Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	SOLID MECHANICS 2
COURSE CODE	:	BDA20903/BDA30303/BDA3033
PROGRAMME	:	2 BDD / 3 BDD
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS OUT OF **SIX (6)** QUESTIONS

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

Q1 (a) Define the main advantage of using Mohr's circle method.

(2 marks)

(b) Referring to the given state of strain in **FIGURE Q1 (a)**, determine the corresponding state of strain at $\theta = 0^0$ by using Mohr's circle and draw the respective element diagram.

(6 marks)

(c) Due to the loadings on Purlin Bracing in **FIGURE Q1 (b)**, the strain readings of the gauges at point A give:

$$\varepsilon_1 = -50\mu,\ \varepsilon_2 = +360\mu,\ \varepsilon_3 = +315\mu$$

Knowing that, $v = 0.3$. Determine:

(i) The orientation and magnitude of the principal strains,

(4 marks)

(ii) The maximum in-plane shear strain, and

(4 marks)

(iii) The absolute maximum shear strain.

(4 marks)

Q2 The beam has a constant E_1I_1 and is supported by the fixed wall at B and the rod AC as shown in **FIGURE Q2**. If the rod has a cross-sectional area A_2 and the material has a modulus of elasticity E_2,

(i) Draw the free body diagram,

(5 marks)

(ii) Determine the elastic curve for the beam, and

(10 marks)

(iii) Calculate the force in the rod AB.

(5 marks)

Q3 (a) For an idealized column shown in **FIGURE Q3 (a)**, solve the following problems:

(i) Draw the free body diagram,

(3 marks)

(ii) Describe the stable equilibrium,

(2 marks)

(iii) Describe the unstable equilibrium, and

(2 marks)

(iv) Describe the neutral equilibrium.

(2 marks)

(b) Two bars are connected or pinned at point B as in **FIGURE Q3 (b)**. Uniformly distributed load, w = 6kN/m is applied across bar BC. Assuming that bar AB is made of steel (E = 200GPa and σ_y = 360MPa) and it is fixed at its bottom end with a buckling safety factor bar AB of 3.

(i) Draw the free body diagram, and

(5 marks)

(ii) Determine the critical force, P_{cr} for bar AB.

(3 marks)

(iii) Determine whether the bar AB will fail or not.

(3 marks)

Q4. (a) Define the Castigliano theorem for deflections.

(2 marks)

(b) Prove an expression for total strain energy, U by neglecting the weight of the cylindrical bar subjected to axial tension force as follows:

(5 marks)

$$U = \frac{P^2 L}{2AE}$$

where,

P = Applied force,

L = Length of the bar,

A = Cross-sectional area, and

E = Modulus of elasticity.

(c) A simply supported beam shown in **FIGURE Q4** is subjected to a concentrated load, P at a point C. It is interested to find the slope at point C by using Castigliano's theorem.

(i) Draw the free body diagram.

(3 marks)

(ii) Determine the internal moment functions, and

(5 marks)

(iii) Determine the slope at point C.

(5 marks)

Q5 (a) Consider the cross-section of a thick cylinder with closed ends as shown in **FIGURE Q5** is subjected to an internal pressure P_i and external pressure P_o, define the longitudinal stress, σ_L.

(5 marks)

(b) A composite cylinder is made by shrinking a tube of 320 mm internal diameter and 40 mm thick over another tube of 320 mm external diameter and 40 mm thick. The radial pressure at the common surface, after shrinking is 160 kgf/cm^2. Suppose the compound cylinder is subjected to an internal fluid pressure of 1000 kgf/cm^2.

(i) Determine the hoop stresses at inner radius and outer radius of inner cylinder,

(5 marks)

(ii) Determine the hoop stresses at inner radius and outer radius of outer cylinder, and

(5 marks)

(iii) Determine the shrinkage clearance at the common radius.

(5 marks)

Q6 Tubular steel shown in **FIGURE Q6** has an outer and inner diameter of 30 and 20 mm, respectively and it is subjected to torques at different locations. If A is a point of interest (Yield strength, σ_y = 250MPa).

