Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	STRUCTURAL ANALYSIS
COURSE CODE	:	BFC21403
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN **SECTION A** AND **ONE (1)** QUESTION IN **SECTION B**

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

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SECTION A

Q1 (a) State the Principle of Equilibrium for planar structure. Write the **THREE (3)** equilibrium equations that must be satisfied.

(3 marks)

(b) Classify the structures in **Figure Q1(b)** based on determinacy and stability.

(6 marks)

(c) **Figure Q1(c)** shows a statically determinate plane truss subjected to a horizontal concentrated load at D. The truss is made using steel with the Young's modulus of elasticity 200 GPa, and the cross section area for all members are constant. If the horizontal displacement at D is limited to 15 mm, determine the minimum cross section area required for the truss. The solution can be based on Method of Conservation Energy or Method of Virtual Work.

(20 marks)

(d) Based on **Figure Q1(c)**, an additional steel bar is braced from point A to C and it becomes indeterminate plane truss. Determine the new internal forces for the truss member.

(11 marks)

Q2 **Figure Q2** shows a continuous beam ABCDE, having three equal spans of 3000 mm and a cantilever span of 1000 mm. The beam carries uniformly distributed load of 12 kN/m and 8 kN/m on spans AB and CE, respectively. Using slope deflection method:

(a) Determine the support moment.

(14 marks)

(b) Draw the shear force and bending moment diagram for the beam.

(6 marks)

(c) Analyse the support moments for the beam by using the same method, if the beam loses its rotational fixity at point A.

(10 marks)

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SECTION B

Q3 (a) **Figure Q3 (a)** shows wheels of a moving truck. The truck is moving from right to the left:

(i) Construct the influence line for moment at C

(6 marks)

(ii) Determine the maximum moment at point C

(9 marks)

(b) Pratt bridge truss as shown in **Figure Q3 (b)** comprised entirely of equilateral triangles with a unit load moving from left to right.

(i) Draw the influence lines for the vertical reactions at support B and E.

(8 marks)

(ii) Calculate the maximum load for member CH.

(7 marks)

Q4 (a) Briefly discuss **TWO (2)** assumptions in plastic analysis.

(5 marks)

(b) A cross section of a simply supported steel beam is shown in **Figure Q4 (b)**. Given that $\sigma_y = 250$ N/mm^2.

(i) Determine the plastic moment, M_p.

(8 marks)

(ii) Calculate the plastic modulus, Z_p.

(7 marks)

(c) A simply supported beam is loaded with various loads as illustrated in **Figure Q4 (c)**. Determine the plastic moment of the beam using virtual work method.

(10 marks)

– END OF QUESTIONS –

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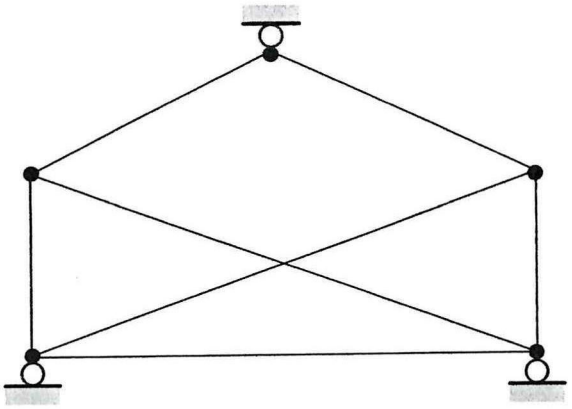
(i)



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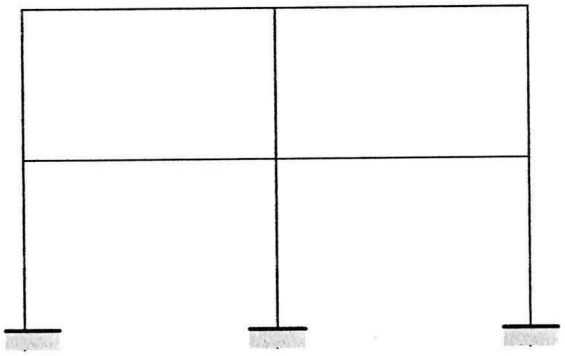

(iii)

FIGURE Q1 (b)

