Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION JANUARY 2017

ME 201: MECHANICS OF SOLIDS

(AU, MA, ME, MP, MT, PE, SF)

Maximum Marks: 100 Time : 3 Hours

PART – A

Answer any three questions.

1. a) Explain the stress-strain curve of a mild steel bar in tension test. (5)

   b) A straight bar 450 mmlong is 40 mm in diameter for the first 250 mm length and 20 mm diameter for the remaining length. If the bar is subjected to an axial pull of 15 kN find the maximum and minimum stresses produced in it and the total extension of the bar. Take E = 2×10^5 N/mm^2. (5)

2. A bar made of brass and steel as shown in Fig.1 is held between two rigid supports A and C.Find the stresses in each material if the temperature rises by 40°C. Take $E_b = 1 \times 10^5$ N/mm^2 ;$\alpha_b = 19 \times 10^{-6}$ / °C , $E_s = 2 \times 10^5$ N/mm^2 ; $\alpha_s = 12 \times 10^{-6}$ / °C

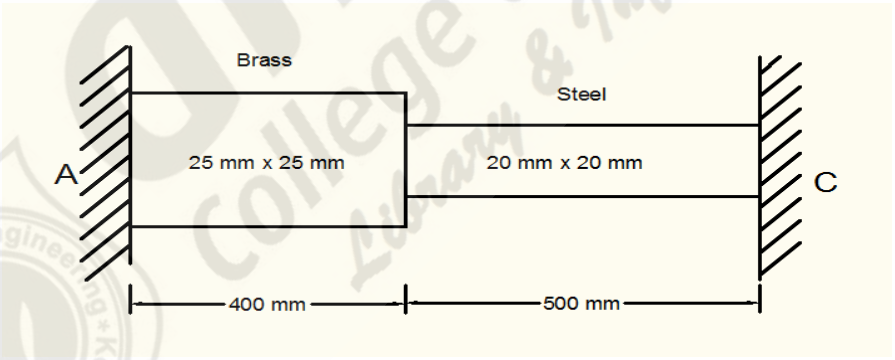

Fig : 1 (10)

3. a) What is a stress tensor? Explain different ranks of a tensor. (5)

   b) A cylindrical bar is 20 mm diameter and 800 mm long. During a tensile test it is found that the longitudinal strain is 4 times the lateral strain. Calculate the modulus of rigidity and the bulk modulus, if its elastic modulus is 1×10^5 N/mm^2. Find the change in volume, when the bar is subjected to a hydrostatic pressure of 100 N/mm^2. (5)

4. A solid shaft of 6m length is securely fixed at each end. A torque of 80 Nm is applied to the shaft at a section 2 m from one end.

a) Find the fixing torques set up at the ends of the shaft. (4)

b) If the shaft is of 50 mm diameter, find the maximum shear stresses in the two portions. (4)

c) Find the angle of twist for the section where the torque is applied. (2)

Take C = 10^5 N/mm^2.

PART B

Answer any three questions

5. Draw SFD and BMD for the overhanging beam shown in Fig. 2. Locate the points of contraflexure. Also determine the maximum bending moment. (10)

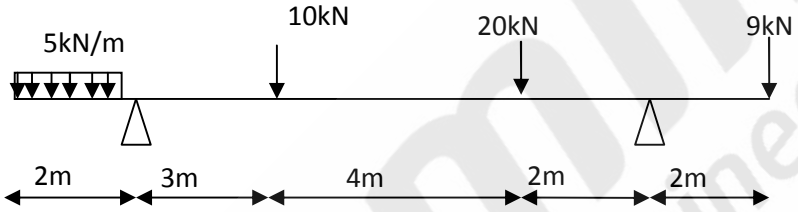

Fig. 2

6. a) Derive the relation between intensity of loading, shear force and bending moment at a section of a uniformly loaded beam. (4)

   b) A simply supported beam of length 4m carries a uniformly distributed load of 3kN/m over the central 2m length and two point loads 2kN and 3kN at distances 0.5m and 3.5m from the left support. Draw SFD and BMD. Locate the point of maximum bending moment and find out the maximum bending moment. (6)

7. a) What is pure bending? Explain with example. (4)

   b) A wooden beam 3m long is simply supported at its ends and has a cross section 200mm x 400mm. It carries a uniformly distributed load of 40kN/m over the entire span. Calculate the bending stress at a point 100mm above the bottom and 1m from the left support. (6)

8. a) Explain how beams of uniform section can be designed in practice (4)

   b) At the critical section of a I-beam, the value of vertical shear force is 40kN and the sectional dimensions are:- Flange width – 200mm, flange thickness – 30mm, web thickness - 40 mm and total depth – 300mm. Draw the shear stress distribution across the depth of the section. (6)

PART – C

Answer any four full questions.

9. A beam of length 6m is simply supported at its ends and carries two point loads of 48kN and 40kN at a distance of 1m and 3m respectively from the left support. Find the deflection under each load and the maximum deflection by Macaulay's method. Given E= 2x105 N/mm^2 and I= 85x106 mm^4. (10)

10. State of stress at a point in a material is 100N/mm^2 (tensile) upon a horizontal plane and 50N/mm^2 (compressive) upon a vertical plane. These planes also carry a shear stress of 75N/mm^2 as shown in fig. Determine principal stresses, maximum shear stress, plane of maximum shear stress and the resultant stress on the plane of maximum shear stress. (10)

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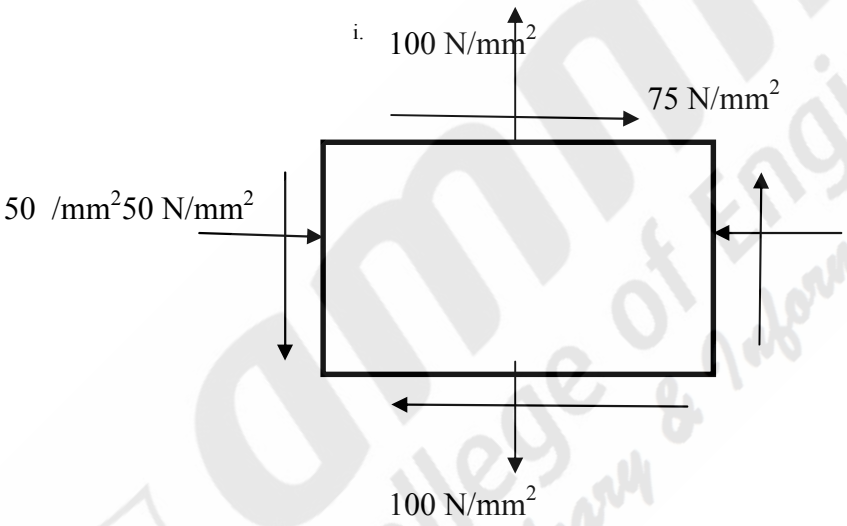

11. Explain double integration method to find the deflection of a cantilever beam with a point load at the free end (10)
12. Derive Euler's buckling load for slender columns with ends hinged (10)
13. A 1.5m long column has a circular cross section of 5cm diameter. One of the ends of the column is fixed in direction and position and other end is free. Taking factor of safety as 3, calculate the safe load using Rankin's formula, take yield stress as 560 N/mm^2 and α = 1/1600 for pinned ends (10)
14. Explain the terms:

a. Principal planes and principal stresses (5)
b. Mohr's circle of stresses (2)
c. Strain rosettes (3)