(i) Draw the free body diagram,

(8 marks)

(ii) Determine the principal stresses and angles using Mohr's circle, and

(7 marks)

(iii) Determine the safety of factor with respect to yield stress at point A according to the maximum-distortion energy theory.

(5 marks)

- END OF QUESTION –

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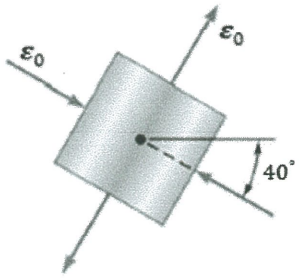

FIGURE Q1 (a)

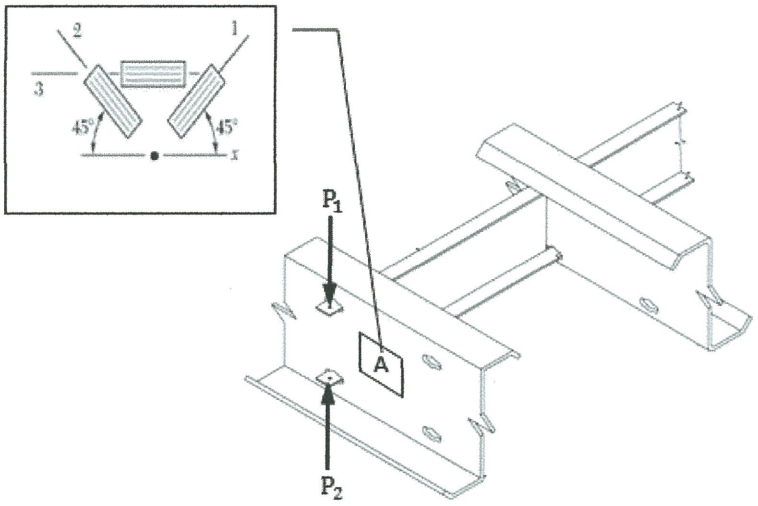

FIGURE Q1 (b)

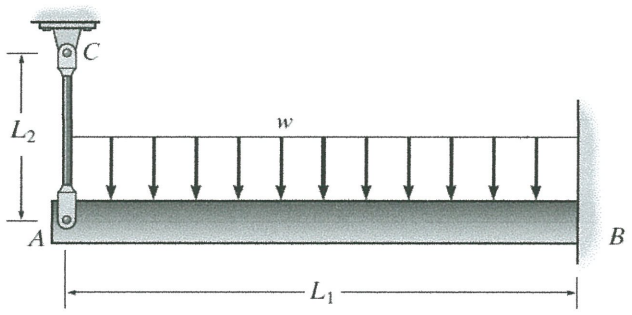

FIGURE Q2

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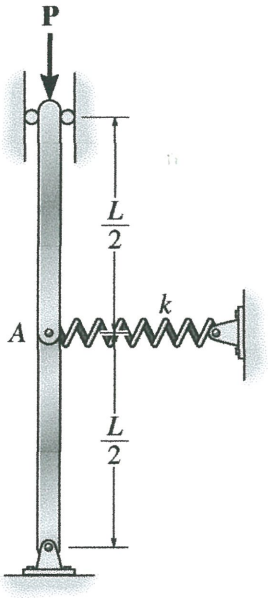

FIGURE Q3 (a)

