Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	MECHANICS OF MATERIAL
COURSE CODE	:	BFC 20903
PROGRAMME	:	BACHELOR OF CIVIL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	DECEMBER 2015/JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) **FIGURE Q1(a)** shows beam AB and BC with the length of 2 m each are applied with loads 35 kN and 60 kN. AB is a hollow beam with 10 mm of thickness and BC is a solid beam. Determine the deformation due to compression for both beams if the modulus of elasticity given is 35 kN/mm^2.

(7 marks)

(b) **FIGURE Q1(b)** shows an element working under stress (σ) in x direction and shear stress (τ) in y direction.

(i) Analyze all forces that work on the element when the object is rotated at $\theta = 30°$.

(13 marks)

(ii) Sketch the rotated element and display the values achieved from the calculation.

(5 marks)

Q2 **FIGURE Q2** shows a concentrated couple of 4 kNm and a uniformly distribute load of 1 kN/m applied to beam AD. Assume $I = 13.4 \times 10^6\ mm^4$

(a) Calculate reaction at support A and support C.

(2 marks)

(b) Determine the expression for shear force (V) and moment (M) for section:

(i) AB ($0 < x < 2$ m)

(2 marks)

(ii) BC (2 m $< x < 4$ m)

(3 marks)

(iii) CD (4 m $< x < 6$ m)

(4 marks)

(c) Draw the shear force and bending moment diagram and calculate the maximum bending stress value before and after point B.

(10 marks)

(d) Explain why two bending stress values are obtained at point B.

(4 marks)

Q3 (a) Derive the maximum shear stress formula over the entire area below the neutral axis as shown in **FIGURE Q3(a)**.

(5 marks)

b) A wide-flange beam has the dimensions as shown in **FIGURE Q3(b)**. The beam is constructed from two boards bolted together with a single row of bolts spaced $s = 80$ mm apart. If the applied shear force is $V = 50$ kN,

(i) Analyze and plot the shear-stress distribution acting over the beams cross-sectional area.

(12 marks)

(ii) If nails can resist total shear strength of 30 N, analyze the maximum vertical shear, V that can supported by fasteners.

(8 marks)

Q4 (a) State **FOUR (4)** factors that influence deflection in structural design.

(4 marks)

(b) **FIGURE Q4** shows a cantilever beam carries the uniform distributed load of 4 kN/m and 2 kN at BC and point A, respectively. Modulus of elasticity of the beam is 200 GPa. The beam cross section is T shaped with flange width of 150 mm and flange thickness of 10 mm, web height of 120 mm and web thickness of 8 mm. By applying Macaulay method,

(i) Derive the general elastic curve equation of bending moment-deflection, slope deflection and deflection-equation of the beam.

(6 marks)

(ii) Calculate the constant value C_1 and C_2 for the differential equation of elastic curve.

(6 marks)

(iii) Analyze the values of slope and deflection at 2 m from free end of the cantilever. Assume the value of moment inertia, I_{xx} as 363.76 cm^4.

(9 marks)

Q5 (a) What is the meaning of the Euler's formula. Explain and describe the column cases that usually found.

(5 marks)

(b) A brass pipe as shown in **FIGURE Q5** having a cross section and axial load P applied 4 mm from its geometric axis. Using $E = 120$ GPa,

(i) Determine the load P for which the horizontal deflection at the mid-point C is 5 mm.

(10 marks)

(ii) Analyze the corresponding maximum stress in the column.

(10 marks)

Q6 (a) Torsion is twisting that subjected to structure members that cause the member to twist on member axes. Give the assumptions that should be taken into account in torsion analysis. Draw a related figure to support an answer.

(4 marks)

(b) The vertical shaft AD is attached to a fixed base at D and is subjected to the torques shown in **FIGURE Q6(a)**. A 44 mm diameter hole has been drilled into portion CD of the shaft. Knowing that the entire shaft is made of steel for which G = 80GPa, analyze the angle of twist at end A.

(8 marks)

(c) The aluminium alloy (G = 28 GPa) shaft of **FIGURE Q6(b)** is attached to rigid support at bolt ends. The right 2000 mm of the shaft, which is hollow, has an inside diameter of 80 mm. If the maximum shearing stress in the shaft must not exceed 80 MPa, determine:

(i) the maximum torque T that can be applied to the shaft.

