B.E./B.Tech END SEMESTER EXAMINATIONS, NOV/DEC 2011

MECHANICAL ENGINEERING

4TH SEMESTER – FULL TIME (R-2008)

CE 9213 – STRENGTH OF MATERIALS

Time : 3 Hrs Max.mark: 100

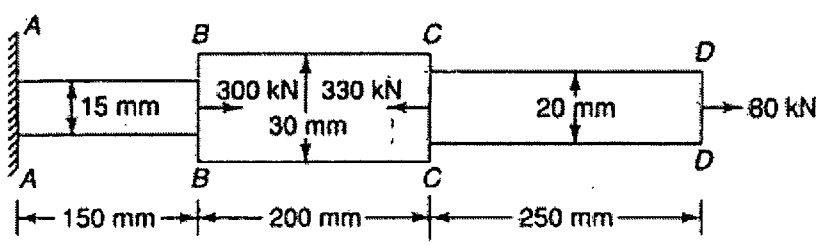
Answer all Questions

PART – A (10 x 2 = 20)

1. Define limit of proportionality
2. When a material is said to be strain hardened?
3. Sketch any two types of statically indeterminate beams.
4. What is polar modulus of a section?
5. Define torsional rigidity
6. State the main difference between a close and open coiled helical spring
7. Express the relationship between deflection, shear force and bending moment at a section
8. State Max well's reciprocal theorem
9. Differentiate thick and thin shells
10. What is autofrettage of thick cylinders

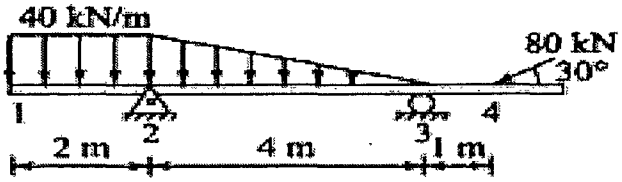
PART – B (5 x 16 = 80)

11. (a) A steel circular bar has three segments as shown below. Determine (i) the total elongation of the bar (ii) the length of the middle segment to have zero elongation of the bar (iii) the diameter of the last segment to have zero elongation of the bar. Take E = 205 GPa. (8 marks)



(b) A steel bar 35 x 35 mm in section and 100 mm long is acted upon by a tensile load of 180 kN along its longitudinal axis and 400 kN and 300 kN along the axes of the lateral surfaces. Determine (i) change in the dimensions of the bar (ii) change in volume (iii) longitudinal axial load acting alone to produce the same longitudinal strain as in case (i). Take E = 205 GPa and ν = 0.3. (8 marks)

12. a) Draw the Shear force and bending moment for a beam loaded as shown below and mark the point of contra flexure if any. (16 marks)



(OR)

12.b) A cast iron T beam has the following dimensions:

Overall depth = 160 mm, Width of flange = 150 mm, Flange thickness = 40 mm and web thickness = 50 mm. The beam is simply supported over a span of 2.5 m placed in the inverted T-position. If the maximum allowable tensile stress in the flange and compressive stress in the web are limited to 20 N/mm^2 and 75 N/mm^2 respectively, find the maximum central load that the beam can safely carry. (16 marks)

13. a) A shaft of 11 m length, fixed at both ends is subjected to an anti-clockwise torque of 45 kNm at a distance of 4.5 m from one end, and a clock wise torque of 63 kNm at 3 m from the other end. Determine the minimum size of the shaft, if the allowable shear stress is 95 MPa. Compute the maximum twist and the section of zero in the shaft assuming G = 75 GPa. (16 marks)

(OR)

13.b) Two coils made of the same material and 12 mm dia wire with 10 coils each are placed co axially. If the mean diameter of the outer coil is twice that of the inner coil, determine the coil sizes to support a load of 1 kN. Assume E = 190 GPa, ν = 0.3 and τ = 120 MPa. The inner and outer spring coil radius can be taken as 42.8 mm and 85.6 mm. Determine the resultant deflection. (16 marks)

14.a) Derive the deflection formula for a cantilever beam subjected to a point load at free end, using double integration method. (16 marks)

(OR)

14.b) A simply supported beam of 8 m length carries two point loads of 64 kN and 48 kN at 1 m and 4 m respectively from the left hand end. Find the deflection under each load and the maximum deflection using Macaulay's method. E = 210 GPa and I = 180 x 10^6 mm^4. (16 marks)

15.a) A cylindrical shell 90 cm long and 20 cm in internal diameter having thickness of metal as 8 mm, is filled with fluid at atmospheric pressure. If an additional 20 cm^3 of fluid is pumped into the cylinder, find (i) the pressure exerted by the fluid on the cylinder and (ii) the hoop stress induced. Take E = 200 GPa and ν = 0.3 (16 marks)

(OR)

15.b) Derive Lame's equations for a thick cylinder of outer radius of R_2 and inner radius of R_1. (16 marks)