Strength of Materials-I
(ME-201, May 2007)

Time: 3 Hours Max. Marks: 60

Note: Question No. 1 is compulsory. Attempt any four questions from section B and two questions from section C.

Section-A

1. (a) Differentiate between column and strut.
   (b) What are principal planes?
   (c) What are flitched beams?
   (d) Define parallel axis theorem.
   (e) What is factor of safety?
   (f) Define flexural rigidity of a beam.
   (g) What is measurement of ductility?
   (h) Define polar moment of inertia.
   (i) What is hoop stress?
   (j) State Hooke's law.

Section-B

2. Derive the torsion formula $T/I_p = \tau/\rho = G\theta/L$ for circular shafts.
3. A beam of triangular section with 100 mm base width and 250 mm deep is subjected to a maximum shear force of 50 KN. Determine the maximum shear stress in the beam.
4. The mid span deflection of a simply supported beam (span = 5m) loaded with a concentrated load 20 KN at the centre, is 2.5 mm. Determine the maximum deflection if the concentrated load is replaced by a UDL of intensity 4KN/m acting over the whole span of the beam.
5. A closed coil spring, having mean coil diameter as 8 times the wire diameter, is to be designed to absorb 250 N-m of energy with an extension of 80 mm. the maximum shear stress is not to exceed 150 MPa. Determine the mean coil diameter and the number of turns. Assume modulus of rigidity G = 84 GPa.
6. For the arrangement shown in Fig-1, there is a gap between the aluminum bar and the rigid slab that is supported by the two copper bars. At 10°C, Δ = 0.18 mm. Neglecting the mass of the slab, calculate stress in each rod when the temperature of the assembly is raised t0 95°C. For each copper bar, A = 500mm^2, E = 120 GPa and α = 16.8 x 10^{-6}/°C, and for aluminum bar A = 400mm^2, E = 70 GPa and α = 23.1 x10^{-6}/°C.

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Fig.-1

7. The state of stress on an element is shown in fig.-2, Determine (a) Principal stresses and their orientations (b) Maximum/minimum shear stresses, their orientations along with the associated normal stresses (c) Values of normal and shear stresses on planes indicated. Show all the results on properly oriented planes.

Fig.-2

8. (a) A thin spherical vessel 200 mm diameter and 5 mm thick is filled with water. More water is pumped in until the pressure reaches 4.5 MPa. How much extra water was required to reach this pressure?
   (b) Find the Euler's crippling load for a hollow cylindrical cast iron (E = 80 GPa) column 150 mm external diameter and 20 mm thick. The column is 6 m long and hinged at both ends.
9. The load diagram for a beam is shown in Fig. 3 below

Fig.3

   (a) Draw the bending moment diagram labeling all the salient points.
   (b) If the cross section of beam is circular with diameter 50 mm, calculate the maximum bending stress in the beam.