Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2020/2021

COURSE NAME	:	MECHANICS OF MATERIAL
COURSE CODE	:	BFC20903
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SEVEN** (7) PAGES

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Q1 (a) Explain the phenomenon of strain hardening.

(4 marks)

(b) A solid circular rod as in **Figure Q1(a)** is 600 mm long and 20 mm diameter. The rod is subjected to an axial force of P = 50kN. Upon loading, the elongation of the rod is δ = 1.40 mm, and its diameter reduce to d' = 19.9837 mm. Determine the modulus of elasticity of the material. Assume that the material does not yield.

(6 marks)

(c) A horizontal force P with a magnitude of 600 N is applied to the end lever of flipped L shape with diameter of 30 mm, 250 mm height and 450 mm length. Prove that the shearing force P does not cause any shearing stress at point C and principal stresses are as shown in **Figure Q1(b)**.

(15 marks)

Q2 A 1.6 m long cantilever beam supports a concentrated load of 7.2 kN as shown in **Figure Q2(a)**. The rectangular beam is made of a woven fabric composite material having a width of 120 mm and a depth of 280 mm as shown in **Figure Q2(b)**. The woven fabric cross-section is stacked with fiber orientation as shown in **Figure Q2(b)**.

(a) Provide your engineering judgements to perform structural behaviour in a composite material.

(5 marks)

(b) Find the second moment of inertia, I and cross-sectional centroid.

(2 marks)

(c) Draw bending stress profiles.

(5 marks)

(d) Calculate the maximum horizontal shear stresses at points located 35 mm, 70 mm, and 140 mm below the top surface of the beam.

(13 marks)

Q3 (a) A cantilever beam ABC in **Figure Q3(a)** consists of two segments with different moments of inertia; I_0 for segment AB and $2I_0$ for segment BC. Segment AB carries a uniformly distributed load of 20 kN/m. Determine the maximum displacement of the beam when EI is constant.

(15 marks)

(b) **Figure Q3(b)** shows a 100 mm solid steel cylinder that is built into the support at C and subjected to the torques T_A and T_B.

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(i) Determine the maximum shear stresses in segments AB and BC of the cylinder.
(6 marks)

(ii) Compute the angle of rotation of end A. Given G=83 GPa for steel.
(4 marks)

Q4 (a) An applied load has caused buckling and bending in structural member.

(i) Explain **THREE (3)** differences between bending and buckling.
(3 marks)

(ii) Explain **TWO (2)** limitations of Euler's formula.
(2 marks)

(b) **Figure Q4(a)** shows a steel beam with length of 4 m that is supported by a steel column at point B. The steel column of AB has a rectangular cross section (40 mm× 70 mm). The ends are assumed to be pin connected. The yield stress of steel is σ_y = 250 MPa. The Modulus Elasticity of the steel is 200 GPa. Use factor of safety of 1.5.

(i) Check whether the Euler's equation is appropriate or not.
(8 marks)

(ii) Determine the maximum distributed load (W) that can be applied to the beam so that the column of AB does not buckle.
(6 marks)

(c) A solid circular column with 40 mm diameter is to be replaced by a hollow circular section of the same material. The cross sections of solid and hollow circular are shown in **Figure Q4(b)**. Find the size of the hollow section if the internal diameter is 0.5 times the external diameter.
(6 marks)

-END OF QUESTIONS-

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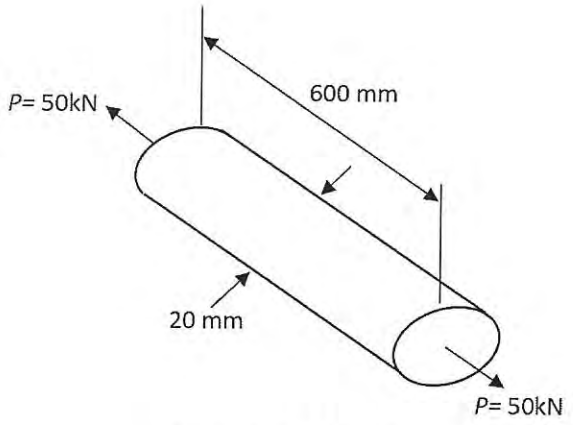

FIGURE Q1(a)

