Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	SOLID MECHANICS
COURSE CODE	:	DAM 21003
PROGRAMME CODE	:	DAM
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTION ONLY

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

QUESTION IN ENGLISH

Q1 (a) Define Normal stress and Shear stress.

(3 marks)

(b) Describe stress and strain.

(3 marks)

(c) A specimen of steel 20 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.25 mm under a load of 80 kN and the load at elastic limit is 102 kN. The Poisson ratio is 0.907, find:

(i) the stress at elastic limit.
(ii) Young's modulus.
(iii) decrease in diameter.
(iv) percentage reduction in diameter.
(v) calculate a free expansion of the specimen length as temperature increase from 15 °C to 65 °C before load been applied.
($\alpha = 12 \times 10^{-6}$ /°C)

(14 marks)

Q2 (a) List out **two (2)** types of Statically Determine Beams.

(2 marks)

(b) Interpret the shape of shear and moment diagrams for the beam shown in **Figure Q2(b1)** and **Figure Q2(b2)**.

(4 marks)

(c) For the beam and loading shown in **Figure Q2(c)**,

(i) calculate the support reactions at A and B.
(ii) show the shear force and bending moment calculations.
(iii) calculate the position of the maximum bending moment.
(iv) sketch the shear force and bending moment diagrams.

(14 marks)

Q3 (a) Explain in diagram the stress relationship at the cross section of the beam when it is subjected to a positive bending moment.

(5 marks)

(b) The composite beam is made of steel bonded to brass and has the cross section shown in **Figure Q3(b).** If it is subjected to a moment of $M = 6.5$ kNm, determine the maximum bending stress in the brass and steel. Given the modulus of elasticity of steel and brass are 200 GPa and 100 GPa.

(15 marks)

Q4 (a) What is torsion and give **three (3)** examples of assumption to determining the relationship of the shearing stress in circular shaft subjected to torsions.

(4 marks)

(b) Refer to **Figure Q4(b)**, knowing that the internal diameter of the hollow shaft shown is $d = 23$ mm, determine the maximum shearing stress caused by a torque of magnitude $T = 1.0$ kNm.

(6 marks)

(c) Initially, a hollow steel shaft having an inner diameter of 30 mm and outer diameter 42 mm is to be used to transmit 75 kW of power. Then the hollow shaft was replaced with a solid steel shaft, having diameter d mm. The allowable shear stress for steel is 100 MPa. Detemine :

(i) the diameter of solid shaft required.
(ii) the frequency of rotation of the shaft.

(10 marks)

Q5 (a) Briefly explain the definition of thin cylinder.

(2 marks)

(b) The hoop stress is the force exerted perpendicular both, to the axis and to the radius of the object, in both directions on every particle in the cylinder wall. Explain the formula used to measure hoop stress (σ_θ).

(4 marks)

(c) A thin cylinder with closed ends has a diameter 650 mm and wall thickness 4.5 mm. It is subjected to internal fluid pressure of 0.5 MPa along with external torsion of 60 x 10^6 Nmm and moment 46 x 10^6 Nmm as depicted in **Figure 5(c).** Determine:

(i) Hoop stress (σ_θ) due to internal pressure.
(ii) longitudinal stress (σ_φ) due to pressure and bending.

(14 marks)

Q6 (a) Name **two (2)** components of the general state of stress act at a point.

(2 marks)

(b) Explain the procedures for analysis, if state of stress at a point is known for a given orientation of an element of material.

(8 marks)

(c) The state of plane stress at a point is shown on the element in **Figure Q6(c).** Determine the maximum in-plane shear stress and the orientation of the element at this point.

(10 marks)

Q7 (a) Give **four (4)** examples of composite beam.

(4 marks)

(b) A boiler of 600 mm diameter is built of steel plate. If a 4 MPa inner pressure is applied to the boiler, calculate the thickness of the steel plate. Given the maximum longitudinal stress is 400 MPa.

(6 marks)

(c) A cross-sectional area of the beam is shown in **Figure Q7(c).** If the limiting bending for the material of the beam are 160 MPa in torsion and 80 MPa in compression. Find length of the beam, L if the beam is simply supported at both ends with uniform distributed load along the beam of 3 kN/m.