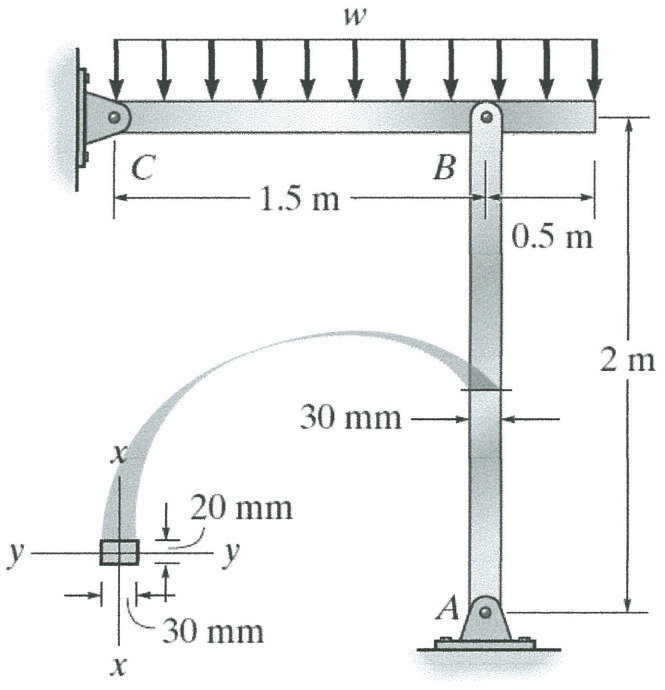

FIGURE Q3 (b)

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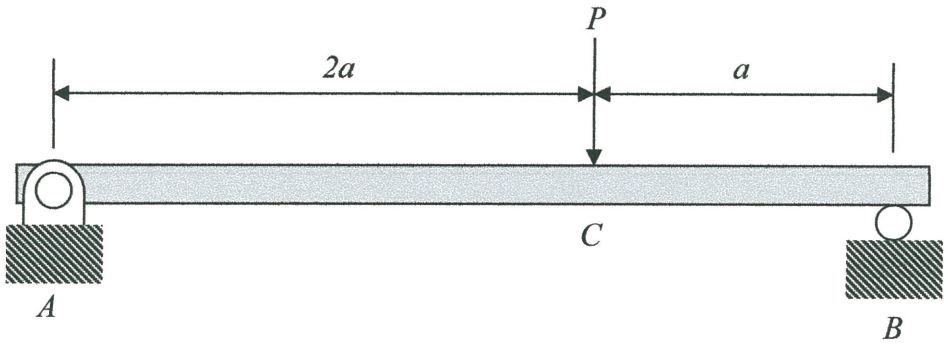

FIGURE Q4

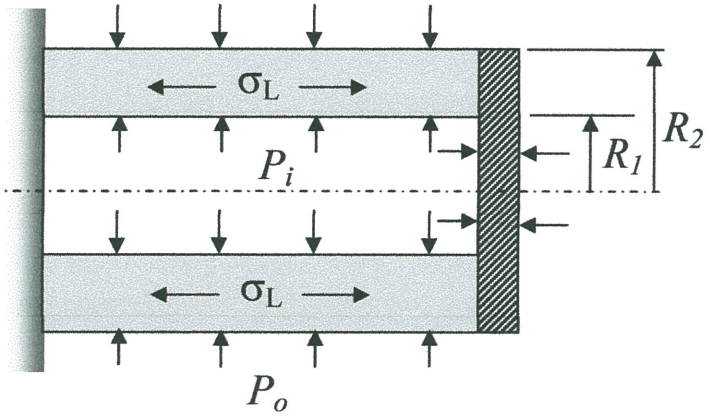

FIGURE Q5

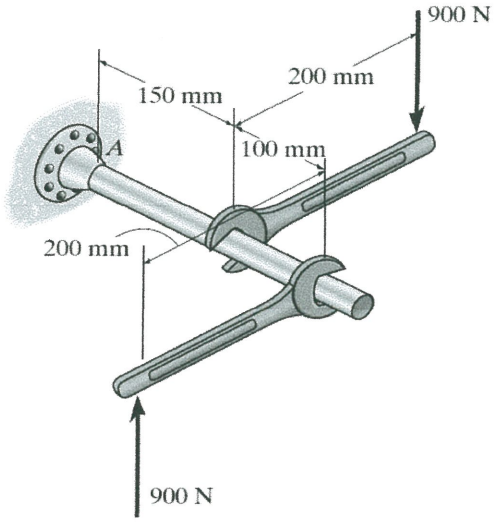

FIGURE Q6