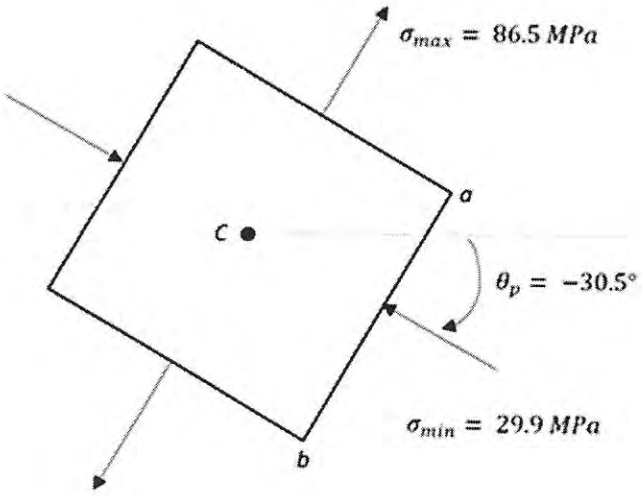

FIGURE Q1(b)

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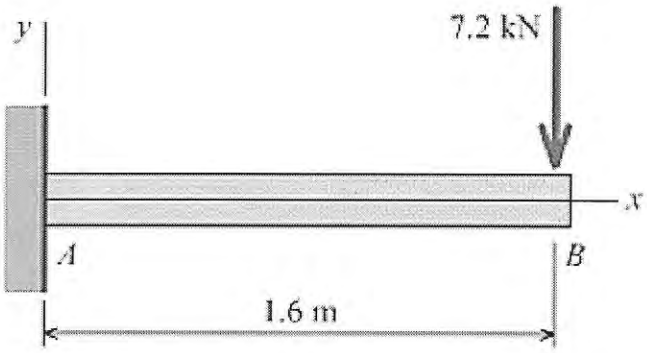
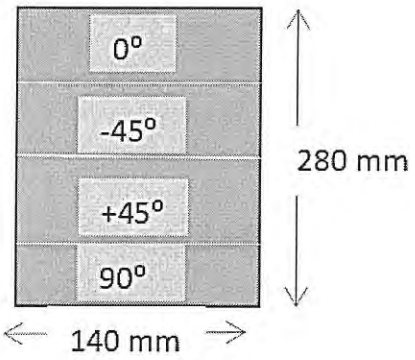


FIGURE Q2(a)



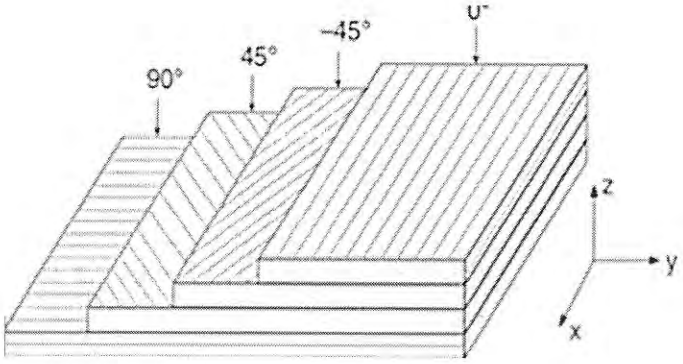


FIGURE Q2(b)

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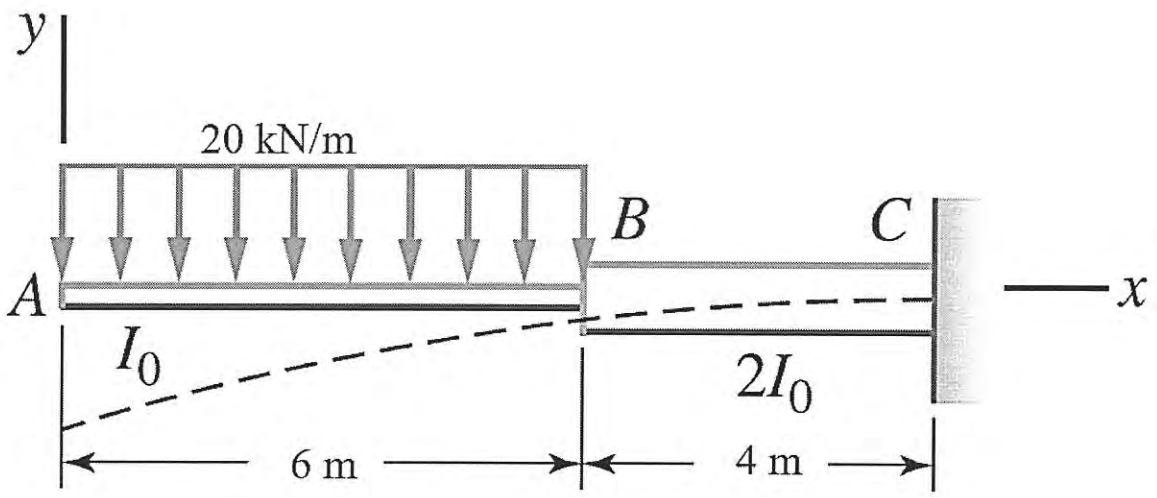

