Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	: SOLID MECHANICS
COURSE CODE	: BDU 20802
PROGRAMME	: 2 BDM
EXAMINATION DATE	: JUNE 2015/JULY 2015
DURATION	: 2 HOURS AND 30 MINUTES
INSTRUCTION	: ANSWER **FOUR (4)** QUESTIONS ONLY

THIS PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) A square brass bar must not stretch more than 2.5 mm when it is subjected to a tensile load. Knowing that modulus of elasticity, E_{brass} is 105 GPa and that the allowable tensile strength, σ_{all} is 80 MPa, determine:

(i) the maximum allowable length of the bar.

(ii) the required dimensions of the cross section if the tensile load is 40 kN.

(10 marks)

(b) At room temperature of 25°C, a 0.5 mm gap exists between the ends of the aluminum and stainless steel rods as shown in Figure **Q1(b)**. At a later time when the temperature has reached 160°C, determine:

(i) the normal stress in the aluminum rod.

(ii) the change in length of the aluminum rod.

(15 marks)

Q2 (a) For the beam and loading shown in Figure **Q2(a)**, determine the maximum normal stress due to bending on a transverse section at C.

(10 marks)

(b) For the beam and loading shown in Figure **Q2(b)**:

(i) Draw the free body diagram, and shear and bending-moment diagrams.

(ii) Derive the equations of the shear and bending-moment curves for the whole beam.

(iii) Determine maximum absolute value of the shear and bending moment.

(15 marks)

Q3 (a) Briefly explain elastic and plastic behaviors of metallic materials and define the engineering stress and true stress.

(8 marks)

(b) Two vertical forces are applied to a beam of the cross section shown in Figure **Q3(b)**.

(i) Draw the free body diagram of the beam and determine the reactions at A and D.

(ii) Determine the location of neutral axis for cross-section of the beam.

(iii) Derive the equations of the bending - moment curves for section BC.

(iv) Determine the maximum tensile and compressive stresses in portion BC of the beam.

(17 marks)

Q4 (a) Figure **Q4(a)** shows solid rod AB which has a diameter d_{AB} = 60 mm and is made of a steel for which the allowable shearing stress is 85 Mpa. The pipe CD, which has an outer diameter of 90 mm and a wall thickness of 20 mm, is made of an aluminum for which the allowable shearing stress is 54 MPa. Both structures are welded together. Determine the largest torque T that can be applied at A and the twist angle at the end A when that torque is applied.

(10 marks)

(b) The pressure tank shown in Figure **Q4(b)** has a 10 mm wall thickness and butt-welded seams forming an angle $\beta = 20°$ with a transverse plane. For a gage pressure of 580 KPa, determine:

(i) the normal stress perpendicular to the weld,

(ii) the shearing stress parallel to the weld.

(iii) sketch τ - σ diagram and indicate the answers in (b)(i) and b(ii) in the diagram.

(15 marks)

Q5 (a) Briefly explain the terms principle stresses and principle planes.

(7 marks)

(b) Figure **Q5(b)** shows a plane stress diagram with three different types of loading. Determine:

(i) the state of stress at the point on another element oriented 30° clockwise from the position shown.
(ii) the principal planes.
(iii) the principal stresses.
(iv) the maximum shearing stress and the corresponding average normal stress.

Show the results obtained in (i), (ii), (iii) and (iv) in Mohr's circle.

(18 marks)

- END OF QUESTION –

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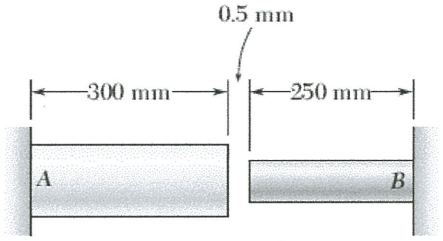

FIGURE Q1(b)

