Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2023/2024

COURSE NAME	:	STATIC AND DYNAMIC
COURSE CODE	:	BFC 10103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JANUARY / FEBRUARY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 **Figure Q1.1** shows a roof truss of a building that subjected to wind forces. A direct pressure wind force of 5 kN, acting downward, at the midpoint of the rafter on the windward roof slope, and suction wind forces of 10 kN, acting upward, at the midpoint along the leeward rafter. These wind forces act perpendicular to the roof slope.

(a) Resolve the wind forces onto its respective x and y components.

(4 marks)

(b) Calculate the overturning moment of point C when both wind forces act simultaneously. Do not consider reaction force from supports.

(15 marks)

(c) Determine the weight of the whole roof system that required to counteract the overturning tendency caused by the wind forces. Do not consider reaction force from supports.

(6 marks)

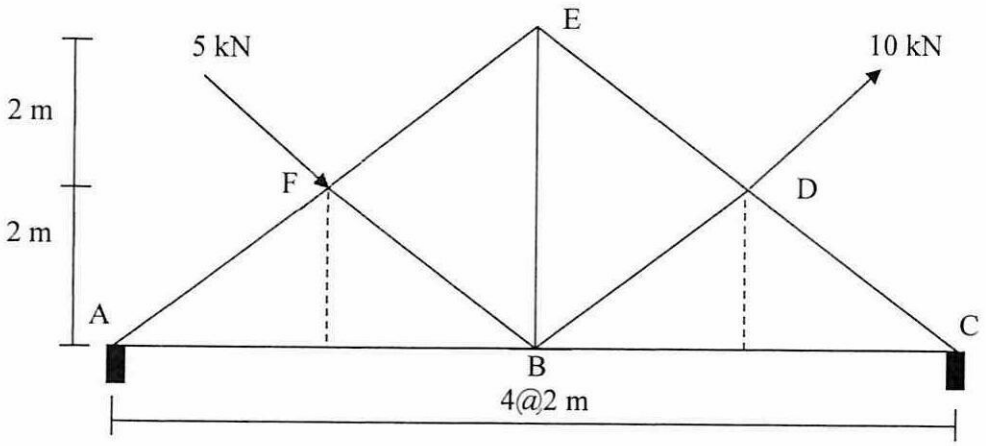

Figure Q1.1

Q2 **Figure Q2.1** shows a proposed new covered extension between gridline B and C. In the original recommendation, the new structural beam PQR is to be constructed with glued laminated timber spaced at 2 m centre to centre.

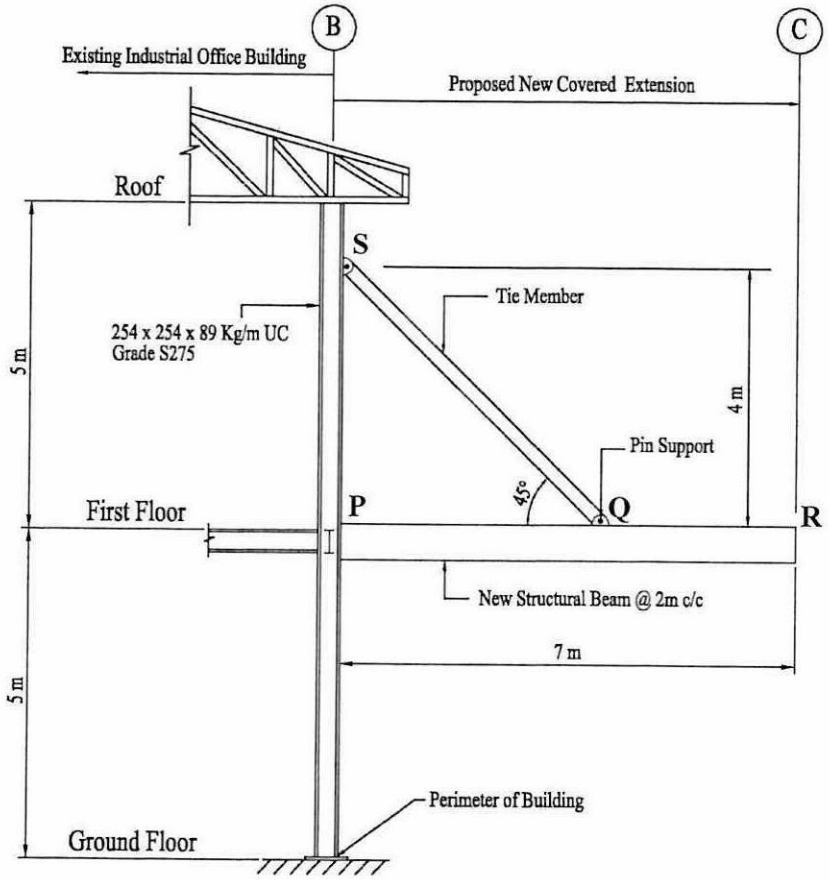

Figure Q2.1

(a) The vertical downward load (permanent action only) carried by the pin at Q is 70 kN.