(10 marks)

- END OF QUESTION -

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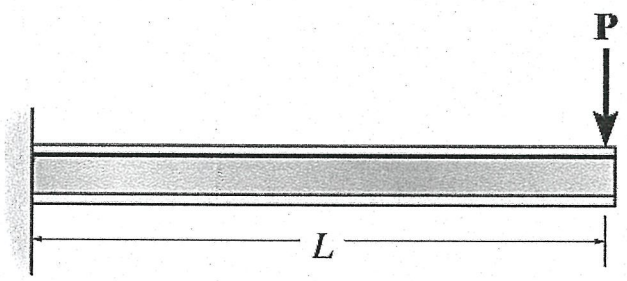

Figure Q2(b1)

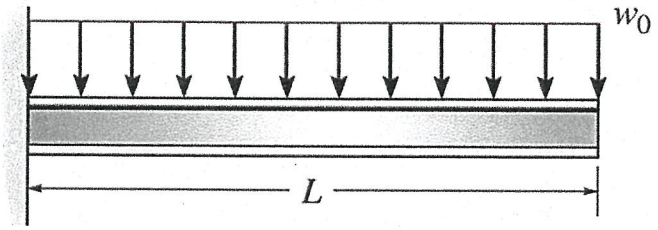

Figure Q2(b2)

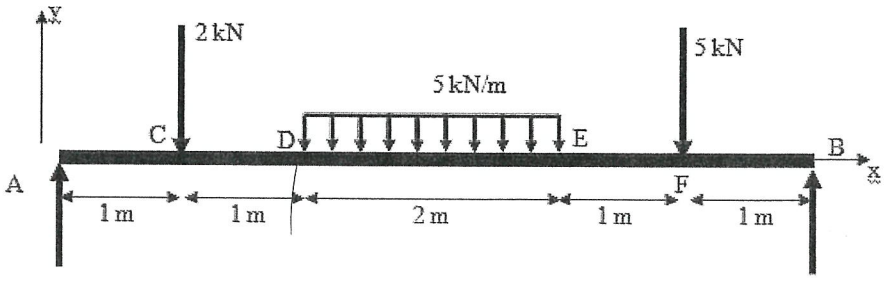

Figure Q2(c)

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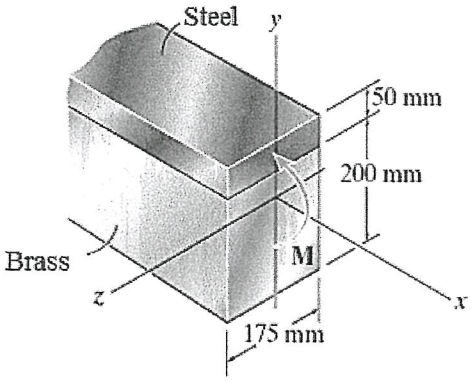

Figure Q3(b)

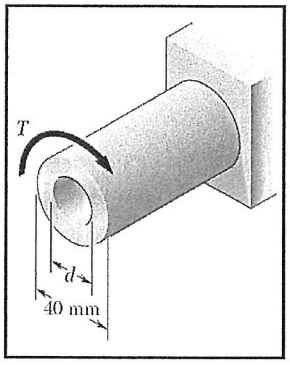

Figure Q4(b)

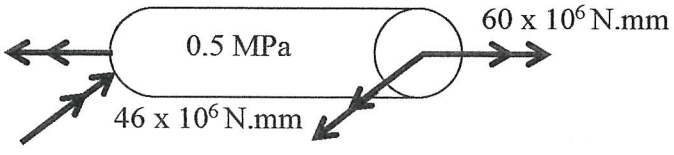

Figure Q5(c)

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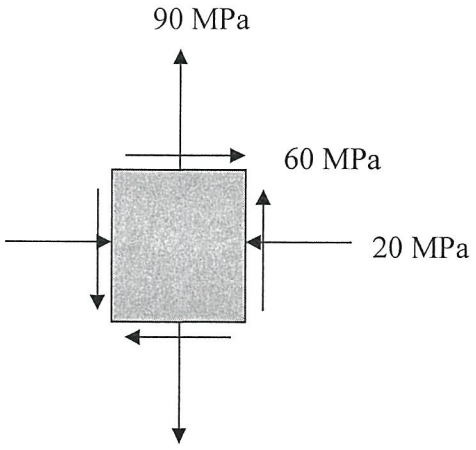

Figure Q6(c)

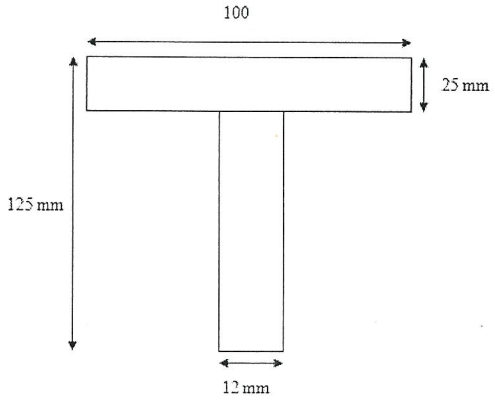

Figure Q7(c)