INTERNATIONAL CENTRE FOR APPLIED SCIENCES
MAHE, MANIPAL

B.S. (ENGG.) End – Semester Theory Examinations – Nov./ Dec. 2020

III SEMESTER - STRENGTH OF MATERIALS (CE 241)

(Branch: Mechanical)

Time: 3 Hours **Date: 25 November 2020** **Max. Marks: 100**

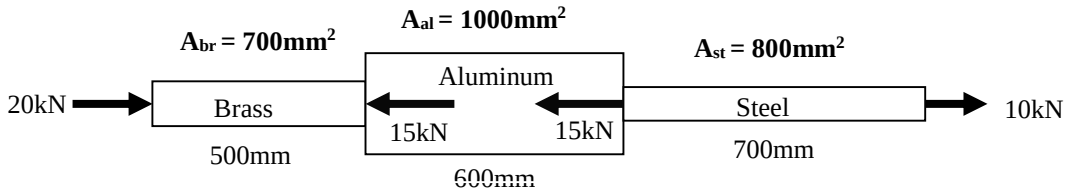
- ✓ **Answer any FIVE full questions.**
- ✓ **Missing data, if any, may be suitably assumed**

1A. Explain (i) Proportional limit (ii) Nominal breaking stress (iii) Yield point (iv) Factor of Safety **[10]**

1B. A 1.5m long steel bar is having uniform diameter of 40mm for a length of 1 m and in the next 0.5m its diameter gradually reduces from 40mm to 20mm. Determine the elongation and stress in both the portions of this bar when subjected to an axial tensile load of 160kN. Take E = 200 GPa. **[10]**

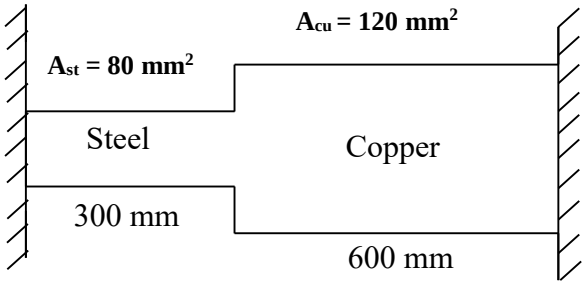
2A. Explain the principle of (i) Compound bar (ii) Temperature stress in compound bar. **[10]**

2B. An aluminum tube is rigidly fastened between a brass rod and steel rod. Axial loads are applied as indicated in the figure. Determine the stresses in each material and total deformation.
Take E_{al} = 70GPa, E_{br} = 100GPa, E_{st} = 200GPa **[10]**



3A. Explain with neat sketches (i) Pure or Simple bending (ii) Neutral axis (iii) BMD **[10]**

3B. A stepped compound bar shown in figure is fixed at two ends rigidly. The bar is free from stresses when its temperature is 30° C. when the temperature of the bar is increased to 90° C, determine the stresses induced in steel and copper portions.
Take E_{cu} = 100 GPa, E_{st} = 200 GPa, α_{cu} = 1.8 x 10^{-5}/°C and α_{st} = 1.2 x 10^{-5}/°C **[10]**



4A. Explain the terms (i) Torsional Rigidity (ii) Flexural Rigidity (iii) SFD (iv) Effective length of a column. **[10]**

4B. A shaft is required to transmit 245kW power at 240 rpm. The maximum torque is 50% more than the mean torque. The shear stress in the shaft is not to exceed 40N/mm^2 and the twist 1^o per meter length. Taking G = 80kN/mm^2, determine the diameter required if the shaft is hollow with external diameter twice the internal diameter. **[10]**

5A. Define the four elastic constants E, G, μ and K with usual notations **[10]**

5B. A beam simply supported at ends A and B separated by distance 6m is loaded with two point loads of 60kN and 50kN at a distance of 1m and 3m respectively from end A. Determine the position and magnitude of maximum deflection. Take E = 210 kN/mm^2, I = 85 x 10^6 mm^4. **[10]**

6A. With usual notation determine the maximum deflection for a cantilever beam of length L, carrying UDL throughout the span. **[10]**

6B. A circular concrete pillar consists of six steel rods of 22mm diameter each reinforced into it. Determine the diameter of pillar required when it has to carry a load of 1000 kN. Take allowable stresses for steel & concrete as 140Mpa & 8Mpa respectively. The modular ratio (E_S/E_C) is 15. **[10]**

7A. At a certain point in a strained material the intensities of normal stresses on two planes at right angles to each other are 20MPa and 10MPa, both tensile. They are accompanied by shear stress of 10MPa. Find the principal planes & the principal stresses and show them on a sketch. **[10]**

7B. A hollow cylindrical column having 400 mm external diameter is hinged at both ends. The length of column is 4.2m. Determine the safe load the column can carry with a factor of safety of 5 using Rankine's formula. Take the internal diameter of the column is 0.8 times the external diameter and σ_c = 550 MPa & a = 1/1600 in the Rankine's formula. **[10]**

8A. The beam having 'T' cross section (Flange width = 200 mm, overall depth = 275 mm and thickness = 25mm) has a simple span of 5 m. If the extreme fibre stresses are restricted to 100 MPa & 50 MPa under tension & compression respectively, calculate the safe UDL (throughout the span) the beam can carry. **[10]**

8B. A single side overhanging beam ABC (with span AB equals 6m and overhanging portion BC of 2m length) is subjected to uniformly distributed load of 5 kN/m over AB portion and a point load of 5 kN at the free end C of the beam. Draw SFD and BMD for the beam. Also Locate the inflection points if any. **[10]**

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