Roll Number:_____

B. E. (Second Year): Semester-I (2016-17)   Course Code: UES010
(CHE/CIE/ EIC/ELE/MEE/MTX/MPE)   Course Name: Solids and Structures
December 2016   Day, Time
Time: 3 Hours, M. Marks: 100   Name Of Faculty: SHG, KKH, SHR,
                                              GUB, APH, NG, GB, RSC, DN

Note: *Attempt all questions. Assume missing data suitably (if any).*

Q1 (a)   A load of 50 kN is applied to a compound axial member shown in Fig. 1. The segment   (10)
       AB is a 20 mm diameter solid brass rod $(E = 100$ GPa) and segment BC is a solid
       aluminum rod $(E = 70$ GPa). Determine the minimum diameter of the aluminum
       segment if the axial displacement of C, relative to support A, must not exceed 5 mm.
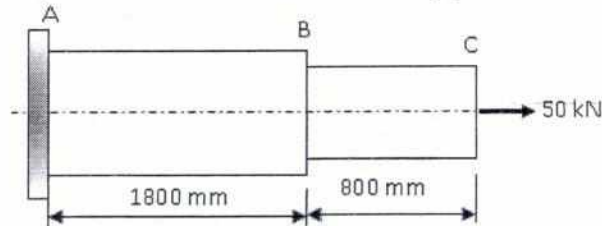

Fig.1

(b)   A 10 mm diameter brass bolt $(E_{br} = 103$ GPa), is fitted inside a steel tube $(E_{st} = 200$ GPa)   (10)
      with 22 mm outer diameter and 3 mm wall thickness. The length of the tube is 300
      mm. The pitch of the bolt is 2.5 mm. After the nut has been fit snugly, it is tightened
      one quarter of the full turn. Determine normal stresses induced in the bolt and the
      tube due to tightening.

Q2(a)   The shear force diagram (SFD) for an overhanging beam is shown in Fig. 2. The beam   (10)
       is supported at 4 m and 20 m from the left end. Draw loading and bending moment
       diagram (BMD) for the beam. The shear force is in kN and distances are in m.
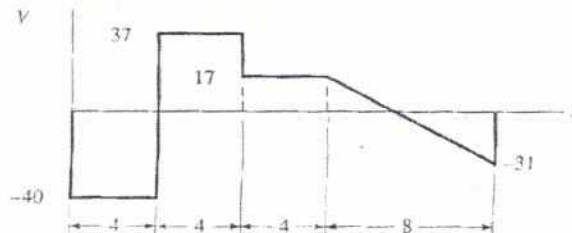

Fig. 2

(b)   A steel column of length L, having rectangular cross section of dimensions 25 mm x   (10)
      100 mm, supports an axial compressive load. Determine the limiting length of the
      member to behave as a short column, if both ends are fixed.
      The modulus of elasticity of the material is 200 GPa and the value of yield stress is
      250 MPa.

Q3   For the state of plane stress as shown in Fig. 3, determine   (20)
      (a) the principal stresses and principal planes,
      (b) maximum shear stress, associated normal stress and planes of maximum shear,
      (c) the state of stress obtained by rotating the given element counterclockwise
      through 30°.
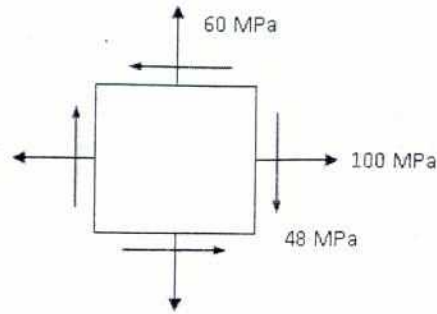   Also, indicate all stresses on properly oriented elements.

60 MPa

100 MPa

48 MPa

Fig. 3

Q4 (a) A copper strip (E_{cu} = 105 GPa) and an aluminum strip (E_{al} = 75 GPa) are bonded (10)
together to form the composite beam, having cross-sectional dimensions as shown in
Fig. 4. Knowing that the beam is bent about a horizontal axis by a bending moment of
35 N-m. Find the maximum stresses in aluminum and copper. Also plot the
distribution of stress across the section.
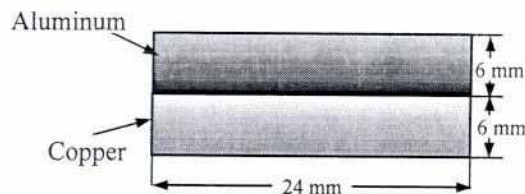(*Make the equivalent section in aluminum*).

Aluminum

6 mm

6 mm

Copper

24 mm

Fig. 4

(b) The I-section with flanges of 80 mm x 20 mm and web of 160 mm x 20 mm is (10)
subjected to a shear force of 60 kN. Draw the shear stress distribution diagram along
the depth. Also, calculate the ratio of maximum shear stress to the mean shear stress.

Q5 Compute the slopes at the ends and deflection at the midpoint of the simply (20)
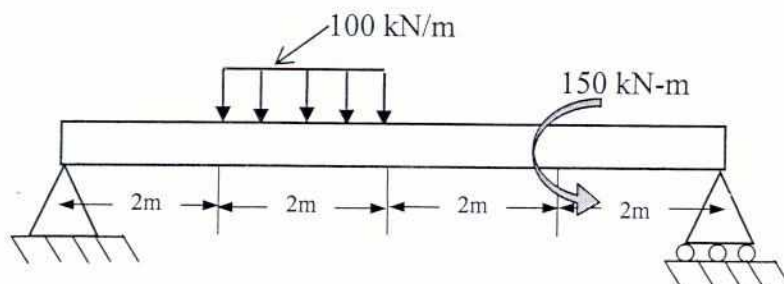supported beam shown in Fig. 5.
Given E = 200 GPa , I = 20 x 10⁶ mm⁴

100 kN/m

150 kN-m

Fig. 5

2m   2m   2m   2m