Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	SOLID MECHANICS
COURSE CODE	:	BNJ 20903
PROGRAMME CODE	:	BNG / BNM / BNK
EXAMINATION DATE	:	JUNE / JULY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS **ONLY**

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

Q1 (a) List **ONE (1)** example of:

(i) Statically determinate beams.

(2 marks)

(ii) Statically indeterminate beams.

(2 marks)

(b) **Figure Q1 (b)** shows a beam AB with loads and supports and have an overhang CB.

(i) Determine the support reaction.

(4 marks)

(ii) Sketch the shear diagram.

(5 marks)

(iii) Sketch the moment diagram.

(5 marks)

(iv) Determine the maximum normal stress on a transverse section at C.

(2 marks)

Q2 Rod AB consists of two cylindrical portions AC and BC, each with a cross-sectional area of 1750 mm^2. Portion AC is made of a mild steel with E = 200 GPa and σ_y = 250 MPa, and portion BC is made of a high-strength steel with E = 200 GPa and σ_y = 345 MPa. A load P is applied at C as shown in **Figure Q2**. If P is gradually increased from zero until the deflection of point C reaches a maximum value δ_m = 0.3 mm and then decreased back to zero. Determine:

(a) The maximum value of P.

(8 marks)

(b) The maximum stress in each portion of the rod.

(6 marks)

(c) The permanent deflection of C after the load removed.

(6 marks)

Q3 **Figure Q3** shows a 4 kN.m torque T is applied at end A of the composite shaft. Knowing that the modulus of rigidity is 77 GPa for Steel and 27 GPa for Aluminum. Determine:

(a) The maximum shearing stress in the steel core.

(7 marks)

(b) The maximum shearing stress in the aluminum jacket.

(7 marks)

(c) The angle of twist at A.

(6 marks)

Q4 (a) An element of material subjected to plane strain as shown in **Figure Q4 (a)** has strains as follows: $\epsilon_x = 220 \times 10^{-6}$, $\epsilon_y = 480 \times 10\text{-}6$ and $\gamma_{xy} = 180 \times 10^{-6}$. Calculate:

(i) The strains for an element oriented at angle $\theta = 50°$

(3 marks)

(ii) Show these strains on a sketch of properly oriented element.

(3 marks)

(b) Determine the equivalent state of stress on an element at the same point in **Figure Q4 (b)** which represents

(i) The principal stresses.

(3 marks)

(ii) The orientation of principle plane.

(3 marks)

(iii) The maximum in-plane shear stress.

(3 marks)

(iv) Orientation of the plane of maximum in-plane shear stress.

(3 marks)

(v) Average normal stress.

(2 marks)

Q5 (a) **Figure Q5 (a)** shows the wide-flange section is reinforced with two wooden board. If the composite beam is subjected to an internal moment of M = 100 kN.m. Take E_w = 10 GPa and E_{st} = 200 GPa. Determine:

(i) The moment of inertia of the transformed section.

(4 marks)

(ii) The maximum bending stress of the steel and the wood.

(4 marks)

(b) **Figure Q5 (b)** shows the wood column has a square cross section with dimension 100 mm length x 100 mm width. It is fixed at its based and free at its top. Determine the load P that can be applied to the edge of the column without causing the column to fail either by buckling or by yielding. Given E_w = 12 GPa and σ_y = 55 MPa.

(12 marks)

Q6 **Figure Q6** shows the cantilevered aluminum alloy rectangular beam with G = 26 GPa and E= 68.9 GPa. Determine:

(a) The internal loadings.

(4 marks)

(b) The shearing strain energy.

(4 marks)

(c) The bending strain energy.

(4 marks)

(d) External work or external force.

(4 marks)

(e) The conservation of energy.

(4 marks)