(i) Draw the free body diagram for the proposed extension. Assume joint at P is roller.

(2 marks)

(ii) Calculate the tension force for cable SQ (tie member).

(5 marks)

(iii) Determine the reaction force for the new structural beam.

(6 marks)

(b) Consider if the pinned support of tie member is removed and replace with the new pinned support at R. The 5 kN vertically downward load is applied at point Q and 25 kN/m distributed load is applied along the beam.

(i) Draw the free body diagram for the new structural beam.

(2 marks)

(ii) Determine the reaction force at P and R.

(10 marks)

Q3 Answer the following questions:

(a) Briefly explain the importance of finding the centroid of a cross-sectional area in civil engineering and how does it affect the analysis and design of structural elements.

(3 marks)

(b) Compare the centroid and the centre of gravity of a structural element, highlighting their similarities and briefly explaining how these two concepts are interconnected.

(2 marks)

(c) **Figure Q3.1** displays an I-beam shaped, characterized by the following dimensions: the top flange has a width of 12 cm and a thickness of 2 cm, while the web measures 18 cm in height with a thickness of 2 cm. The bottom flange is 20 cm width and 4 cm thickness. Calculate the followings for this I-beam cross-section:

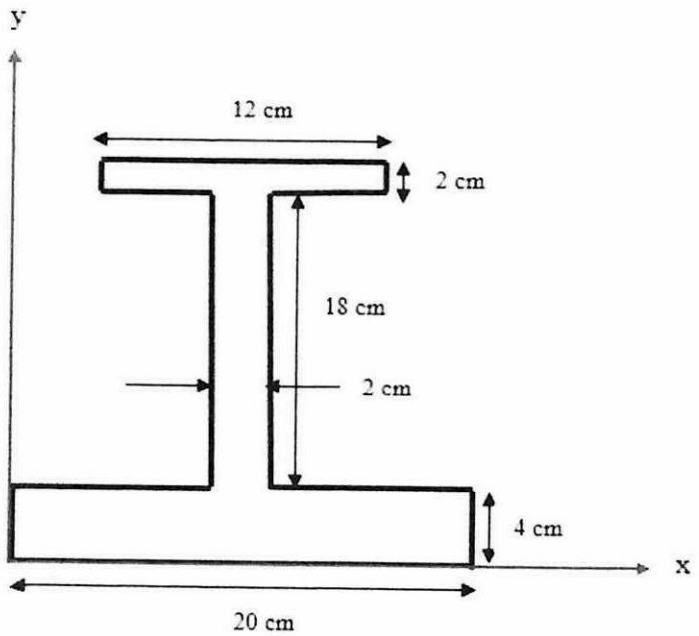

FIGURE Q3.1

(i) The centroid of the cross-sectional area. Provide step-by-step calculations.

(8 marks)

(ii) The moment of inertia of the beam about x and y axis.

(12 marks)

Q4 Answer the following questions:

(a) Briefly explain differences between kinetic and kinematic in the context of dynamic.

(3 marks)

(b) A car moves in a straight line with a velocity of 2 m/s. It starts to accelerate at $60/v^4$ m/s^2. Determine:

(i) The velocity 3 seconds after the acceleration.

(6 marks)

(ii) The position 3 seconds after the acceleration.

(6 marks)

(c) **Figure Q4.1** shows three toy cars, labeled as A, B, and C, each having masses of $m_A = 0.1$ kg, $m_B = 0.2$ kg and $m_C = 0.3$ kg, are linked together and subjected to a horizontal force of F=3 N. Assuming no friction, calculate the following:

(i) The acceleration of the cars.

(5 marks)

(i) The force between car A and B.

(5 marks)

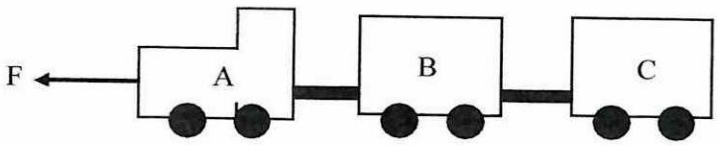

Figure Q4.1

- END OF QUESTIONS -