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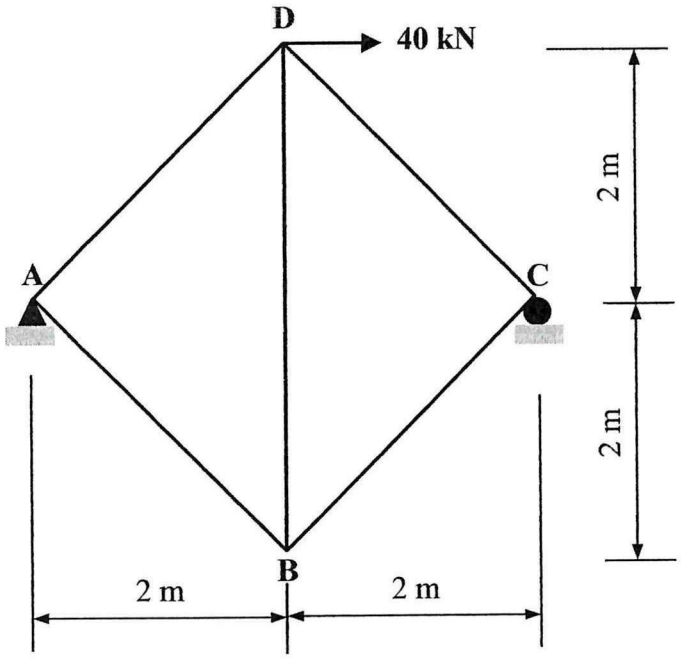

FIGURE Q1 (c)

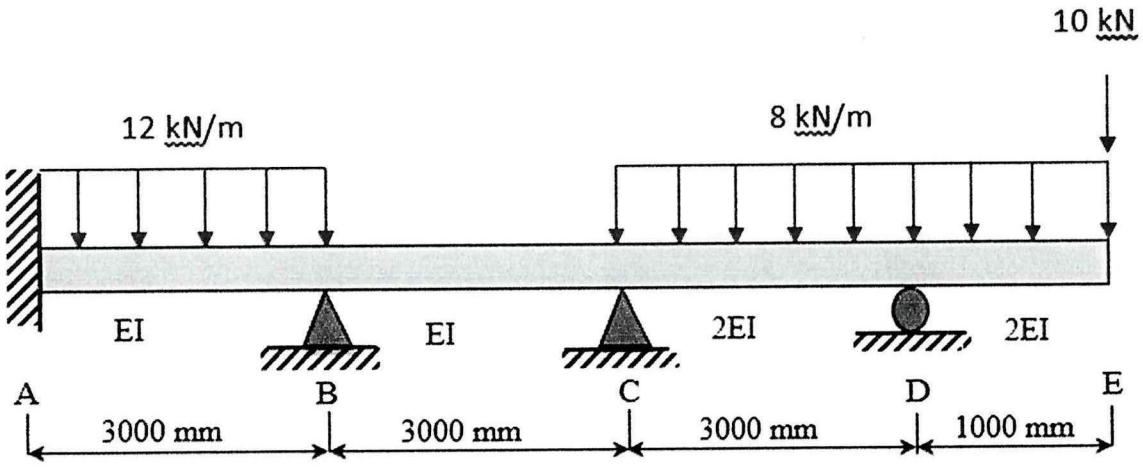

FIGURE Q2

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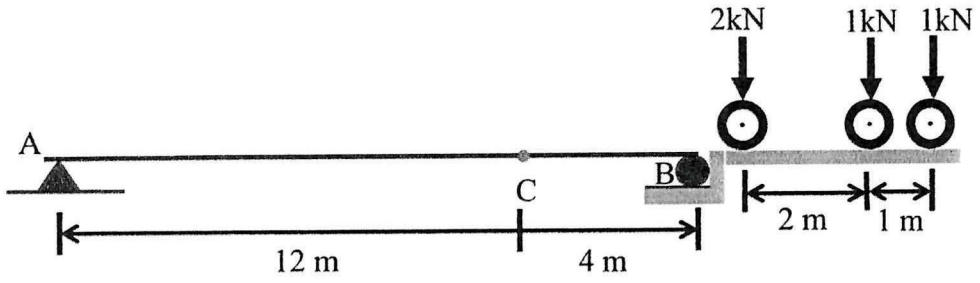

