X. (a) What is the difference between a thin cylindrical shell and thick cylindrical shell? Explain. (8)

(b) A thick cylindrical shell is subjected to an internal pressure of 8N/mm^2. If the safe tensile stress of the material is 25N/mm^2, determine the thickness of the shell. The internal diameter of the shell is 145mm. (12)

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B.Tech. Degree III Semester Examination January 2002

ME 304 MECHANICS OF SOLIDS

Time: 3 Hours Maximum Marks: 100

I. (a) Define stress and strain. (4)

(b) What are statically indeterminate problems? Explain the procedure for solving them. (4)

(c) A composite bar consists of a 20mm diameter mild steel rod located centrally inside a copper tube and the ends brazed together. The inside and outside diameters of the copper tube are 25mm and 30mm respectively. The bar is subjected to an axial pull of 40kN. Find the stresses developed in the rod and the tube.
Take E for the copper as 100 GN/m^2 and that for steel as 200GN/m^2. (12)

OR

II. (a) Write notes on Mohr's circle of stresses. (8)

(b) At a point in an elastic material under strain there are normal tensile stresses of 50N/mm^2 and 30N/mm^2 respectively at right angles to each other, accompanied by a shear stress of 25N/mm^2. Locate the principal planes, maximum shear stress and its plane. Verify the results from Mohr's circle of stress. (12)

(Turn over)

III. (a) State the assumptions made in the theory of simple bending. (6)

(b) A beam of uniform cross section 8m long is simply supported at 2m and 6m from the left end. It carries a uniformly distributed load of 5kN/m over the left overhang of 2m and two concentrated loads 10kN and 20kN at distances 4m and 8m respectively from the left end. Draw the B.M. and S.F. diagrams for the beam. What is the maximum bending moment? (14)

OR

IV. (a) Explain the concept of beams of uniform strength in bending. (6)

(b) A simply supported beam of rectangular section is subjected to a load of 2kN distributed over its entire length of 4m span. If the depth of the section is to be twice the breadth, and the stress in the beam is not to exceed 7MPa, find the cross sectional dimensions of the beam. How will you modify the section if the load of 2kN is concentrated at the centre? (14)

V. A beam ABCD is simply supported at its ends A and D, over a span of 15m. It is made up of 3 portions AB, BC and CD, each 5m in length. The moment inertia of these sections are I, 3I and 2I respectively, where $I = 2 \times 10^{10}$ mm^4. The beam carries point loads of 150kN at B and 300kN at C. Calculate the deflection at B and slope at C. Take E = 200kN/mm^2. (20)

OR

Contd.....3

VI. A cantilever beam 4m long carries a uniformly distributed load of 3kN/m for the entire length. Two concentrated loads of 5kN each are also acting at 1m and 2m from the fixed support. Compute the slope and deflection at the free end. Assume E = 200GPa and $I = 1.5 \times 10^8$ mm^4. (20)

VII. A hollow shaft of diameter ratio of 0.6 is required to transmit 560KW at 110 rpm, the maximum torque being 20% greater than the mean. The shear stress is not to exceed 63MPa and the twist in a length of 3m is not to exceed 1.4 degrees. Determine the diameters of the hollow shaft. Take $N = 0.84 \times 10^5$ MPa. (20)

OR

VIII. A hollow shaft with its external diameter equal to 1.5 times internal diameter has to transmit a twisting moment of 100kN-m. It is subject to a bending moment of 30kN-m also. Design the shaft considering the maximum normal stress theory and also considering the maximum shear stress theory. Take safe stress value in shear as 60MPa and safe normal stress value as 120MPa. (20)

IX. An I section joist 40cm x 20cm x 2cm and 6m long is used as a strut with both ends fixed. What is Euler's crippling load for the column? Take $E = 2 \times 10^5$ MPa. (20)

OR

Contd.....4.