Roll Number:_____

Thapar University, Patiala

EST

B. E. (Second Year): Semester-III (2017/18) (CHE, CIE, ELE, MEE, MPE, MTX, EIC)	Course Code: UES010 Course Name: Solids and Structures
Date: December 16, 2017	Timing: 9:00 – 12:00 Hrs.
Time: 3 Hours, M. Marks: 100	Name Of Faculty: SHG, SHR, KKH, NG, GB, DN, RKS, RG

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

Q1 (a) Design a hollow steel shaft which is required to transmit power of 550 kW at 700 r.p.m. The maximum shear stress produced in the shaft is limited to 50 MPa. The ratio of internal diameter to external diameter of the shaft is 0.6. (8)

(b) A steel rod, 10 *mm* diameter, and aluminum rod, 20 *mm* diameter, are joined together and are fixed between supports as shown in **Figure 1**. If E_{steel} = 200 *GPa* and $E_{aluminum}$ = 70 *GPA*, find the reaction at the supports and the stresses in the metals. (12)

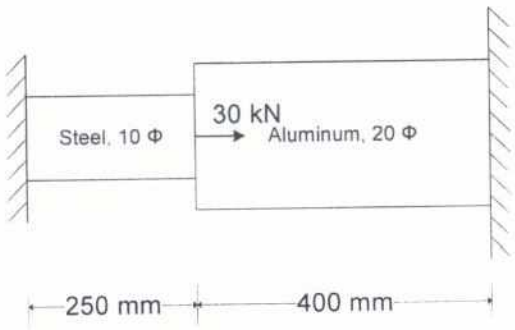

Figure 1

Q2 (a) Draw the shear force and bending moment diagram for the beam shown in the **Figure 2**. Mark all the relevant points. (12)

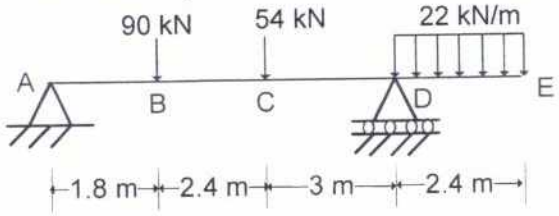

Figure 2

(b) Determine the shortest length for a steel column, fixed at both ends, of cross-section 75 *mm* × 48 *mm* using Euler's formula. Take critical stress value as 220 *MPa* and *E* = 205 *GPa*. (8)

Q3 (a) The square cross section of beam as shown in **Figure 3a**. The beam section is subjected to a shear force of 200 *k*N. Determine the shear stress distribution across the depth of the section. (10)

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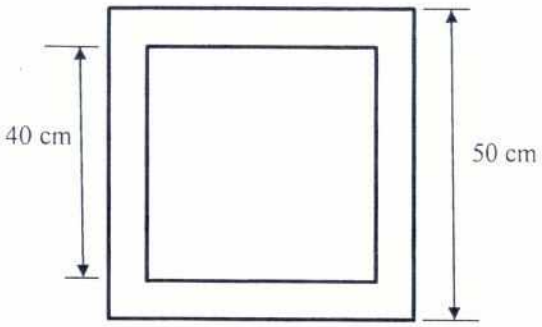

Figure 3a

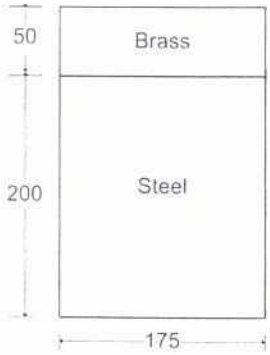

Figure 3b

(All dimensions in *mm*)

(b) The composite beam is made of steel bonded to brass and has the cross section as shown in **Figure 3b.** If the allowable bending stress for the steel is 180 *MPa* and the allowable bending stress for the brass is 60 *MPa*, determine the maximum moment '***M***' that can be applied to the beam. Given E_{brass} = 100 *GPa*, E_{steel} = 200 *GPa*. (10)

Q4 For the state of plane stress shown **Figure 4**, determine (1) the largest value of τ_{xy} for which the maximum in-plane shearing stress is equal to 82 *MPa*, (2) the corresponding principal stresses and principal planes, (3) plane of maximum shear stress (4) the state of stress at 30°. Represent all the stresses on properly oriented elements. (20)

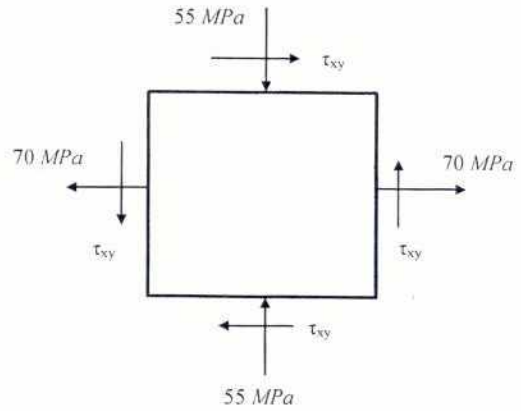

Figure 4

Q5 Determine the mid-span deflection and slope at support '***A***' in the simply supported beam shown in **Figure 5**. The beam section is rectangular 200 *mm* wide × 300 *mm* deep. (Take *E* = 200 *GPa*) (20)

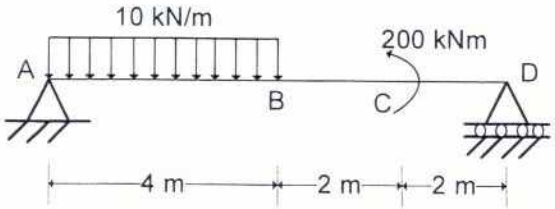

Figure 5