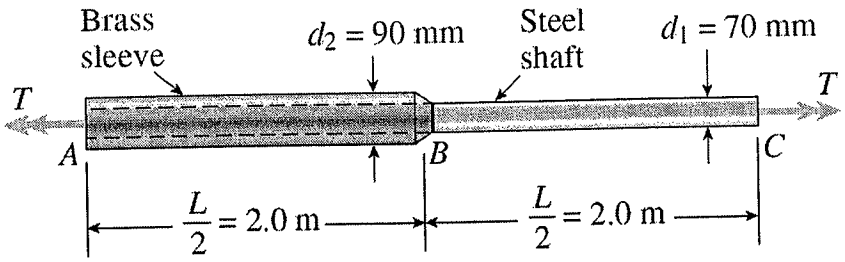
Uva Wellassa University, Sri Lanka
End Semester Examination – August 2011
SCT 364-2 Strength of Materials

Time: Two (02) Hours

Total **04** Questions
Answer **all** questions

1. A steel shaft (G_s = 80 GPa) of total length L = 4.0 m is encased for one-half of its length by a brass sleeve (G_b = 40 GPa) that is securely bonded to the steel (see FigQ01). The outer diameters of the shaft and sleeve are d_1 = 70 mm and d_2 = 90 mm, respectively.



FigQ01

a) Determine the allowable torque T_1 that may be applied to the ends of the shaft if the angle of twist ψ between the ends is limited to 8.0°.

(25 Marks)

b) Determine the allowable torque T_2 if the shear stress in the brass is limited to τ_b = 70 MPa.

(25 Marks)

c) Determine the allowable torque T_3 if the shear stress in the steel is limited to τ_s = 110 MPa.

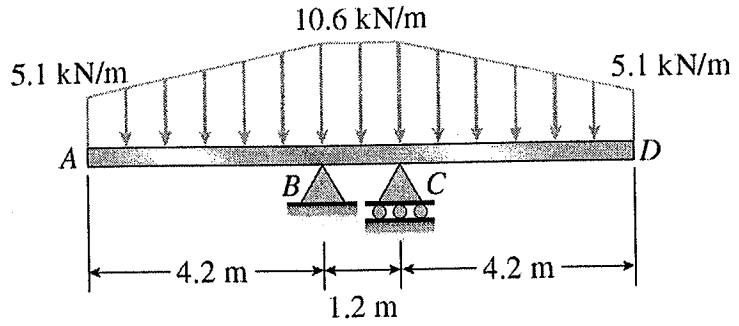
(25 Marks)

d) What is the maximum allowable torque T_{max} if all of the above three preceding conditions must be satisfied?

(25 Marks)

2.

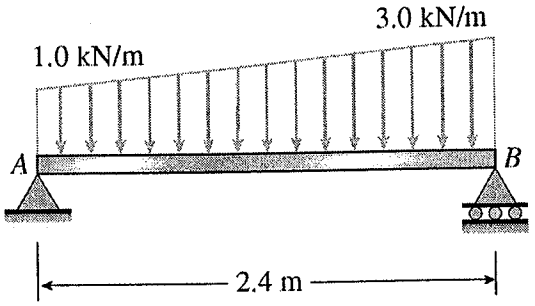
a) The beam *ABCD* shown in the Fig02a has overhangs that extend in both directions for a distance of 4.2 m from the supports at *B* and *C*, which are 1.2 m apart. Draw the shear-force and bending-moment diagrams for this overhanging beam.



FigQ02a

(50 Marks)

b) A beam with simple supports is subjected to a trapezoidally distributed load (see FigQ02b). The intensity of the load varies from 1.0 kN/m at support *A* to 3.0 kN/m at support *B*. Draw the shear-force and bending-moment diagrams for this beam.



FigQ02b

(50 Marks)

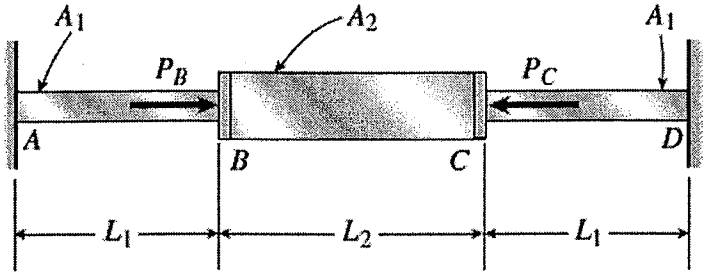
3. The fixed-end bar *ABCD* consists of three prismatic segments, as shown in the FigQ03. The end segments have crosssectional area A_1 = 840 mm^2 and length L_1 = 200 mm. The middle segment has cross-sectional area A_2 = 1260 mm^2 and length L_2 = 250 mm. Loads *PB* and *PC* are equal to 25.5 kN and 17.0 kN, respectively.

a) Determine the reactions R_A and R_D at the fixed supports.

(25 Marks)

b) Determine the compressive axial force F_{BC} in the middle segment of the bar.

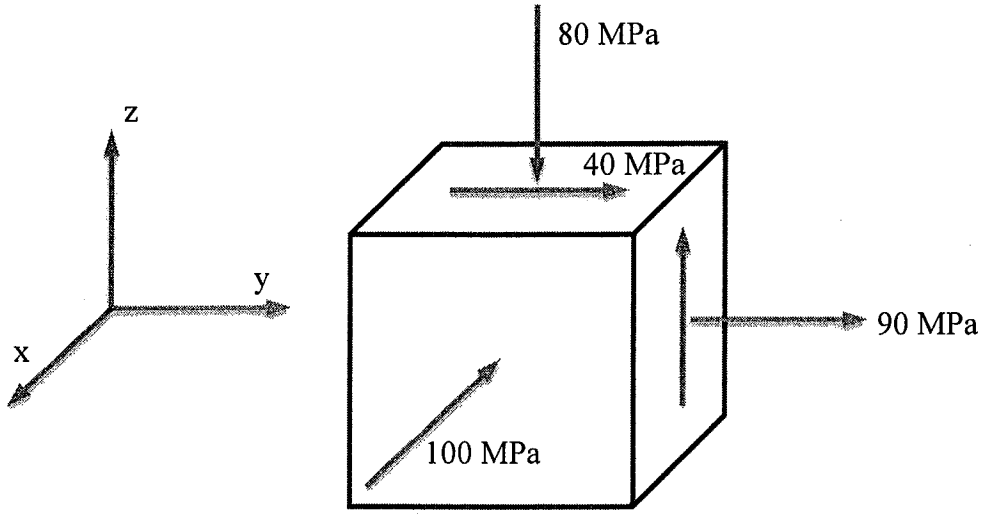
(75 Marks)



FigQ03

4.

a) Stress at a point is shown on the element (FigQ04). Determine the principal stresses and the absolute maximum shear stress.



FigQ04

(50 Marks)

b) An element of material in *plane strain* is subjected to strains $\varepsilon_x = 480 \times 10^{-6}$, $\varepsilon_y = 70 \times 10^{-6}$, and $\gamma_{xy} = 420 \times 10^{-6}$. Determine the following quantities:

(i) the strains for an element oriented at an angle $\theta = 75°$,

(12 Marks)

(ii) the principal strains, and

(12 Marks)

(iii) the maximum shear strains.

(12 Marks)

(iv) Show the results on sketches of properly oriented elements.

(14 Marks)

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