Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020

COURSE NAME	: SOLID MECHANICS
COURSE CODE	: BDU 20802
PROGRAMME CODE	: BDM
EXAMINATION DATE	: JULY 2020
DURATION	: 2 HOURS
INSTRUCTION	: ANSWER **FOUR (4)** QUESTIONS **ONLY**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) **Figure Q1** 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)

(b) Referring to **Figure Q1**, 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 d_1 and d_2 obtained in 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.
(ii) The deformation of rod BC.
(iii) The total deformation of the composite rod ABC.
(iv) The deflection of point B

(12 marks)

Q2 (a) Briefly explain elastic and plastic behaviors of metallic materials. Sketch σ-ε diagram and indicate elastic limit, elastic and plastic regions.

(5 marks)

(b) The beam with rectangular cross sectional area is subjected to the loading as shown in **Figure Q2(b)**. The thickness of the beam is 20 mm. Given the moment of inertia, I for the beam is 2.98×10^6 mm^4, determine:

(i) The reactions at A and B. Draw free body diagram, and shear and bending moment diagrams for the beam.
(ii) The maximum normal stress due to bending.
(iii) The point at which the shear stress is zero.
(iv) The points at which the bending moment are zero.

(15 marks)

Q3 (a) Briefly explain neutral axis and neutral plane.

(5 marks)

(b) The extruded beam with rectangular cross sectional area is subjected to the loading as shown in **Figure Q3(b)**. Knowing that the allowable stress of the beam is 120 MPa in tension and 150 MPa in compression, determine:

(i) The centroid of the beam.
(ii) The moment of inertia of the beam.
(iii) The largest couple M that can be applied.

(15 marks)

Q4 (a) Determine the torque exerted on the shaft at point E and draw the torque diagram for the gear-shaft system shown in **Figure Q4(a)**. (Use the right hand rule and assume the positive torque is directed to the left hand side).

(8 marks)

(b) **Figure Q4(b)** shows a circular shaft AB in which 125 mm long and 16 mm diameter cavity has been drilled from end B. The shaft is attached to fixed supports at both ends, and a 120 Nm torque is applied at its midsection.

(i) Determine the torque exerted on the shaft by each supports before and after the cavity is drilled.
(ii) Draw the torque diagrams for both cases solved in b(i). Use the similar assumption made for the positive torque as in (a).

(12 marks)

Q5 (a) Briefly explain the definition and the importance of factor of safety (FS).

(5 marks)

(b) 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 v = 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)

Q6 (a) Briefly explain the terms principle stresses and principle planes.

(5 marks)

(b) **Figure Q6(b)** shows a plane stress diagram with three different types of loading.

(i) Calculate the principal planes.

(ii) Calculate principal stresses.
(iii) Calculate the maximum shearing stress and the corresponding average normal stress.
(iv) Show the results obtained in (i), (ii) and (iii) in Mohr's circle.
(15 marks)

- END OF QUESTIONS -

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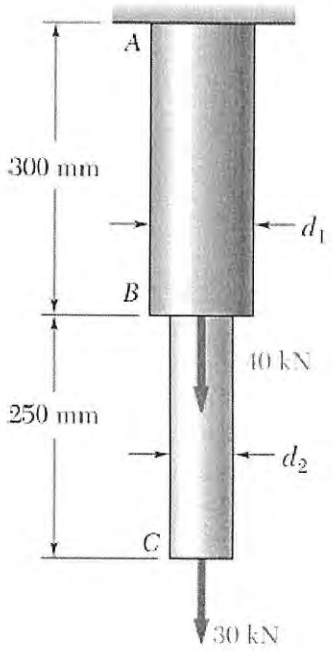

Figure Q1

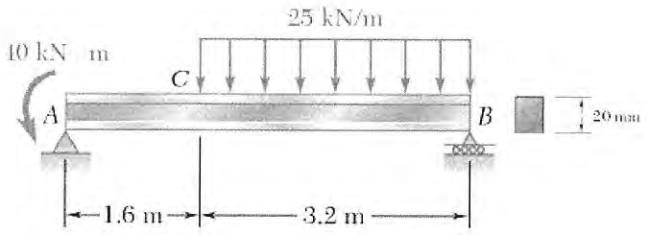

Figure Q2(b)

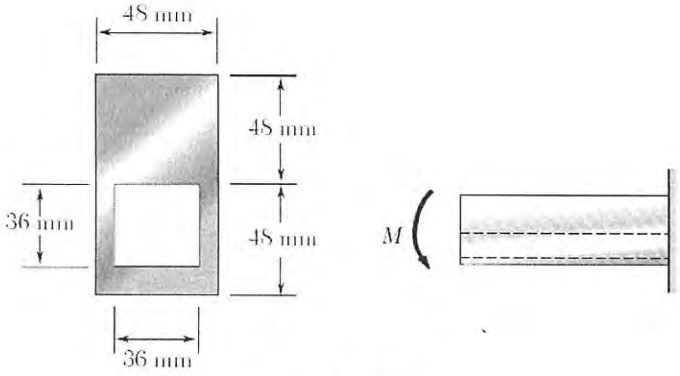

Figure Q3(b)

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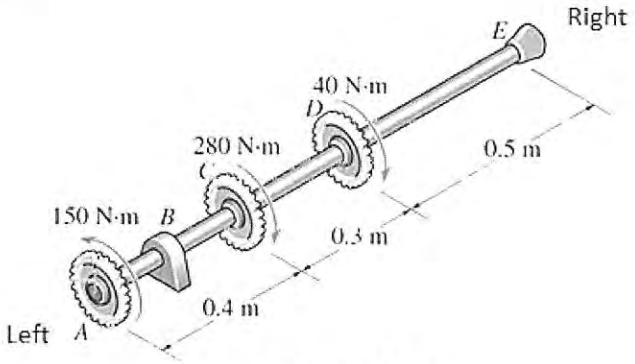

Figure Q4(a)

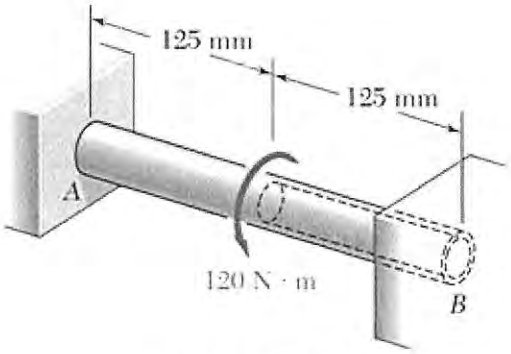

Figure Q4(b)

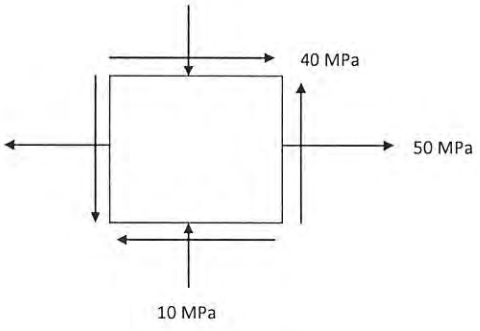

Figure Q6(b)