FIGURE Q3 (a)

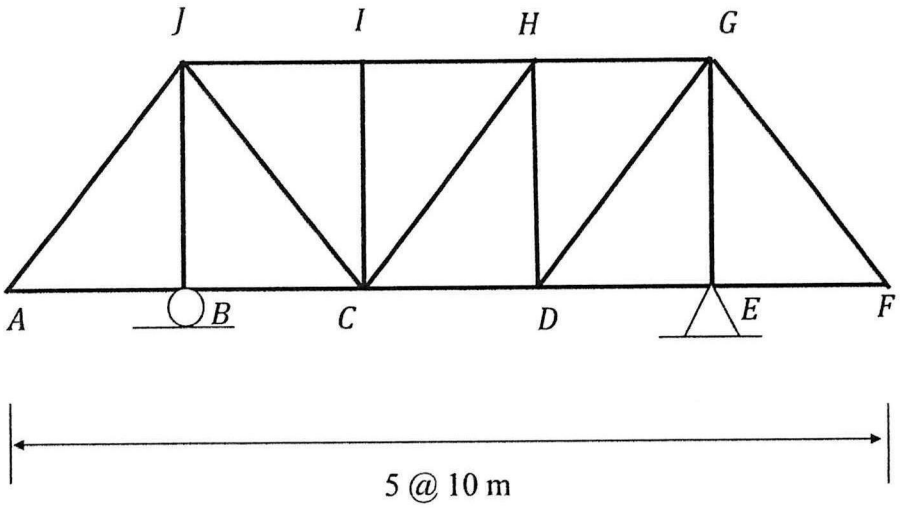

FIGURE Q3 (b)

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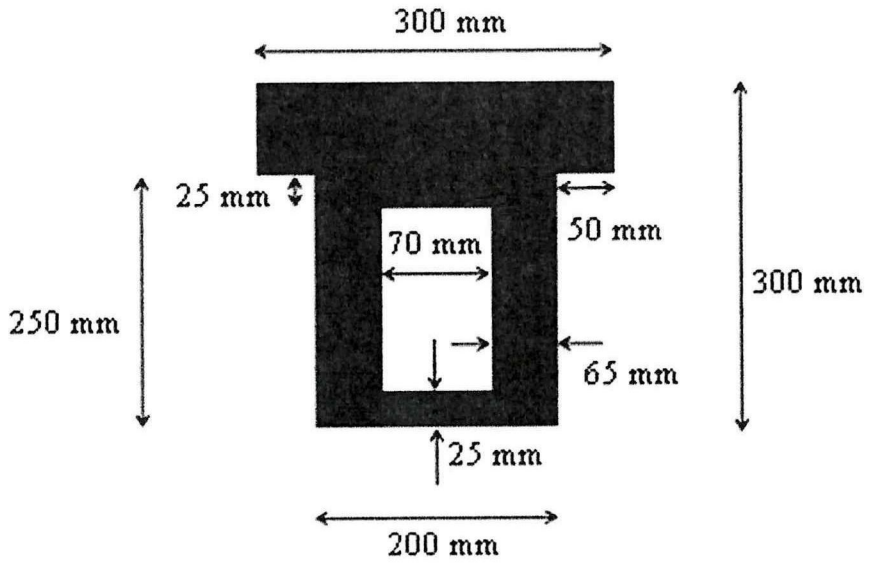

FIGURE Q4 (b)

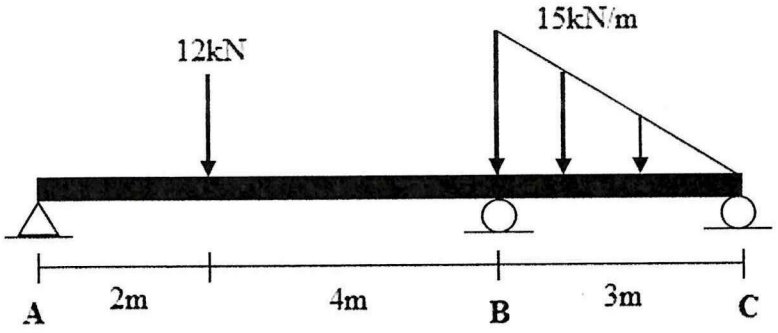

FIGURE Q4 (c)

