Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

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) Differentiate between(i) Normal stress and shear stress (ii) Young's modulus and Rigidity modulus (iii) Poisson's ratio and volumetric strain (3)

b) A steel bar ABCD consists of three sections: AB is of 20 mm diameter and 200 mm long, BC is 25 mm square and 400 mm long and CD is of 12 mm diameter and 200 mm long. The bar is subjected to an axial compressive load which induces a stress of 30 MN/m^2 on the largest cross section. Determine total decrease in length of the bar when the load is applied. Assume E = 210 GPa (8)

c) Find the Poisson's ratio and bulk modulus of a material whose modulus of elasticity is 200 GPa and modulus of rigidity is 80 GPa. A 2 m long rod of 40 mm diameter made with the same material is stretched by 2.5 mm under some axial load. Find the lateral contraction. (4)

2 a) A linearly tapered bar with circular cross section is subjected to an axial load. Derive an expression for the change of length. (5)

b) A brass bar of 25 mm diameter is enclosed in a steel tube of 25 mm internal diameter and 50 mm external diameter. Both of them are 1m long at room temperature and fastened rigidly to each other at the ends. If the room temperature is 20^oC, find to what temperature the assembly should be heated so as to generate a compressive stress of 48.7 MN/m^2 in brass. What is the stress in steel at this temperature? Assume E_s=200 GN/m^2; E_b=100 GN/m^2; α_s=11.6 x 10 $^{-6}/^oC$; α_b =18.7 ×10 $^{-6}/^oC$ (8)

c) Obtain the expressions for strain energy stored in a prismatic bar due to axial load. (2)

3 a) Draw the stress strain curve of mild steel and mark the salient points (6)

b) A vertically suspended bar with collar at lower end has 30 mm diameter. If a tensile load of 7500 N is applied gradually it produces an extension of 0.3 mm. Determine the height from which this load should be dropped to produce a (9) maximum stress of 95 N/mm^2. Assume E = 200GPa

PART B

Answer any two full questions, each carries 15 marks.

4 a) A simply supported beam of span L carries a clockwise moment M at its centre. Draw the SFD and BMD (4)

b) Draw the shear force and bending moment diagrams for a cantilever beam of span 5 m subjected to a uniformly distributed load of 5 kN/m over a length of 2 m starting from the free end. (7)

c) Draw the shear stress distribution for a triangular cross section and mark the salient values. (4)

5 a) What is section modulus? Express the section modulus of (i) rectangular section (width=b, depth=d) , (ii) circular section (diameter=d) and (iii) Hollow circular section (Internal diameter=d, External diameter=D) . (5)

b) A beam of I section 200 mm wide and 300 mm deep with flange and web thickness 20 mm is used as a simply supported beam over a span of 7 m. The beam carries a distributed load of 5 kN/m over the whole span and a concentrated load of 20 kN at mid span. Determine the maximum bending stress set up and sketch the stress distribution. (10)

6 a) Obtain the relationship between bending moment, shear force and load intensity at any section of a beam. (5)

b) The intensity of loading on simply supported beam of 5 m span increases gradually from 1 kN/m at one end to 2 kN/m at the other end. Find the position and amount of maximum bending moment. Also draw the SFD and BMD. (10)

PART C

Answer any two full questions, each carries20 marks.

7 a) Derive the expression for the stresses on an oblique plane of a rectangular body when the body is subjected simple shear stress. (6)

b) A hollow shaft is of external diameter 70 mm and diameter ratio 0.8. It transmits a power of 2 HP at 25 rpm. If the maximum torque exceeds the average torque by 25%, draw the shear stress distribution across the section of the shaft indicating the values. (8)

c) Calculate minimum wall thickness of a thin cylinder 1 m in diameter if it is to withstand an internal pressure of 2 N/mm^2 and hoop stress not to exceed 40 (6)

N/mm^2. Also find change in diameter. E = 210 GPa; Poisson's ratio = 0.3.

8 a) At point in an elastic material under strain, there are normal stresses of 60 MN/m^2(tensile) and 35 MN/m^2(compressive) respectively at right angles to each other with a shearing stress of 25 MN/m^2. Find the principal stresses and position of principal planes. Find also the maximum shear stress and its plane. (10)

b) State the two theorems of determining beam deflections by moment area method. (4)

c) Determine the ratio of buckling strength of two columns one hollow and other solid, both are made of same material and have equal length, cross sectional area and same end conditions. Internal diameter of hollow column is half the external diameter. (6)

9 a) Differentiate between long column and short column. (5)

b) Derive Rankine's formula for finding the critical load of columns. (5)

c) A cantilever of length 3 m is carrying a UDL of 10 kN/m over a length of 2 m from fixed end. Find the maximum slope and deflection. Assume EI = 4×10^{12} Nmm^2 (10)

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