Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	STRUCTURAL ANALYSIS
COURSE CODE	:	BFC 21403
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 **SEVEN (7)** PAGES

Q1 (a) As a structural engineer, you are assigned to perform an analysis for ALL member forces of a plane truss as shown in **Figure Q1(a)**. All answers are in three decimal places.

(i) Identify the stability and determinacy of the plane truss.

(1 mark)

(ii) Determine the force in each member of the loaded truss by Method of Joints.

(9 marks)

(iii) Predict the vertical displacement at joint D by applying unit load method.

(5 marks)

(b) **Figure Q1(b)** shows the steel truss with a 3-meter span. The cross-sectional area for all members of the truss is 400 mm^2. Span BC carried a uniformly distributed load of 30 kN/m. Prove that the plane truss is internal statically indeterminate. Then, using the Method of Virtual Work, approximate the member forces AC. Assume that member AC is redundant in your analysis. Given $E_s = 200\ GPa$. All answers are in three decimal places.

(10 marks)

Q2 **Figure Q2** shows the continuous beam ABCD. The beam is supported with a fixed end at A and roller at B and C. Using the slope deflection method;

(a) Calculate Fixed end moment (FEM).

(5 marks)

(b) Determine End moments and reaction at every support.

(10 marks)

(c) Draw the shear force diagram for the entire beam.

(5 marks)

(d) Draw the bending-moment diagram for the entire beam.

(5 marks)

Q3 (a) **Figure Q3(a)** shows a beam fixed at A, hinge at B and roller at C. Using equilibrium equations, determine;

(i) The influence line for the reaction at C.

(4 marks)

(ii) The influence line for the moment at E.

(7 marks)

(b) As a structural engineer, you are required to prepare a report regarding the safety of truss bridge as shown in **Figure Q3(b)**. In particular, you are instructed to do as follows;

(i) Construct and discuss the influence line of member CH.

(8 marks)

(ii) Determine the maximum force (compression or tension) that can be developed in member CH due to uniform distributed load (15 kN/m) and a series of four moving concentrated loads from the left to the right.

(6 marks)

Q4 (a) **Figure Q4(a)** shows the idealized stress-strain curve for steel and **Figure Q4(b)** shows the yielding of the beam section due to bending. Explain in detail the relation between these **TWO (2)** Figures based on your understanding of plastic analysis.

(6 marks)

(b) **Figure Q4(c)** shows a continuous beam subjected to uniformly distributed load at span AB and span EF. Span BE of the continuous beam is subjected to the concentrated load of 10 kN and 20 kN at C and D, respectively.

(i) With the aid of sketches, identify all the possible collapse mechanism of the beam and label the corresponding plastic hinges, plastic moment (M_p) and rotation (θ).

(7 marks)

(ii) Virtual work is one of the methods that can be used to analyze plastic moment (M_p). State the principle of virtual work, then by using this method, determine the maximum plastic moment, (M_p) of the continuous beam.

(12 marks)

– END OF QUESTIONS –

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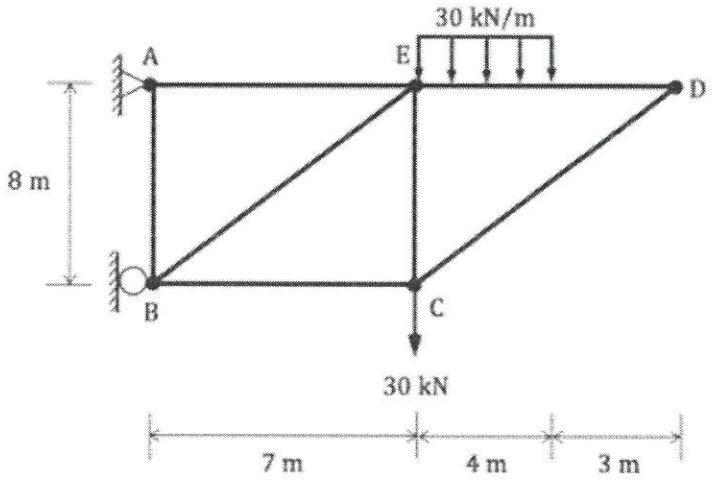

FIGURE Q1(a)

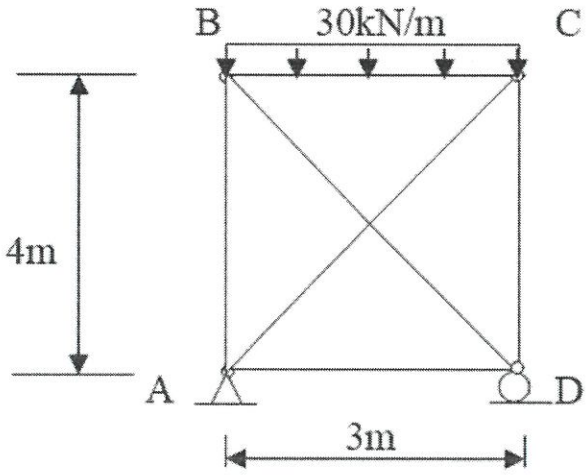

FIGURE Q1(b)