(10 marks)

(ii) the rotation of the section where the torque is applied with respect to its no-load position when T = 60 kNm.

(3 marks)

- END OF QUESTIONS -

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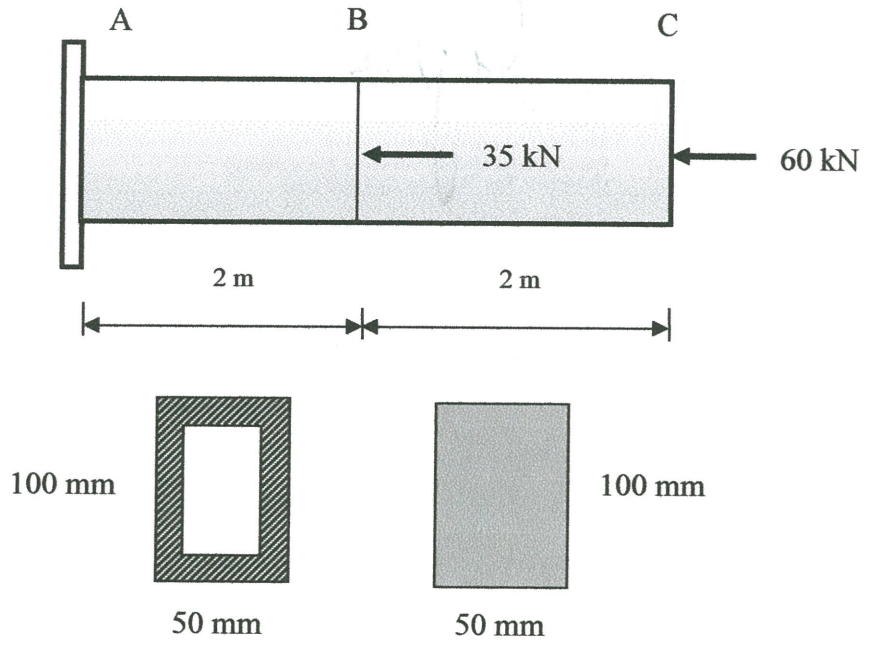

FIGURE Q1(a)

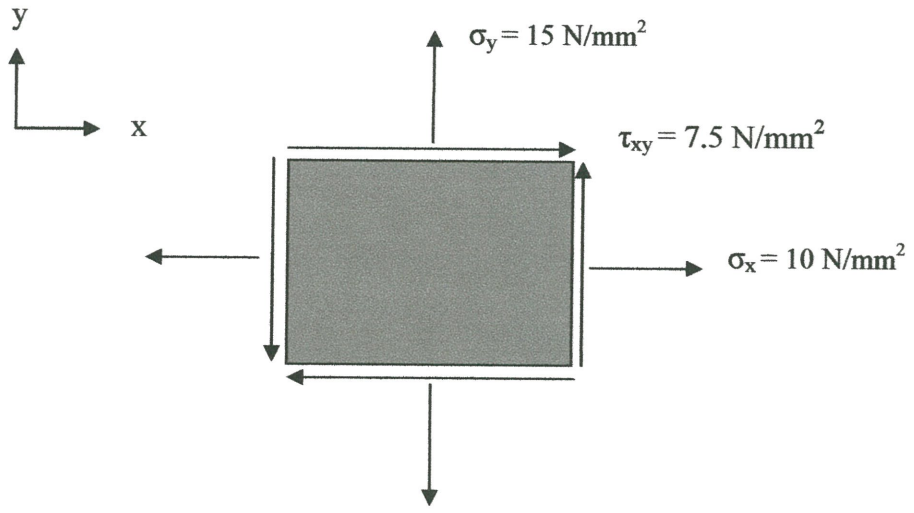

FIGURE Q1(b)

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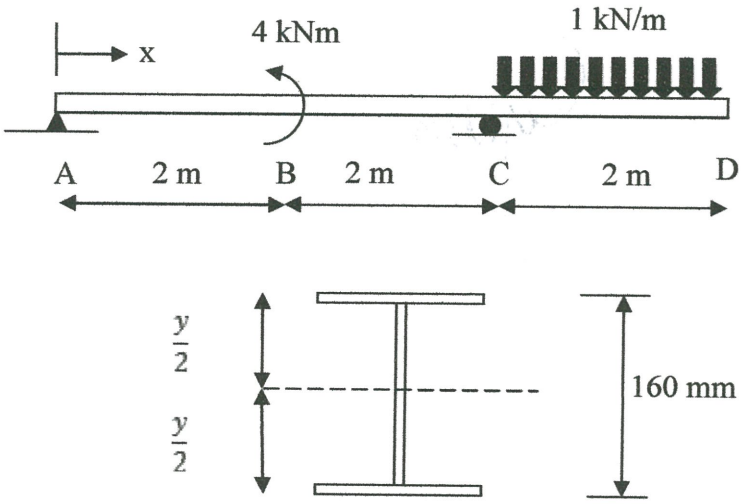

