Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

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) Define the following terms: (i) Modulus of Rigidity (ii) Proof Resilience (iii) Factor of safety. (3)

b) The maximum instantaneous extension, produced by an unknown falling weight through a height of 4 cm in a vertical bar of length 3 m and of cross sectional area 5 cm^2, is 2.1 mm. Determine (a) the instantaneous stress induced in the vertical bar, and(b)the value of unknown weight. Take $E=2\times10^5$ N/mm^2 (8)

c) Derive the relation between Modulus of elasticity and Bulk Modulus. (4)

2 a) Write down the expression for elongation of tapering bars of (i) circular cross section (ii) rectangular cross section (4)

b) A steel rod of 3 cm diameter and 5 m length is connected to two grips and the rod is maintained at a temperature of 95°C. Determine the stresses and pull exerted when the temperature falls to 30°C if (i) the ends do not yield and (ii) the ends yield by 0.12 cm. Take $E = 2\times10^5$ N/mm^2 and $\alpha = 12\times10^{-6}$ /° C. (7)

c) A cylindrical bar with two sections of lengths 50cm and 25cm, and diameters 20mm and 15mm respectively is subjected to an axial pull such that the maximum stress is $150MN/m^2$. Calculate the strain energy stored in the bar. $E=200GN/m^2$ (4)

3 a) When a copper wire of length 2 m and diameter 40 mm is subjected to an axial pull of 80 kN, its diameter reduces by 0.00775 mm. The modulus of elasticity of copper is 105 GPa, calculate the extension of the wire, Poisson's ratio and modulus of rigidity of the material. (6)

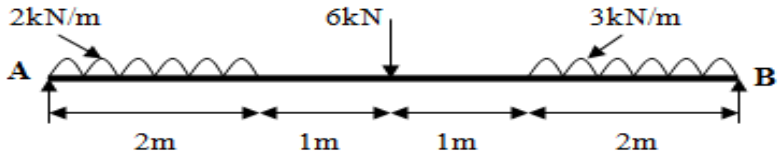
b) A compound tube consists of a steel tube 140 mm internal diameter and 160mm external diameter and an outer brass tube 160 mm internal diameter and 180 mm external diameter. The length of the compound tube is 150 mm and it carries an axial load of 900 kN. Find the stresses and load carried by each tube and the amount it shortens. Take E steel = 2×10^5 N/mm^2 and E brass = 1.1×10^5 N/mm^2. (9)

PART B

Answer any two full questions, each carries 15 marks.

4 a) A cantilever beam of span L, fixed at the left end, carries a clockwise moment M at its centre and a point load at the free end. Draw the SFD and BMD (5)

b) Draw the shear force and bending moment diagram of the simply supported beam AB shown below. Mark the salient values. Also find maximum bending moment. (10)



5 a) Define point of contra flexure and section modulus. (5)

b) A beam ABCD 12 m long carries a uniformly distributed load of 25kN/m. It is simply supported at A and C 10 m apart with an overhang CD of 2m. It also carries a clockwise couple of 100 kNm at B, 3 m from A. State the position and amount of maximum BM. Sketch the SFD and BMD (10)

6 a) What are beams of uniform strength? (5)

b) A cast iron beam of triangular section of 100 mm width and 100 mm depth is placed with its base horizontal. The beam is simply supported over a span of 6 m. If the allowable stress in tension and compression are 50 MPa and 150 MPa respectively, find the safe concentrated load at the centre of the beam. What are the extreme fibre stresses? (10)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Derive the expression for normal stress on a plane inclined at an angle θ to x axis and subjected to normal stresses in X and Y directions. (6)

b) Show that in thin cylinders, the circumferential stress is twice the longitudinal stress when subjected to internal pressure. (6)

c) Determine the maximum power transmitted at 280 rpm by a steel shaft of 35 mm internal diameter and 4.5 mm thick, if the allowable stress is 75 MPa and the angle of twist is not to exceed 1˚ in a length of 1.5 m. Assume G= 80 GPa for the material. (8)

8 a) At a point in a stressed material, the normal stress on a plane is 50 N/mm^2 (T) and a normal stress of 30 N/mm^2 (C) is acting on the plane perpendicular to the given plane. The shear stress acting on these planes is 25 N/mm^2. Determine the principal stresses and their planes using Mohr's circle. Also determine the maximum shear stress at that point. (10)

b) Differentiate Macaulay's method, double integration method and moment area method in computation of slope and deflection in beams (4)

c) A steel column made of a 4 m long hollow circular section, having 300 mm internal diameter and 20 mm thick, is fixed at both the ends. Determine the safe axial load the column can carry with a factor of safety 3.5 using Euler's formula. $E=2.1\times10^5$ N/mm^2 (6)

9 a) Define i) slenderness ratio ii) Kern of a circular section (5)

b) State the various stresses acting at a point in a thick cylinder with closed ends subjected to internal pressure. Write down the Lame's equations detailing the various terms. (5)

c) Find the maximum deflection and slope at the supports of a simply supported beam of span 6 m and carrying a udl of 2 kN/m over the left half of the span. Assume EI = 4×10^{12} Nmm^2 (10)

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