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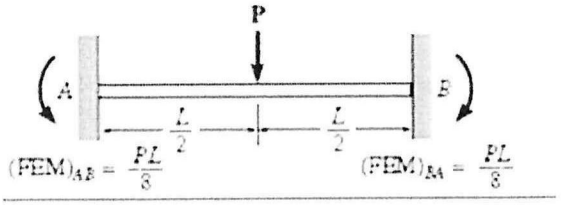
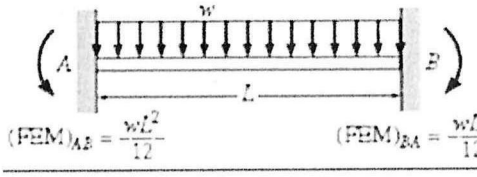
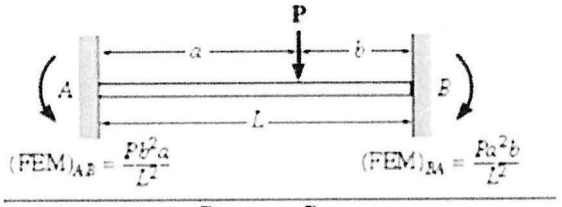
Fixed End Moment



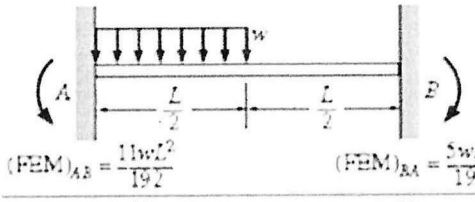
$(FEM)_{AB} = \frac{PL}{8}$ $(FEM)_{BA} = \frac{PL}{8}$



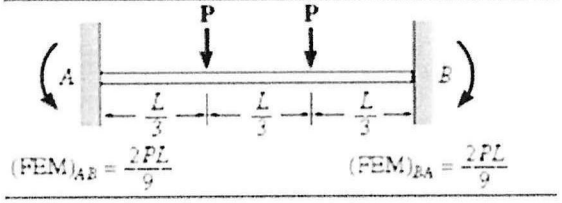
$(FEM)_{AB} = \frac{wL^2}{12}$ $(FEM)_{BA} = \frac{wL^2}{12}$



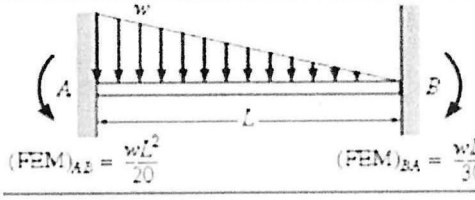
$(FEM)_{AB} = \frac{Pb^2a}{L^2}$ $(FEM)_{BA} = \frac{Pa^2b}{L^2}$



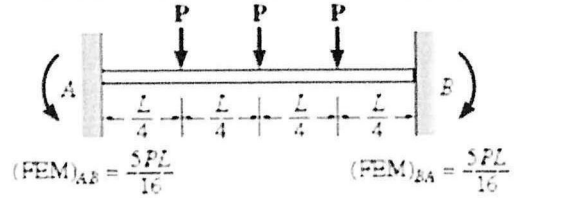
$(FEM)_{AB} = \frac{11wL^2}{192}$ $(FEM)_{BA} = \frac{5wL^2}{192}$



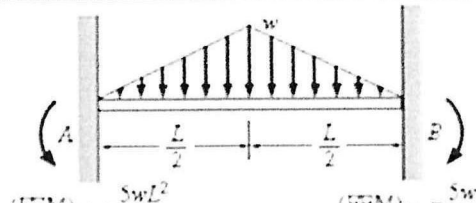
$(FEM)_{AB} = \frac{2PL}{9}$ $(FEM)_{BA} = \frac{2PL}{9}$



$(FEM)_{AB} = \frac{wL^2}{20}$ $(FEM)_{BA} = \frac{wL^2}{30}$



$(FEM)_{AB} = \frac{5PL}{16}$ $(FEM)_{BA} = \frac{5PL}{16}$



$(FEM)_{AB} = \frac{5wL^2}{96}$ $(FEM)_{BA} = \frac{5wL^2}{96}$

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