Total No of Questions: [8] ***SEAT NO. :***

[Total No. of Pages :*3*]

S. E. (Mechanical / Mechanical - SW / Automobile) 2012 course

Strength of Materials (Code: 202051)

May 2014 (Semester - II)

Time: 2 Hours ***Max. Marks : 50***

Instructions to the candidates:

1. ***Answer four questions out of 8.***
2. ***Solve Q 1 or 2, Q 3 or 4, Q 5 or 6, Q 7 or 8.***
3. ***All the four questions should be solved in one answer book and attach extra supplements if required.***
4. ***Draw Diagrams wherever necessary.***
5. ***Use of scientific calculator is allowed.***
6. ***Assume suitable data where ever necessary***

Q1) a) A bar of metal 100 mm X 50 mm in cross-section is 250 mm long. It carries a tensile load of 400 kN in the direction of its length, a compressive load of 4000 kN on its 100 mm X 250 mm faces and a tensile load of 2000 kN on its 50 mm X 250 mm faces. If E = 2 X 10^5 N / mm ^{2} and Poisson's ratio is 0.25, find the change in volume of the bar. [6]

b) A beam AB 10 meters long has supports at its ends A and B. It carries a point load of 5 kN at 3 meters from A and a point load of 5 kN at 7 meters from A and a uniformly distributed load of 1 kN per meter between the point loads. Draw SF and BM diagrams for the beam. [6]

OR

Q2) a) A steel rod of 30 mm diameter is enclosed in a brass tube of 42 mm external diameter and 32 mm internal diameter. Each is 360 mm long and the assembly is rigidly held between two stops 360 mm apart. The temperature of the assembly is then raised by 50^0C. Determine [6]

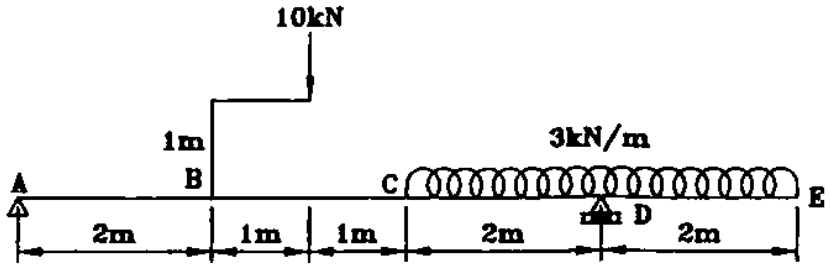
(i) Stresses in the tube and the rod.

(ii) stresses in the tube and the rod, if the stops yields by 0.15 mm

E_s = 205 GPa; E_b = 90 GPa

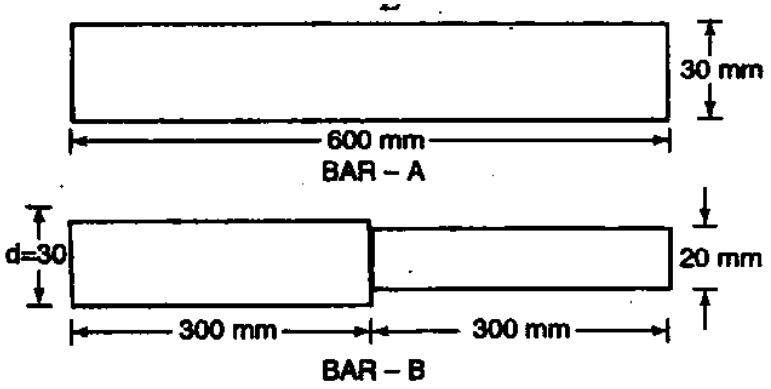
α_s=11 X 10^{-6} per ^{0}C; α_b= 19 X 10^{-6} per ^{0}C

b) Draw SF and BM diagrams for the beam ABCDE shown in following figure [6]



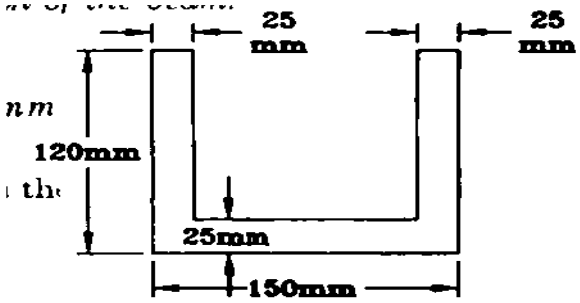
Q3) a) A cast iron pipe of internal diameter 450 mm is 15 mm thick and is supported on a span of 8 m. Find the maximum bending stress in the pipe when it is full of water. Take specific weight of cast iron = 71600 N / m^3 and that of water = 9810 N / m^3. [6]

b) Compare the strain energy stored in the two bars of the same material shown in following figure, if gradually applied load is same. [6]

