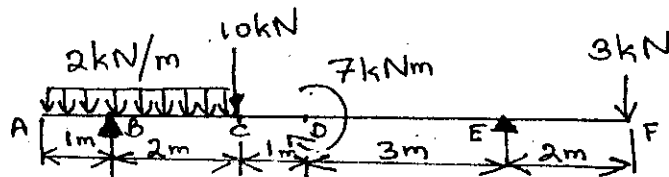
For Brass, $E = 95 \times 10^9 \text{ N/m}^2$ $\alpha = 15 \times 10^{-6} \text{ per } ^{\circ}\text{C}$.



(14)

- II. (a) Briefly explain the terms. (8)
 (i) Hook's Law (ii) Modulus of Elasticity
 (iii) Poisson's Ratio (iv) Principal Stresses
 (b) A rectangular block of material is subjected to a tensile stress of 110 MPa on one plane and a tensile stress of 47 MPa on a plane at right angles, together with a shear stress of 63 MPa on the same plane. Find the magnitude and direction of principal stresses. (12)

- III. Construct the shear force and bending moment diagrams for the beam shown below. Also locate the point of contraflexure. (20)



OR

- IV. (a) Explain the terms with reference to the bending of beams. (4)
 (i) Section Modulus (ii) Neutral Axis (4)
 (b) State the assumptions made in the theory of simple bending. (4)
 (c) Two circular beams where one is solid of diameter D and other is a hollow of outer diameter D_o and inner diameter D_i , are of the same length, same material and of the same weight. Find the ratio of section modulus of these circular beams. (12)

(Turn Over)

- V. (a) State and explain Castigliano's Theorem. (6)
 (b) A simply supported rectangular beam of span 3m is carrying in uniformly distributed load of 8KN/m over the entire span. If the allowable bending stress is $7N/mm^2$ and the allowable deflection is 10mm, find the necessary width and depth of the section. Take $E = 10^{10} N/m^2$. (14)
- OR**
- VI. (a) Briefly explain conjugate beam method. (4)
 (b) What is continuous beam? What are the advantages of continuous beams over simply supported beam? (4)
 (c) A cantilever of length 2m carries a point load of 20KN at the free end and another load of 20KN at its centre. If $E = 10^{11} Pa$ and $I = 1 \times 10^{-4} m^4$ for the cantilever then determine by moment area method, the slope and deflection of the cantilever at the free end. (12)
- VII. (a) Obtain the expression for shear stress in a circular shaft subjected to torsion. (8)
 (b) A hollow shaft with diameter ratio 3/5 is required to transmit 450KW at 120rpm with a uniform twisting moment. The shearing stress in the shaft must not exceed $60 \times 10^6 N/m^2$ and the twist in a length of 2.5m must not exceed 1° . Calculate the minimum external diameter of the shaft satisfying these conditions. Take the modulus of rigidity $C = 8 \times 10^{10} N/m^2$. (12)
- OR**
- VIII. (a) Explain the principle of superposition. (4)
 (b) Explain compound stresses with examples. (4)
 (c) 500KW power has to be transmitted at 100rpm. Determine
 (i) the necessary diameter of the solid shaft
 (ii) diameter of the hollow shaft if the inside diameter is 0.8 times the outside diameter
 (iii) saving in material when a hollow shaft is used. Allowable shear stress is $75 \times 10^6 N/m^2$ (12)
- IX. (a) Obtain the expressions for radial and circumferential stresses in a thin cylindrical vessel subjected to internal pressure. (10)
 (b) Determine the maximum and minimum hoop stress across the section of a pipe of 400mm internal diameter and 100mm thick, when the pipe contains a fluid at a pressure of $8 \times 10^6 N/m^2$. (10)
- OR**
- X. (a) State the assumptions used in the Euler's theory for long columns. (5)
 (b) Explain maximum shear stress theory. What are the limitations of this theory? (5)
 (c) Find out the ratio of strength of a solid steel column to that of a hollow steel column having same cross sectional area. Internal diameter of the hollow column is 0.6 times the external diameter. The columns have the same length and same end conditions. (10)