Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	SOLID MECHANICS
COURSE CODE	:	BDU 20802
PROGRAMME CODE	:	2 BDM
EXAMINATION DATE	:	JUNE/JULY 2019
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTION	:	ANSWER **ONLY FOUR (4)** QUESTIONS FROM **FIVE (5)** QUESTIONS PROVIDED

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

Q1 (a) Define these terms:
(i) Bearing stress
(ii) Beam
(iii) Torsion

(5 marks)

(b) **Figure Q1 (b)** shows two solid cylindrical rods which are joined at B. The 30 KN and 40 kN loads are applied to the cylindrical rods as shown in the figure. If the average normal stress must not exceed 175 MPa in rod AB and 150 MPa in rod BC, determine:
(i) The reaction force at A. Show the free body diagrams for each rod.
(ii) The smallest allowable values of d_1 and d_2.

(8 marks)

(c) Referring to **Figure Q1 (b)**, rod AB is made of steel and rod BC of brass. The modulus of elasticity, E of steel and brass are 200 GPa and 105 GPa, respectively. The values of d1 and d2 obtained in Q1(a)(ii) above are replaced with 50 mm and 30 mm, respectively. If both tension loads are replaced with equal magnitude of compression loads, determine:
(i) The deformation of rod AB.
(iii) The deformation of rod BC.
(iv) The total deformation of the composite rod ABC.
(v) The deflection of point B.

(12 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 the difference between true stress and engineering stress. Sketch σ - ε diagram to show the difference.

(10 marks)

(b) Bar is made from bonded pieces of steel (E_s = 200 GPa) and brass (E_b = 100 GPa) as shown in **Figure Q3 (b)**. Determine the maximum stress in the steel and brass when a moment of 4.5 kNm is applied in vertical plane.

(15 marks)

Q4 (a) Briefly explain the definition and the importance of factor of safety (FS).

(3 marks)

(b) The two wooden members shown in **Figure Q4 (b)** which support a 20 KN load are joined by plywood splices fully glued on the surfaces in contact. The ultimate shearing stress in the glue is 2.8 MPa and the clearance between the members is 8 mm. Determine the factor of safety, knowing that the length of each splice is L = 200 mm.

(7 marks)

(c) A thin cylinder with 95 mm internal diameter, 500 mm long and 4.5 mm thick is subjected to an internal pressure of 9 MN/m^2. If E = 200 GPa and ν = 0.25, and assuming the cylinder is constrained by rigid plates, determine:

(i) The change in volume.
(ii) The change of internal diameter and change in length.
(iii) The value of hoop and longitudinal stresses.

(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 QUESTIONS –

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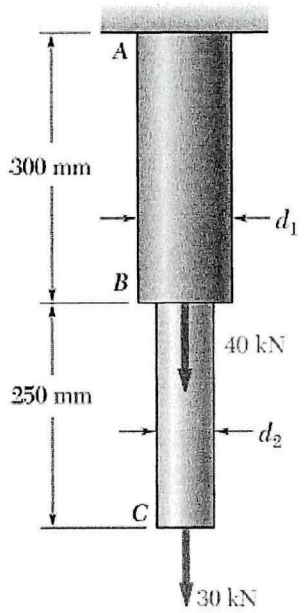

Figure Q1

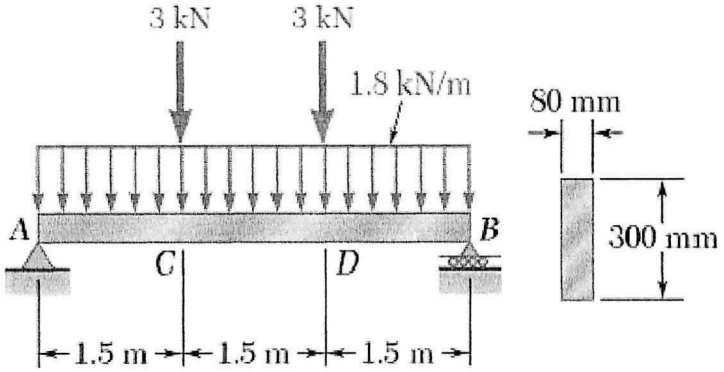

Figure Q2 (a)

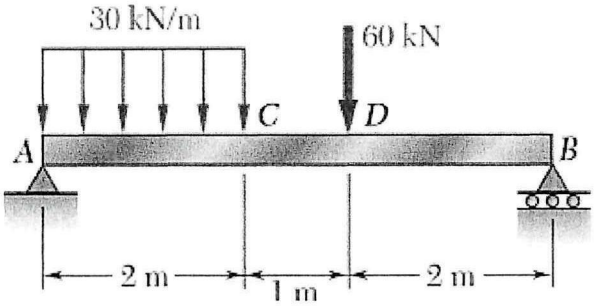

Figure Q2 (b)

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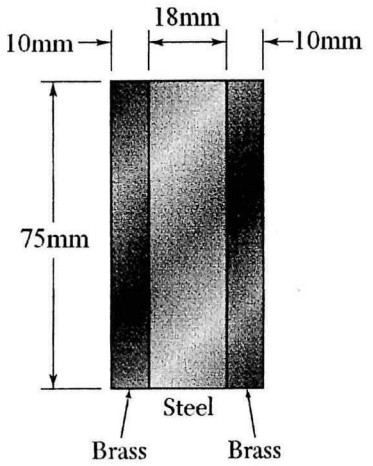

Figure Q3 (b)

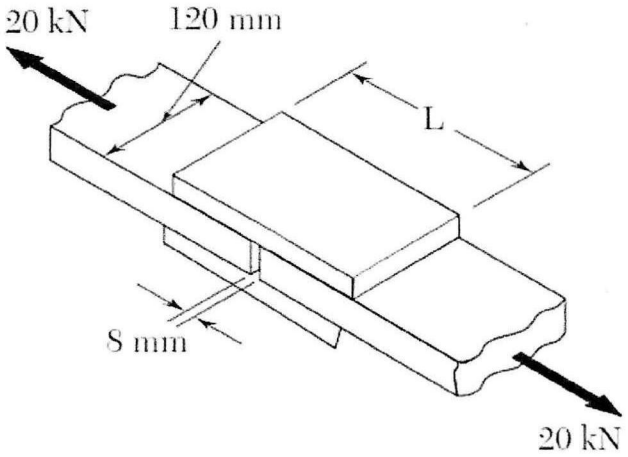

Figure Q4 (b)

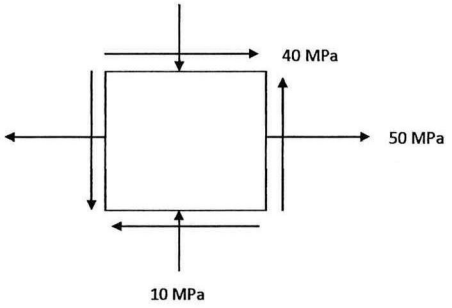

Figure Q5 (b)