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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022**

COURSE NAME : MECHANICS OF MATERIAL
COURSE CODE : BFC 20903
PROGRAMME CODE : BFF
EXAMINATION DATE : JANUARY / FEBRUARY 2022
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER **ALL** QUESTIONS.
2. THIS FINAL EXAMINATION IS
AN **ONLINE** ASSESSMENT AND
CONDUCTED VIA **CLOSE BOOK**.

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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- Q1** (a) A 4 kN/m uniformly distributed load is applied to the beam with length of 5 m, as shown in **Figure Q1 (a)**. Supports at A and B are pin and roller, respectively. The cross section of the beam is shown in **Figure Q1 (b)**. Determine the minimum height of h if the maximum flexural stress is 20 MPa. (13 marks)
- (b) A steel beam is subjected to a maximum shear force of 80 kN. The cross-section of the beam is shown in **Figure Q1 (c)**.
- (i) Determine the shear stress at the neutral axis. (6 marks)
- (ii) Determine the shear stress at the junction between the flange and web of the beam. (6 marks)
- Q2** (a) A simply supported beam is shown in **Figure Q2 (a)**. Determine the slope at point A and the deflection at mid-span of the beam by using the Macaulay's method. Take $E=200$ GPa and $I=120 \times 10^{-6} \text{ m}^4$ (15 marks)
- (b) The cantilever beam is loaded as shown in **Figure Q2 (b)**. Use method of moment area to determine slope at point B and deflection at point C. Take EI as constant. (10 marks)
- Q3** (a) **Figure Q3 (a)** shown a single channel structure. Determine the;
- (i) cross-sectional area, A (2 marks)
- (ii) centroid in y-direction, \bar{y} (2 marks)
- (iii) centroid in z-direction, \bar{z} (2 marks)
- (iv) second moment of inertia in y-direction, I_{yy} (3 marks)
- (v) second moment of inertia in z-direction, I_{zz} (3 marks)

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- (b) Two similar channel sections from **Figure Q3 (a)** arranged back-to-back with 10 mm gap as shown in **Figure Q3 (b)**. Calculate the moment of inertia, I_{yy} and I_{zz} of the double channel section given in **Figure Q3 (b)**.
(8 marks)
- (c) Determine the critical load, P_{cr} in both x-x and y-y axes of a 10 m column cross-section in **Figure Q3 (b)** with pin-end restraints. Which axis of the column is prone to buckle? Take $E = 200$ GPa.
(5 marks)
- Q4** (a) **Figure Q4 (a)** shows a steel column connected at its web to two steel beams. The steel beam carries uniform load from their adjacent slabs. Describe how torsional action takes place by assuming fixed connection at base foundation. Sketch a diagram, if necessary to aid your explanation.
(10 marks)
- (b) Calculate the polar second moment of inertia, J of the steel column with cross-section given in **Figure Q4 (b)**.
(5 marks)
- (c) Determine the angle of twist if the column of 5 m long is subjected to torque of 10 kNm. Take shear modulus of steel is 81 GPa
(5 marks)
- (d) In your opinion, give **THREE (3)** considerations to improve torsional resistance of the column.
(5 marks)

– END OF QUESTIONS –

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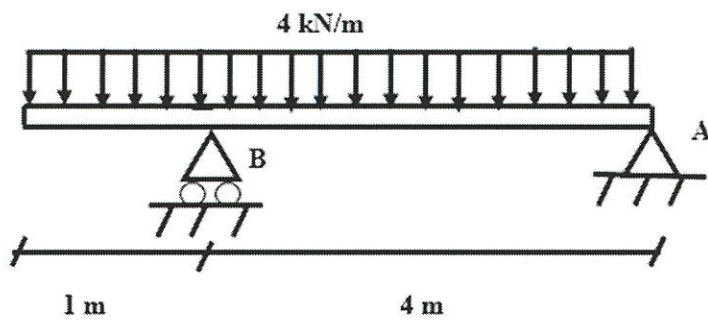


FIGURE Q1 (a)

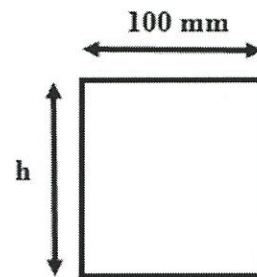


FIGURE Q1 (b)

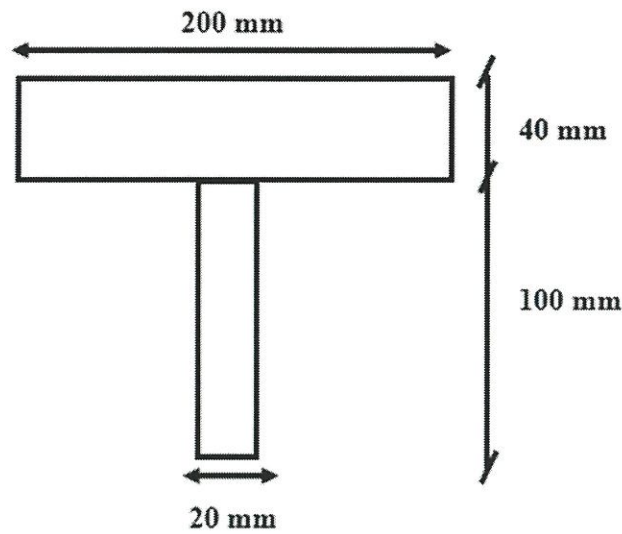


FIGURE Q1 (c)