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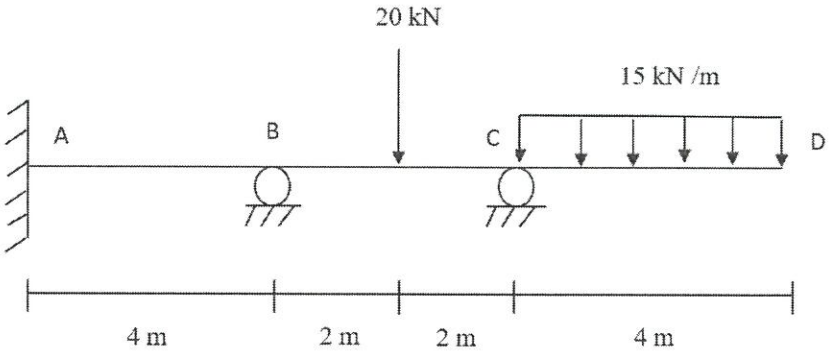

FIGURE Q2

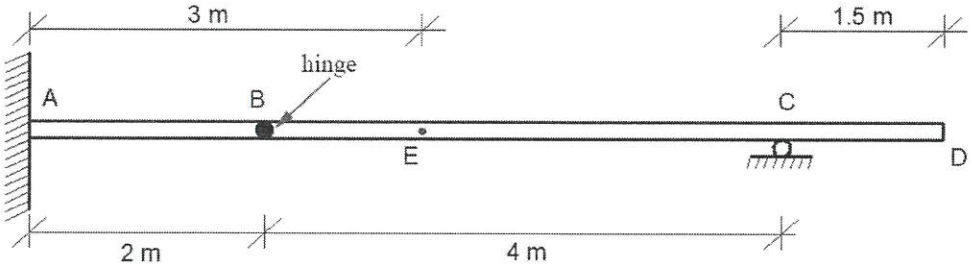

FIGURE Q3(a)

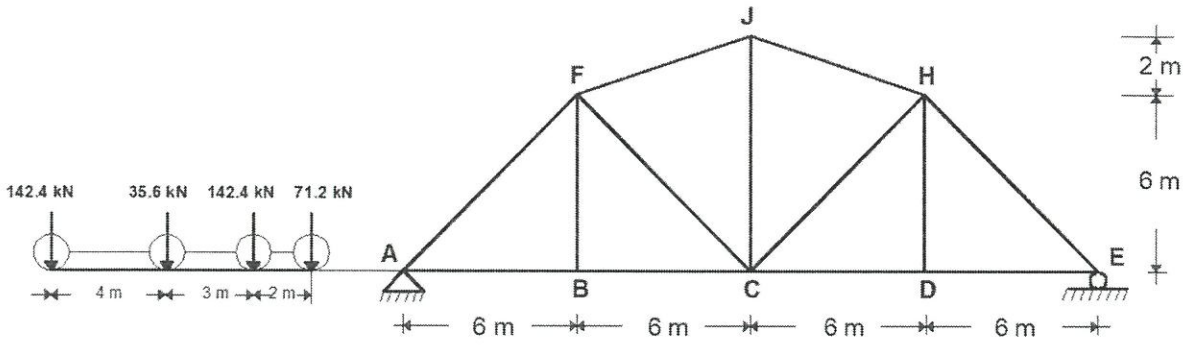

FIGURE Q3(b)

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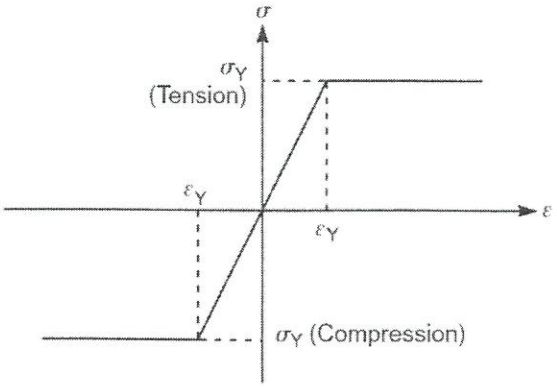

FIGURE Q4(a)

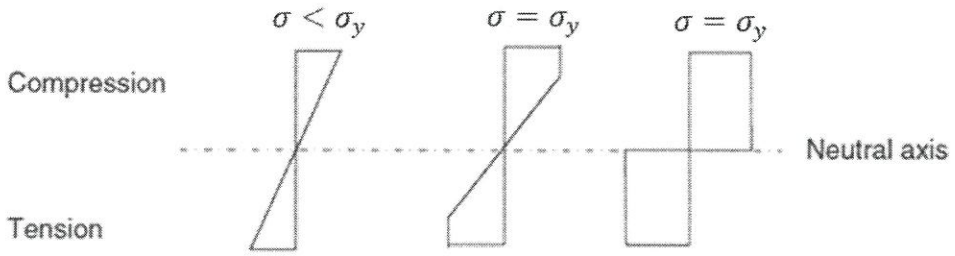

FIGURE Q4(b)

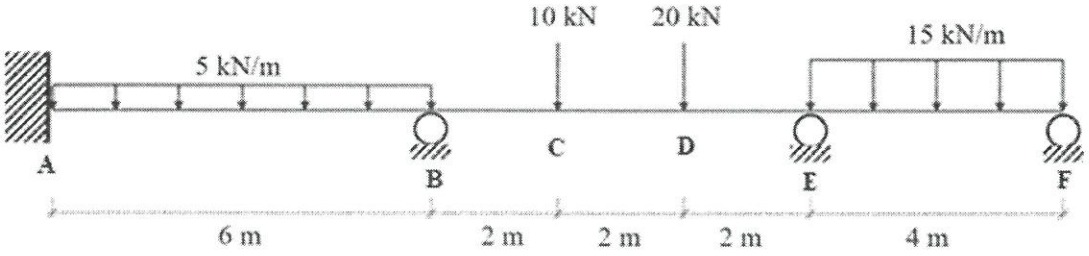

FIGURE Q4(c)

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Fixed End Moment