FIGURE Q2

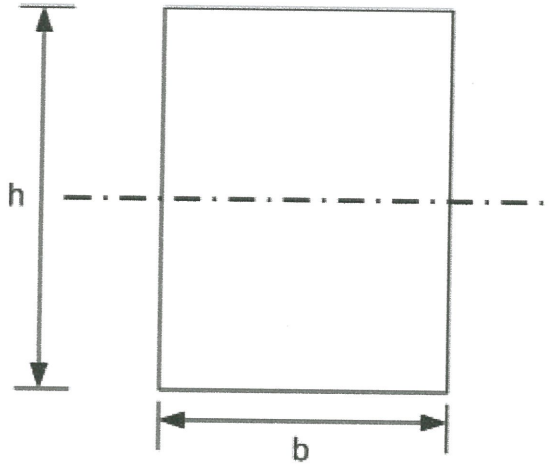

FIGURE Q3(a)

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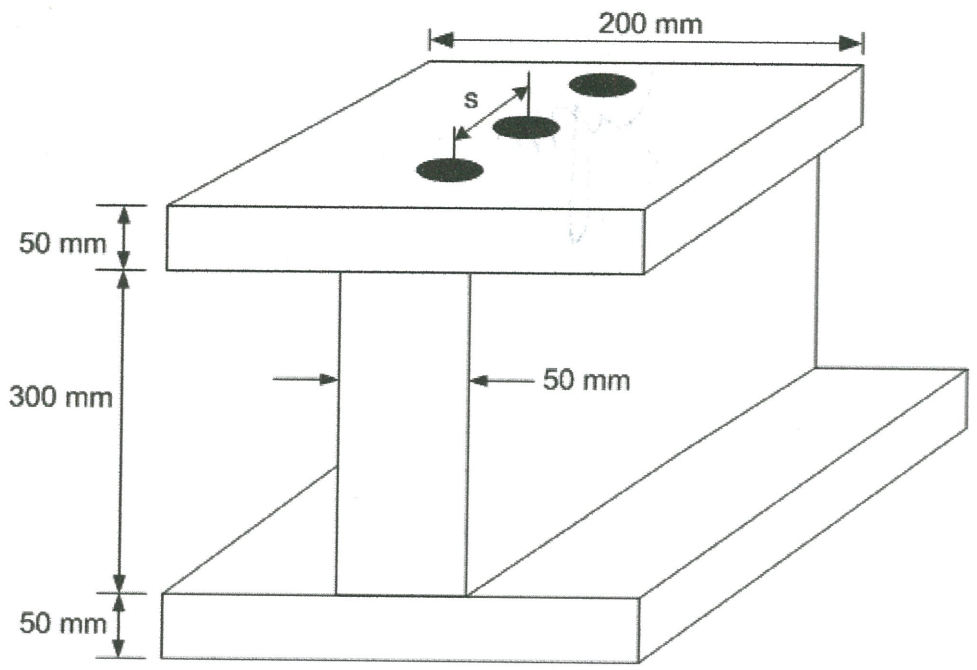

FIGURE Q3(b)

