Strength of materials-II
(ME-204, DEC 2006)

Time: 3 Hrs
Max Marks: 60

Note: Section A is compulsory. Attempt any four questions from Section B and any two from Section-C.

Section-A

1. a) The proof resilience of the spiral spring is_____
   b) Total strain energy per unit volume may be written as_____
   c) Draw the variation of radial stress in a thick cylindrical pressure vessel.
   d) When fabricating a chain link the joint should come at a location_____
   e) The distribution of bending stress in curved beams is_____
   f) A flat spiral spring is 5 mm wide, 0.25 mm thick and 3 meter long, calculate the torque to wind up the spring so that the maximum stress at the point of greatest bending does not exceed 10^5 MPa.
   g) A 300 mm x 150 mm I-girder has 12 mm thick flanger and 8 mm thick web. It is subjected to a S.F. of 150 KN at a particular section. What is the max. shear stress in the flange?
   h) A cantilever beam of length L is loaded with a point load W at its free end. Determine the strain energy of the beam. EI is constant.
   i) Write a note on significance of theories of failure.
   j) Determine the shear centre of a semi circular arc of radius 'r'.

Section-B

2. A beam of square section is used as a beam with diagonal horizontal. Find the magnitude and location of maximum shear stress in the beam. Also sketch the shear stress distribution across the section.
3. Design a laminated steel spring, simply supported at the ends, and centrally loaded with a span of 800 mm, given the following: (a) Proof load = 8.5 KN, (b) Max. central deflection = 50 mm, (c) Ratio of width to thickness = 10, (d) $E = 2 \times 10^5$ MPa, (e) Permissible bending stress = 370 MPa. The plates are available in the multiples of 1 mm for thickness and in the multiples of 3 mm for width.
4. A compound thick cylinder is formed by shrinking a tube of eternal diameter 300 mm over another tube of internal diameter 150 mm. After shrinking, the diameter at the junction of the tube is found to be 250 mm and radial compression as 28 MPa. Find the original difference in radii at the junction. Take $E = 2 \times 10^5$ MPa.
5. A simply supported beam of span L has an overhang of length 'a' on the left. The vertical load W is applied at the end of the overhang. Calculate the deflection of the point of application of the load by castigliano's first theorem.
6. If the close coiled spring formula is used in finding the extension of an open coiled spring under axial load, determine the maximum angle of helix for which the error in the value of the extension is not to exceed one percent. Assume E = 2.5 G.

Section-C

7. A smaller light piston 100 sq. mm in area compresses oil in a rigid container of 1000 cc capacity. When a weight of 70 N is gradually applied to the piston, its movement is observed to be 2.5 mm. If the weight of 20 N falls from a height of 40 mm on to the piston, determine the maximum pressure developed in the oil container neglecting the effect of friction and loss of energy.
8. A ring made of 25 mm diameter steel bar carries a pull of 10 k N. Calculate the maximum tensile and compressive stresses in the material of the ring. The mean radius of the ring is 15 cm.
9. A solid circular shaft is subjected to a B.M. of 100 k N.m and a torque of 120 k N.m. In a uniaxial test the shaft material gave following results:
   $E = 2 \times 10^5$ MPa; stress at yield point σ_p = 300 MPa, Poisson's ratio = 0.3 = 1/m; F.O.S = 3
   Estimate the least diameter of the shaft using (a) Maximum shear stress theory and (b) Maximum strain energy theory