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### Third Semester B.E. Degree Examination, June/July 2017
## Mechanics of Materials

Time: 3 hrs.                                                     Max. Marks:100

**Note:** *Answer FIVE full questions, selecting*
*at least TWO questions from each part.*

## PART – A

1   a. List and explain the mechanical properties of engineering materials. **(10 Marks)**
    b. A round stepped bar is subjected to an axial force of 30 kN. Diameter and length of first portion are 40 mm and 200 mm respectively and those of second portion are 20 mm and 100 mm respectively. Determine change in deformation when a uniform bar with same volume and length as that of stepped bar is subjected to 30 kN. Take E = 200 GPa.
                                                                    **(10 Marks)**

2   a. Show the relation between Young's modulus and modulus of rigidity. **(10 Marks)**
    b. A compound bar consisting of steel, Bronze and aluminium bars connected in series is held between two supports as shown in Fig.Q2(b). When the temperature of the compound bar is increased by 50°C, determine the stresses induced in each bar. Consider the two cases: i) Rigid supports and ii) Supports yield by 0.5 mm. Take $\alpha_s = 12 \times 10^{-6}/°C$, $\alpha_B = 19 \times 10^{-6}/°C$, $\alpha_{AL} = 22 \times 10^{-6}/°C$, $E_s = 200$ GPa, $E_B = 83$ GPa and $E_{AL} = 70$ GPa.


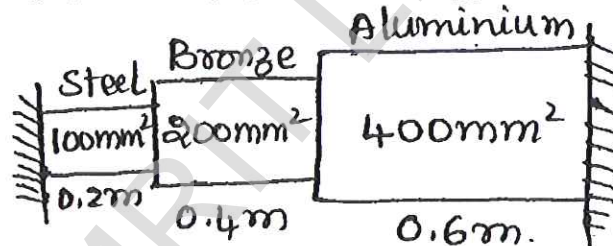Fig.Q2(b)                                                           **(10 Marks)**

3   a. Explain : i) Principal planes and principal stresses and ii) Maximum and minimum shear stresses with respect to compound stress. **(06 Marks)**
    b. Describe the construction of Mohr's circle for plane stress. **(06 Marks)**
    c. A point in a beam is subjected to maximum tensile stress 110 MPa and shear stress 30 MPa. Find the magnitudes and directions of principal stresses. If the point in the beam is in the compression zone under the same magnitude of bending stress and shear stress. Find the magnitudes of principal stresses and their directions. **(08 Marks)**

4   a. Explain the concept of circumferential stress and longitudinal stress corresponding to thin cylinders. **(10 Marks)**
    b. A cylindrical pressure vessel of 1 meter inner diameter and 1.5 meters long is subjected to an internal pressure P, thickness of the cylinder wall is 15 mm. Taking allowable stress for cylinder material as 90 MPa. Determine: i) Magnitude of maximum internal pressure P that the pressure vessel can with stand and ii) Change in dimensions. Take E = 200 GPa and $\gamma = 0.3$. **(10 Marks)**

## PART – B

5  a. Define and explain the following terms:
   i) Shear force        ii) Bending moment
   iii) Shear force       iv) Bending moment diagram      **(06 Marks)**

   b. Define and explain the following types of load:
   i) Concentrated load
   ii) Uniformly distributed load
   iii) Uniformly varying load          **(06 Marks)**

   c. A simply supported beam of length 6m, carries point load of 3 kN and 6 kN at distances of 2 m and 4 m from the left end. Draw the shear force and bending moment diagrams for the beam.      **(08 Marks)**

6  a. What do you mean by 'simple bending'? What are the assumptions made in the theory of simple bending?      **(07 Marks)**

   b. A cantilever of length 2 meter fails when a load of 2 kN is applied at the free end. If the section of the beam is 40 mm × 60 mm, find the stress at the failure.      **(05 Marks)**

   c. An I-section beam 350 mm × 150 mm has a web thickness of 10 mm and a flange thickness of 20 mm. If the shear force acting on the section is 40 kN, find the maximum shear stress developed in the I-section.      **(08 Marks)**

7  a. Derive an equation for deflection.      **(10 Marks)**

   b. What is a Macaulay's methods? Where is it used?      **(04 Marks)**

   c. A 2 meters long cantilever is subjected to UDL of 10 kN/m throughout its length and is vertically downward point load 20 kN at its free end. Taking E = 200 GPa and maximum deflection as 0.3 mm determine the width and depth of rectangular section. Depth of the section is twice the width.      **(06 Marks)**

8  a. Derive the relation for a circular shaft when subjected to torsion as given by $\dfrac{T}{J} = \dfrac{\tau}{R} = \dfrac{G\theta}{L}$.

   Also list out the assumptions made while deriving the relation.      **(10 Marks)**

   b. Derive an expression for the Euler's crippling load for a long column when both the ends of the column are hinged.      **(10 Marks)**

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