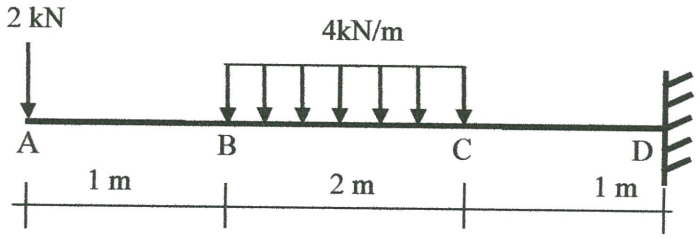

FIGURE Q4

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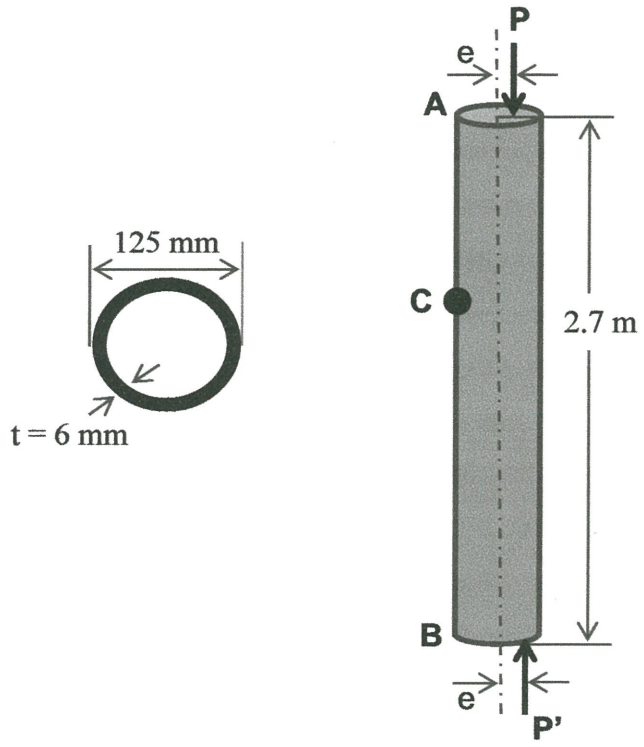

FIGURE Q5

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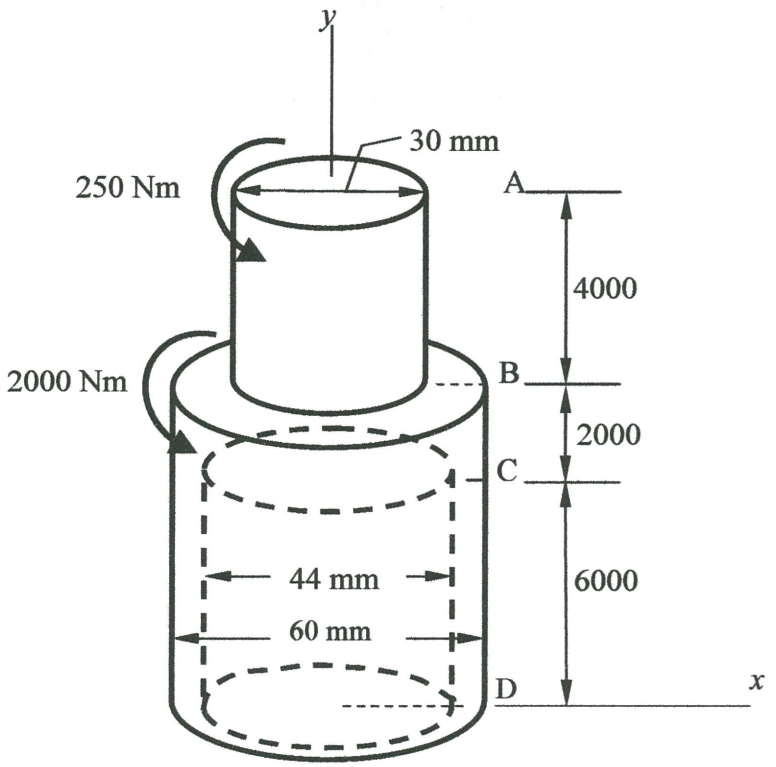

FIGURE Q6(a)

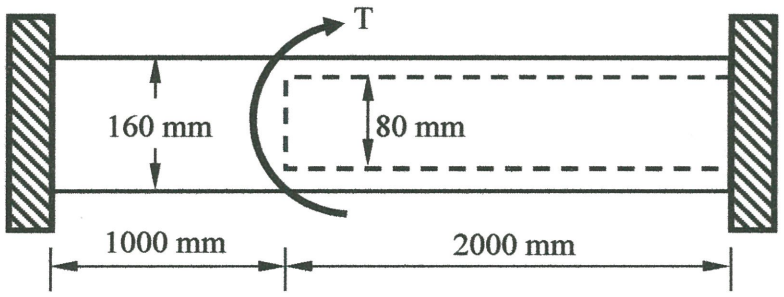

FIGURE Q6(b)