Department of Civil Engineering

NATIONAL INSTITUTE OF TECHNOLOGY CALICUT

Winter Semester 2024

Mid Sem Exam, 28 Feb 2024

Name:_____

Roll. No:_____

Sl. No:_____ S_2 $C_1/C_2/C_3/C_4$

CE1012E MECHANICS OF SOLIDS

Duration: 11 am to 1 pm | Maximum Marks: [30]

Note: (a) *Answer* **all** *questions* (b) Provide neat sketches (c) Assume missing data suitably (d) Read the questions carefully

1. A tensile force of 2 kN is applied to a 400 mm long aluminium rod with a diameter of 10 mm. If the length extends to 400.15 mm due to the applied load, calculate the tensile stress and modulus of elasticity of the rod. [4]

2. A steel rod of 60 mm diameter is encased by a cast iron tube of internal diameter 60 mm and thickness 8 mm as shown in Fig. 2. The 1 m long rod ends are rigidly fixed and the assembly is subjected to an axial tensile force of 40 kN. Find the stresses in the two materials and elongation of the assembly. Assume E_s = 200 GPa and E_c = 100 GPa. [6]

3. A steel rod of 20 mm diameter and 1.2 m length is rigidly connected to a brass rod of 30 mm diameter and 1.8 m length and fastened to rigid supports at the ends as shown in Fig. 3. It is heated up from a room temperature of 30° C to 70° C. If $\alpha_s = 12\times10^{-6}$ / °C and $\alpha_b = 17\times10^{-6}$ / °C, determine the stresses developed in the bars. Also find the displacement of point *B*. Assume E_s = 200 GPa and E_b = 100 GPa. [6]

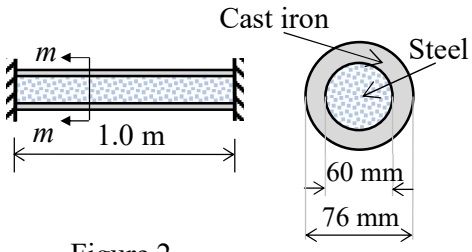


Figure 2

Section *m-m*

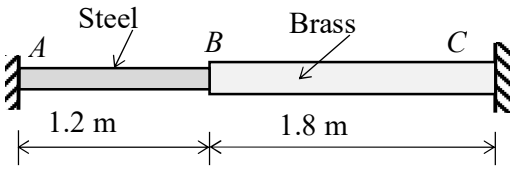


Figure 3

4. Compute the maximum compressive and tensile bending stresses in a cantilever beam subjected to a concentrated load of 100 N as shown in Fig. 4. Assume *E* = 101 GPa. [6]

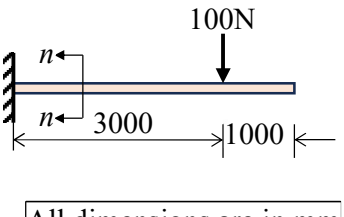
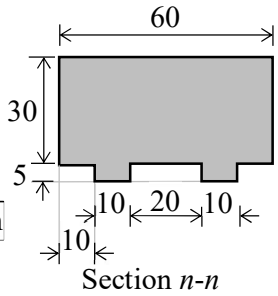


Figure 4



Section *n-n*

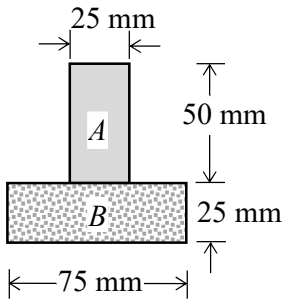


Figure 5

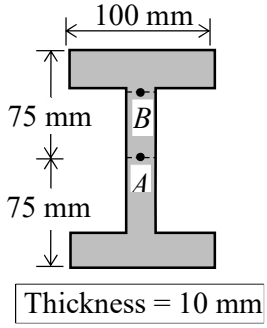


Figure 6

5. The cross section of a composite beam is shown in Fig. 5. Member *A* has a modulus of elasticity of 100 GPa and member *B* has a modulus of elasticity of 200 GPa. Find the maximum bending stresses in the section both in tension and compression, if the maximum bending moment in the beam is 5 kNm. [6]

6. The cross section of an *I*-beam is shown in Fig. 6. Determine the vertical shear stresses at *A* and *B* for a vertical shear force of 20 kN. Note that point *B* is located just below the top flange. [4]

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