-END OF QUESTION-

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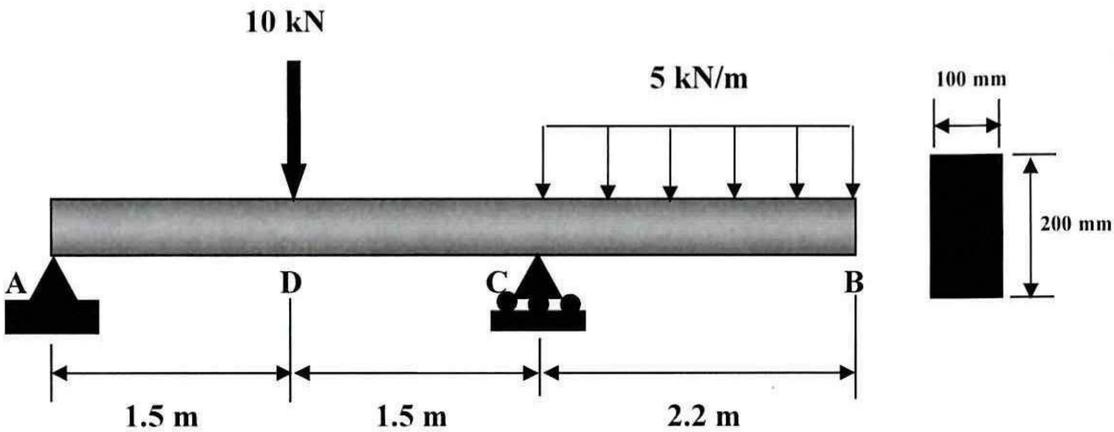

Figure Q1 (b)

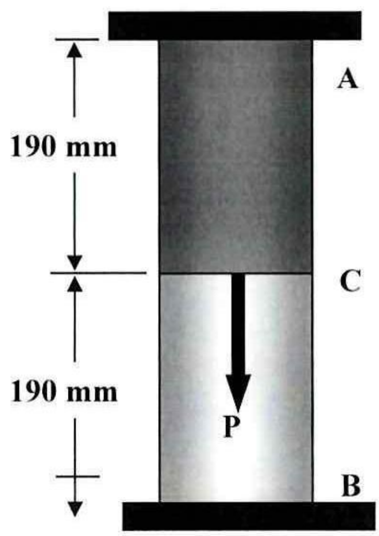

Figure Q2

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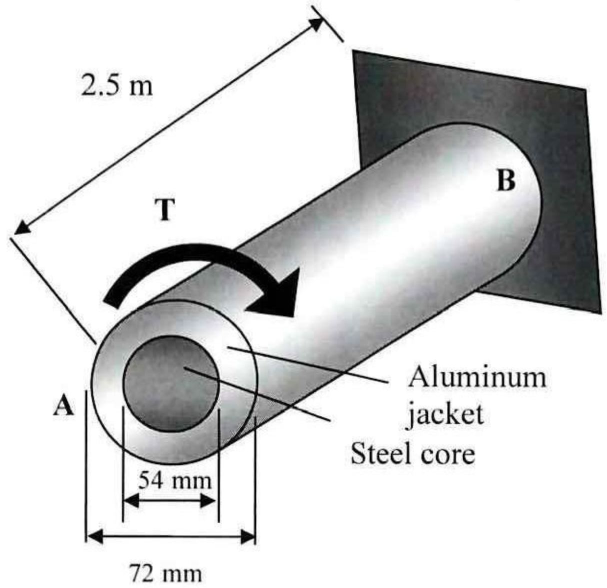

Figure Q3

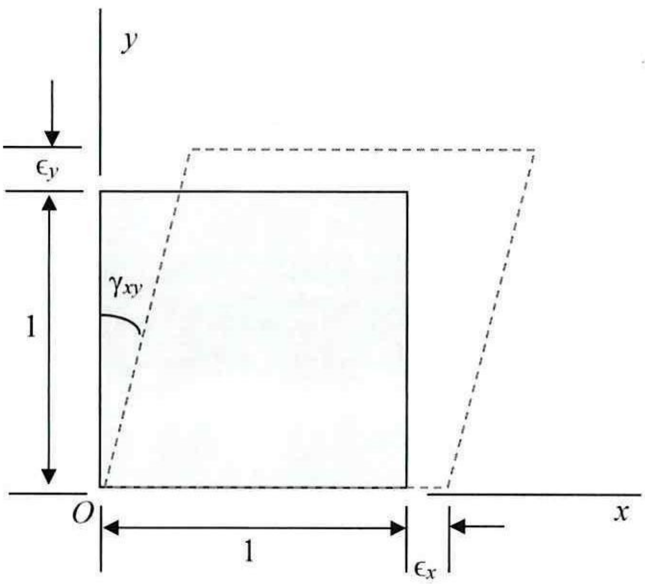

Figure Q4 (a)