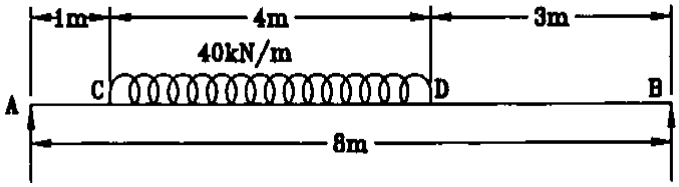


OR

Q4) a) A horizontal beam of the section shown in following fig. is 3 m long and is simply supported at the ends. Find the maximum uniformly distributed load it can carry, if the compressive and tensile stresses must not exceed 55 N / mm^2 and 30 N / mm^2 respectively. [6]



b) Following fig. shows a simply supported beam of uniform section whose moment of inertia is 4.3 x 10^8 mm^4. For the loading shown, find the position and magnitude of the maximum deflection. Take E = 200 kN / mm^2. [6]

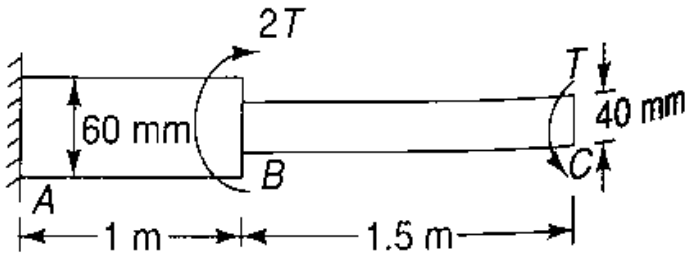


Q5) a) Compare the weights of equal lengths of a solid and a hollow shaft to transmit a given torque for the same maximum stress, if the inside diameter of the shaft is three fourth of the outside. [6]

b) Determine the buckling load for a strut of tee section, the flange width being 100 mm, overall depth 80 mm and both flange and stem 10 mm thick. The strut is 3 m long and is hinged at both ends. Take E = 200 GN / m^2. [7]

OR

Q6) a) Following fig. shows a stepped steel shaft. It is subjected to a torque 'T' at the free end and a torque '2T' in the opposite direction at the junction of the two sizes. Determine the total angle of twist, if the maximum shear stress is limited to 80 MPa. Take G = 80 GPa. [6]



b) A straight cylindrical bar of 15 mm diameter and 1.2 m long is freely supported at its two ends in a horizontal position. It is loaded with a concentrated load of 100 N at the centre when the centre deflection is observed to be 5 mm. If placed in the vertical position and loaded vertically, what load would cause it to buckle? Also find the ratio of the maximum stress in the two cases. [7]

Q 7) a) An axial pull of 20 kN along with a shear force of 15 kN is applied to a circular bar of 20 mm diameter. The elastic limit of the bar material is 230 MPa and the Poisson's ration, $\mu = 0.3$. [6]

Determine the factor of safety against failure based on

a) maximum shear stress theory

b) maximum strain energy theory

c) maximum principal strain energy theory

d) maximum shear strain energy theory

b) In a 2 D stress system, stresses at a point in a material are 50 MPa compression and 30 MPa shearing in one plane and 20 MPa tensile and a shearing stress in another plane at 60^0 to the first one. Determine the value of the shearing stress in the second plane and the principal stresses and position of their planes.Use Analytical method. [7]

OR

Q8) a) A solid circular shaft is subjected to a bending moment of 40 kN-m and a torque of 10 kN-m. Design the diameter of the shaft according to [6]

i) Maximum principal stress theory

ii) Maximum shear stress theory

iii) Maximum strain energy theory.

Take $\mu = 0.25$, Stress at elastic limit = 200 N / $mm^2$and factor of safety = 2.

b) The stresses on two perpendicular planes through a point in a body are 30 MPa and 15 MPa both tensile along with shear stress of 25 MPa. Find [7]

(i) magnitude and direction of principal stresses

(ii) maximum shear stress and their planes

(iii) normal and shear stresses on the planes of maximum shearing stress

Use Mohr's Circle method.