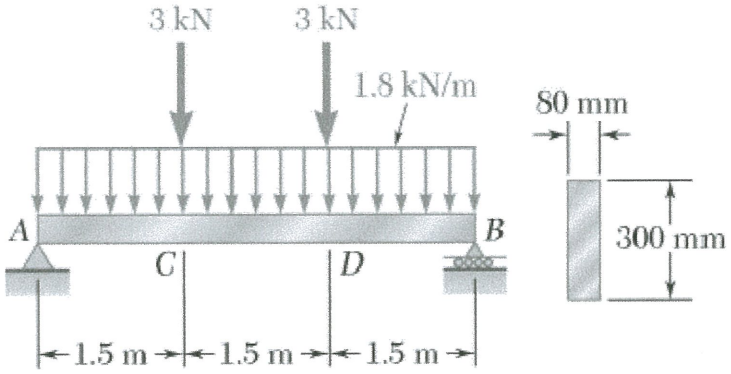

FIGURE Q2(a)

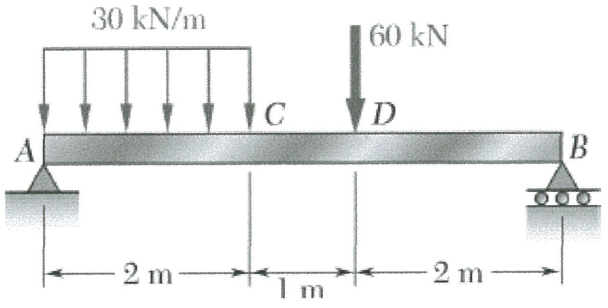

FIGURE Q2(b)

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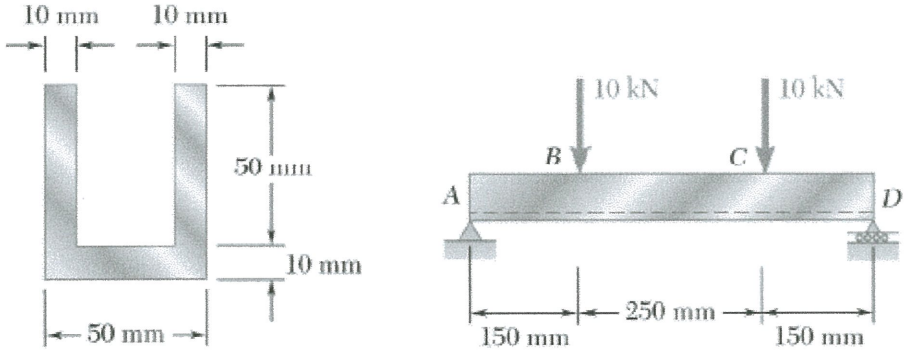

FIGURE Q3(b)

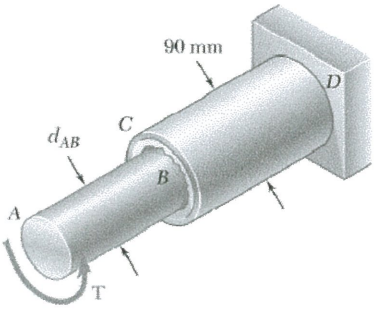

FIGURE Q4(a)

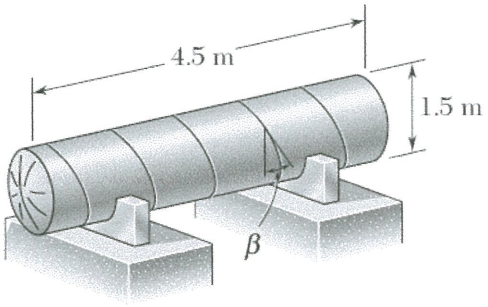

FIGURE Q4(b)

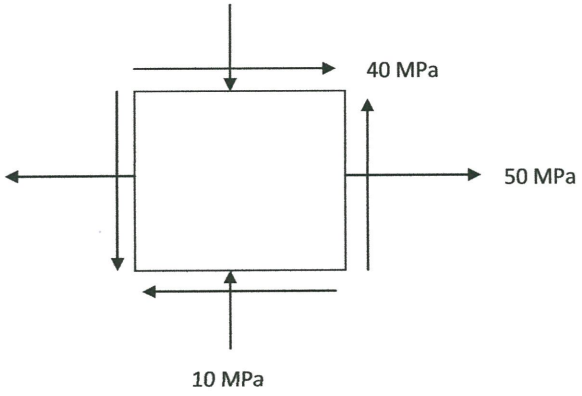

FIGURE Q5(b)