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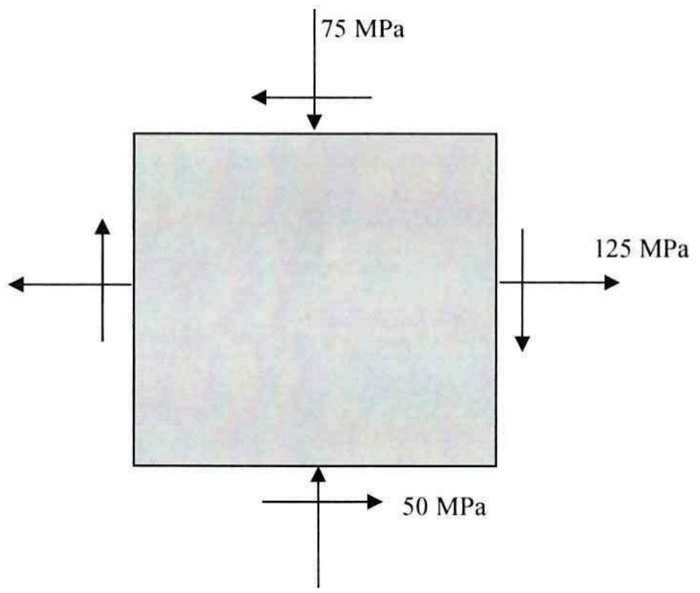

Figure Q4 (b)

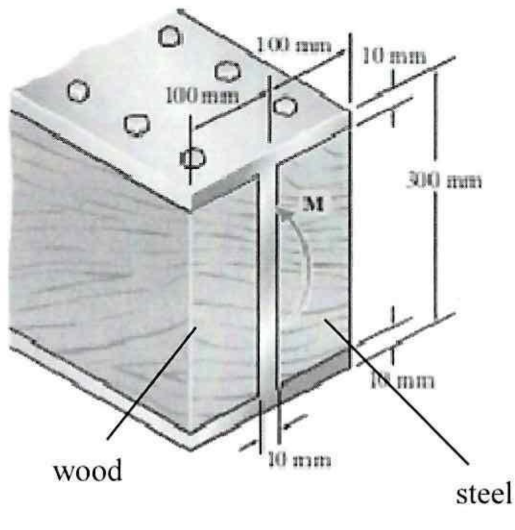

Figure Q5 (a)

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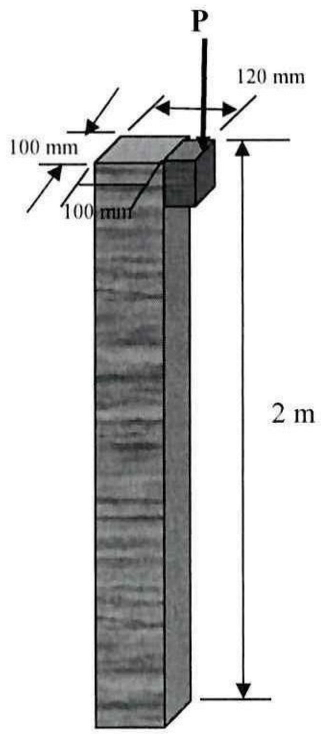

Figure Q5 (b)

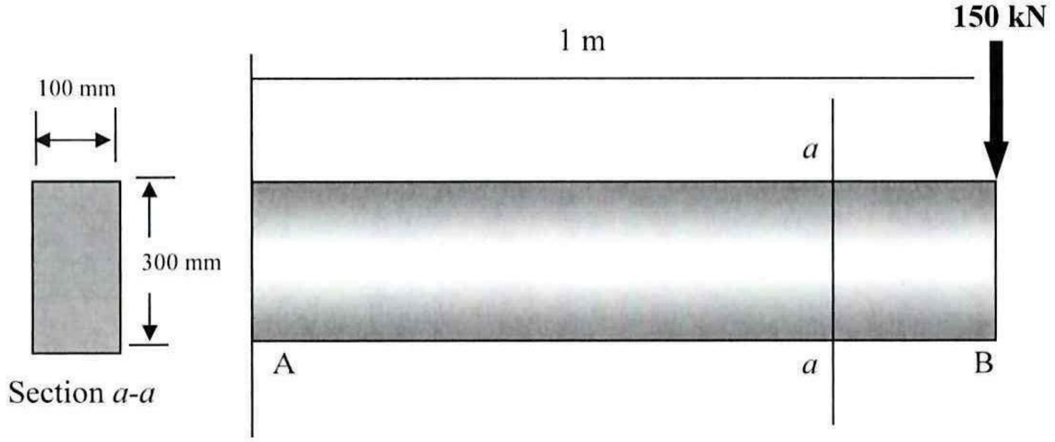

Figure Q6