

Reg No.: _____

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

Course Code: ME201

Course Name: MECHANICS OF SOLIDS (ME, MP, MA, MT, AU, PE, SF)

Max. Marks: 100

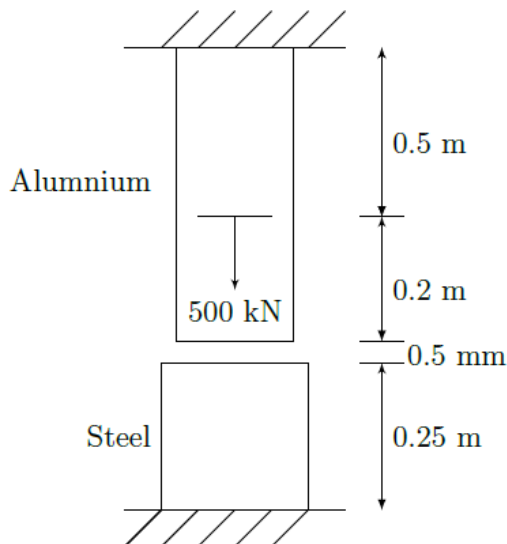
Duration: 3 Hours

PART A

Answer any three full questions, each carries 10marks

Marks

- 1 A bar 460 mm long is of diameter 25 mm for an initial length of 200 mm and 40 mm diameter for the remaining length. Find the stresses produced in the individual sections for an applied load of 20 kN and the total elongation. Take E as 200 GPa. (10)
- 2 a) Define isotropic and orthotropic material? (3)
- b) Figure shows an aluminium bar of 700 mm length and of 1250 mm² cross sectional area suspended from the ceiling so that its clearance is 0.5 mm between it and a steel bar of 250 mm length and of 2500 mm² cross sectional area. Find the stress in the two bars when 500 kN of load is applied at 500 mm from the ceiling, $E_a=70$ GPa and $E_s=210$ GPa. (7)



- 3 A brass rod 30 mm diameter is enclosed in a steel tube of 50 mm external diameter and 30 mm internal diameter is initially kept at room temperature of 28°C. The ends of rod and tube which are of length 1.6 m are fastened. Find the stresses developed in both the materials when the temperature is raised to (10)

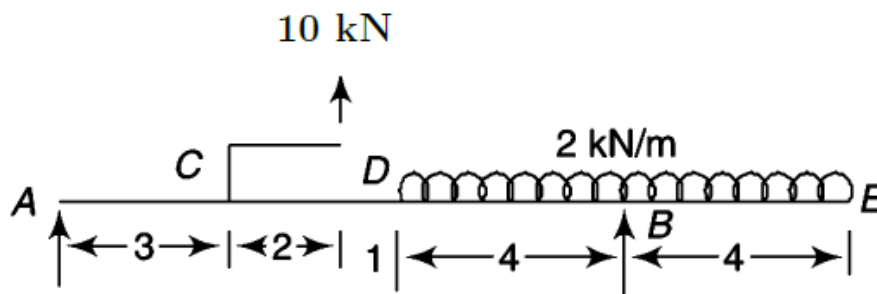
100°C. The Young's modulus for steel and brass are respectively 200 kN/mm² and 100 kN/m². The coefficient of thermal expansion values for steel and brass are respectively $11.6 \times 10^{-6}/^\circ\text{C}$ and $18.7 \times 10^{-6}/^\circ\text{C}$.

- 4 a) Derive the torsion formula with assumptions. (8)
 b) Define the term torsional rigidity. (2)

PART B

Answer any three full questions, each carries 10marks

- 5 a) Distinguish between roller and hinged support. (2)
 b) A simply supported beam has a span of 9 m and carries a uniformly distributed load of 20 kN/m over the whole span along with two, point loads of 30 kN and 40 kN at 6 m and 7.5 m respectively from the left-hand support. Draw the shear force and bending moment diagrams indicating values at the point loads. (8)
- 6 A 14-m simply supported beam with an overhang at the right end is loaded as shown in Fig. It carries a load of 10 kN applied through a bracket and also a uniformly distributed load for 8 m length from the right end. Draw the shear force and bending moment diagram. Also find point of contra flexure. (10)



- 7 a) Discuss the significance of flexural rigidity in the design of beams. (3)
 b) A simply supported 150 mm wide, 300 mm deep and 4 m long beam carries a uniformly distributed load of 15 kN /m throughout the span. Determine the maximum bending stress and also determine the bending stress at the point which is 50 mm below the top surface and 1.2 m from the left support. (7)
- 8 At critical section of a I beam, the value of shear force is 45 kN and the sectional dimensions are: flange width 200 mm, flange thickness 30 mm, web thickness 30 mm and the total depth is 300 mm. Draw the shear stress distribution across the depth of the section. (10)

PART C

Answer any four full questions, each carries 10marks.

- 9 a) A cantilever of uniform section has a length 'l' and carries a point load W at the free end. Find the deflection at a point 'l/3' from the fixed end. (7)
- b) State the significance of stress transformation equations (3)
- 10 A simply supported beam of length 6 m carries a uniformly distributed load of 10 kN/m from 1 m and ending at 4 m from left end. Using Macaulay's method calculate i) Slope at left end. (10)
- ii) Deflection at mid span.
- iii) Maximum deflection.
- Take E=200 Gpa and Moment of inertia $I=450 \times 10^6 \text{ mm}^4$
- 11 The normal stresses at a point in an elastic material are 100 MPa (tensile) and 60 MPa (compressive) respectively at right angles to each other with shearing stress of 50 MPa. Determine the i) Principal stresses and the position of principal planes ii) Maximum shear stress and its plane. (10)
- 12 a) The two-dimensional state of stress in a body is $\sigma = \begin{bmatrix} 0 & 60 \\ 60 & 0 \end{bmatrix}$ in Mpa. Using Mohr's circle method, determine the principal stresses, location of principal planes, maximum shear stress and its planes. (7)
- b) Define two-dimensional state of stress. (3)
- 13 a) Write short note on strain rosette. (3)
- b) A shaft at a certain cross section of 120 mm diameter is subjected to a bending moment of 5 kN-m and twisting moment 10 kN-m. Find the principal stresses and maximum shear stresses. (7)
- 14 a) Define the term equivalent length and slenderness ratio of column. (4)
- b) A 4 m long column with both ends firmly fixed supports an axial load of 500 kN. The inside diameter of the column is 0.5 times the outside diameter. Determine the inside and outside diameter of column. Assume factor of safety to be 5, crushing stress 560 MPa and Rankine constant 1/1600. (6)