FIGURE Q3 (a)

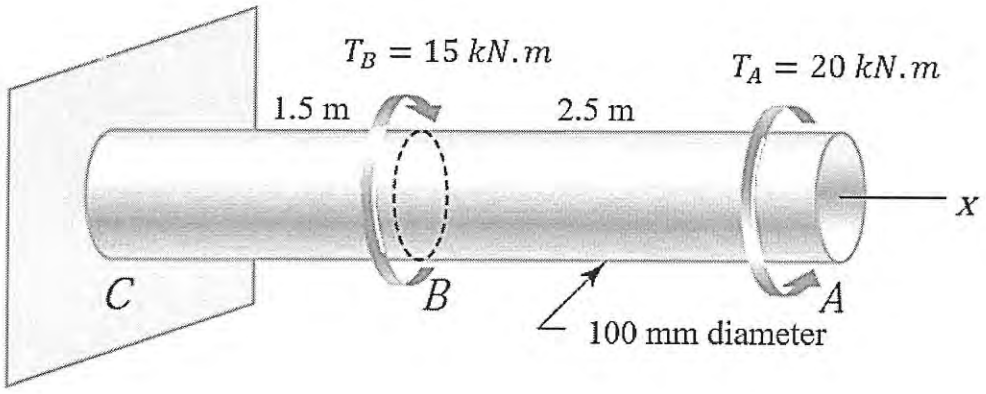

FIGURE Q3(b)

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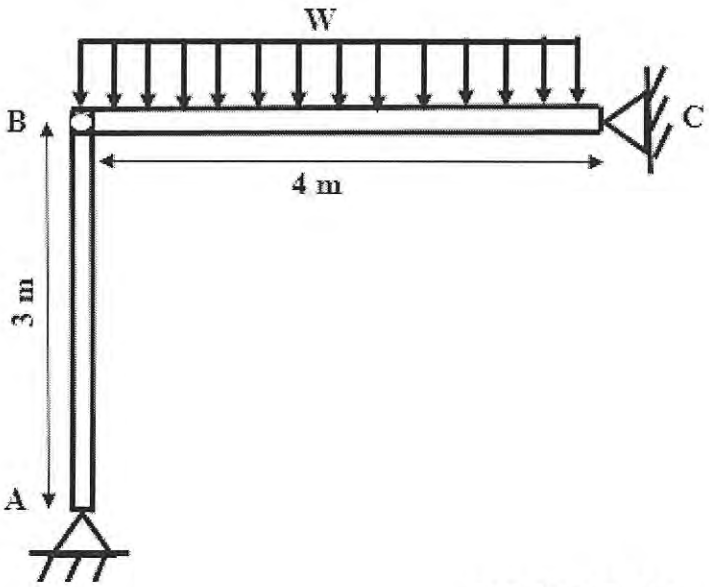
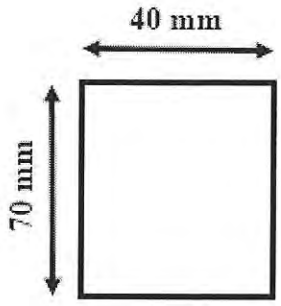
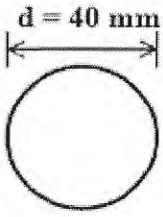


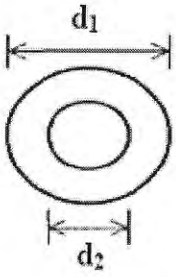


Column Section

FIGURE Q4 (a)



Solid circular cross section



Hollow circular cross section

FIGURE Q4 (b)

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