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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S3 (S,FE) / S1 (PT) (S,FE) Examination June 2024 (2015 Scheme)

Course Code: CE201

Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Draw the stress strain diagram for a mild steel specimen under uniaxial tension and mark the salient points. (4)

b) A hollow steel tube 3.5m long has an external diameter of 120mm. In order to determine the internal diameter, the tube was subjected to a tensile load of 400kN and extension was measured to be 2mm. If the modulus of elasticity of the tube material is 200GPa, determine the internal diameter of the tube. (5)

c) State Hooke's law and derive the formula for finding the elongation of a bar of uniform cross-sectional area 'A', Young's Modulus 'E' and length 'L' subjected to a tensile load of 'P'. (6)

2 a) A circular alloy bar 2m long uniformly tapers from 30mm diameter to 20mm diameter. Calculate the elongation of the rod under an axial force of 50kN. Take Young's Modulus for the alloy as 140GPa. (5)

b) A steel bar 2m long and 40mm in diameter is subjected to an axial pull of 80kN. Find the length of the 20mm diameter bore, which should be centrally carried out, so that the total elongation should increase by 20% under the same pull. Take modulus of elasticity for the bar material as 200GPa. (10)

3 a) A load of 50kN is suspended by a steel pipe of 50mm external diameter. If the ultimate tensile strength of steel is 500N/mm^2 and factor safety is 4, determine i) the thickness of the pipe, ii) elongation of the pipe over a length of 200mm if stressed to its maximum permissible value. Take E = 200kN/mm^2. (7.5)

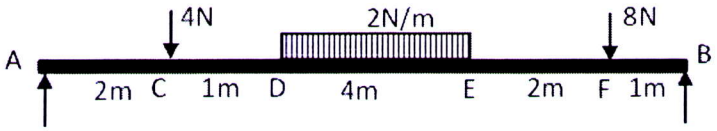
b) A gun metal rod screwed at the ends passes through a steel tube. The tube has 30mm external diameter and 25mm internal diameter. The diameter of the rod is 22mm. The assembly is heated to 423K and the nuts on the rod are then screwed tightly on the ends of the tube. Find the intensity of stress in rod and in tube when (7.5)

the common temperature has fallen to 293K. Coefficient of expansion per K for steel is 12×10^{-6}, Coefficient of expansion per K for gun metal = 20×10^{-6}, Young's modulus for gun metal is 0.915×10^5 N/mm^2 and Young's modulus for steel is 2.05×10^5 N/mm^2.

PART B

Answer any two full questions, each carries 15 marks.

4 A simply supported beam of span 10m is subjected to a combination of loads as shown in figure. Sketch the shear force and bending moment diagrams and find the position and magnitude of maximum bending moment. (15)



5 a) Draw the shear force and bending moment diagram of a cantilever of length 'l' subjected to a uniformly distributed load of 'w' per unit length over the whole span. (4)

b) Define point of contra flexure? In which beam it occurs? (3.5)

c) A circular pipe of external and internal diameter 100mm and 80 mm respectively is used as a simply supported beam. The span of the beam is 4m. Find the safe concentrated load that the beam can carry at the mid span, if permissible bending stress in the beam is 120N/mm^2. (7.5)

6 A water main of 500mm internal diameter and 20mm thick is running full. The water main is of cast iron and is supported at two points 10m apart. Find the maximum bending stress in the metal. The cast iron and water weigh 72000N/m^3 and 10000N/m^3 respectively. (15)

PART C

Answer any two full questions, each carries 20 marks.

7 Two planes which are at right angles carry shear stress of intensity 17.5N/mm^2 while these planes also carry a tensile stress of 70N/mm^2 and a compressive stress of 35N/mm^2 respectively. Determine the principal planes and the principal stresses. Also determine the maximum shear stress and planes on which it acts. (20)

8 a) A rolled steel joist ISMB 300 is to be used as a column of 3m length with both ends fixed. Find the safe axial load on the column. Take factor of safety as 3, f_c = 320N/mm^2 and $\alpha = \frac{1}{7500}$. Properties of the column section are as follows: Area = 5625mm^2 ; I_{xx} = 8.603 x 10^7 mm^4 ; I_{yy} = 4.539 x 10^7 mm^4. (10)

b) A hollow shaft of diameter ratio 3/5 is required to transmit 450kW at 120 r.p.m with a uniform twisting moment. The shear stress in the shaft must not exceed 60MPa and the twist in a length 2.5m must not exceed 1°. Calculate the minimum external diameter of the shaft. Take N = 8 x 10^4 MPa. (10)

9 a) What is meant by kern of a section? Sketch the kern of (5)

i) Circular section

ii) Square section.

b) A solid round bar of 60 mm diameter and 2.5m long is used as a strut. Find the safe compressive load for the strut using Euler's formula, if (15)

i) both ends are hinged

ii) both ends are fixed

iii) one end fixed and one end hinged.

Take E = 2 × 10^5 N/mm^2 and factor of safety = 3.

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