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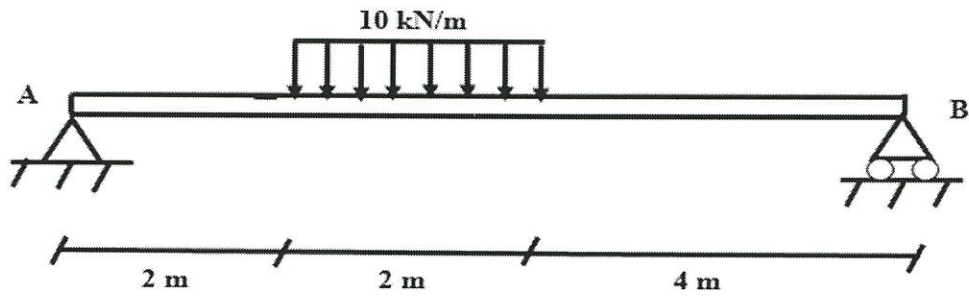


FIGURE Q2 (a)

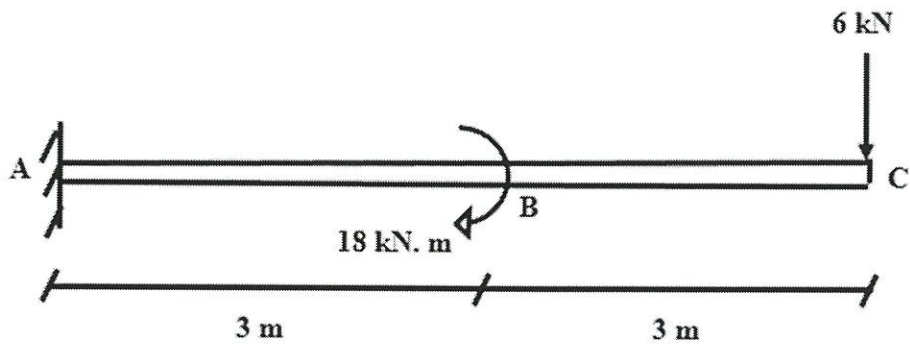


FIGURE Q2 (b)

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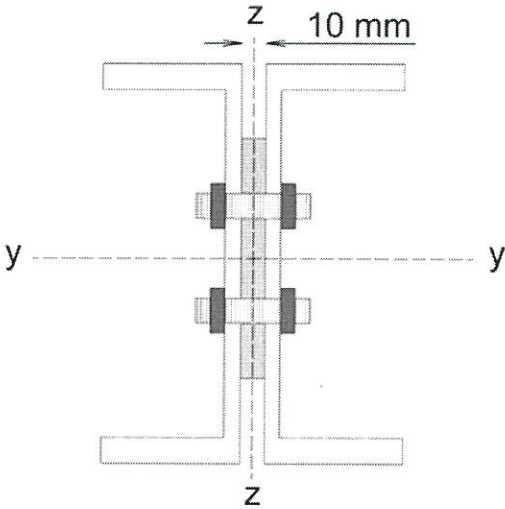


FIGURE Q3 (a)

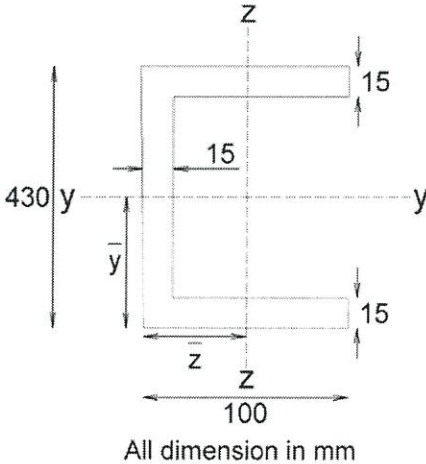


FIGURE Q3 (b)

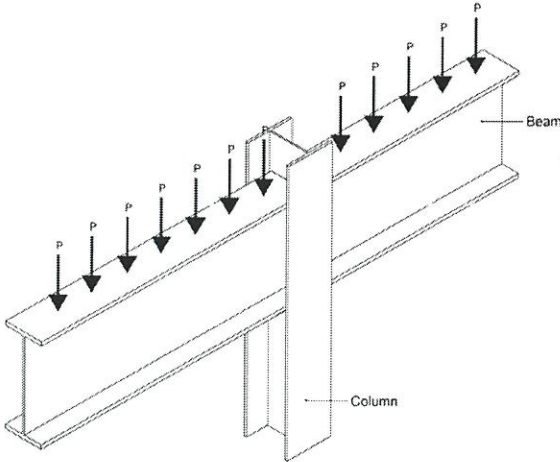


FIGURE Q4 (a)

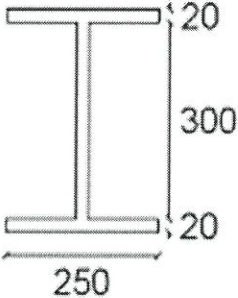


FIGURE Q4 (b)

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