Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	ADVANCED STRUCTURE ANALYSIS
COURSE CODE	:	BFS40103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	DECEMBER 2019/ JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) List **TWO (2)** advantages and disadvantages of indeterminate structure.

(4 marks)

(b) A continuous beam in **Figure Q1(b)** is subjected to a point load P at 2 m from A and 2 m from C. Using force method:

(i) Determine the reactions at the supports of the beam. Give the answers in P.

(16 marks)

(ii) Draw the shear force and bending moment diagram if EI is constant.

(5 marks)

Q2 A truss as shown in **Figure Q2** is pinned supported at points 2, 3 and 4. Point load of 20kN is acting downward at point 1. Using finite element method, determine:

(i) Horizontal and vertical deflection at point 1.

(15 marks)

(ii) Reactions at each support.

(10 marks)

Q3 (a) Derive the equation for Euler buckling load for column fixed supported at one end and free at the other end.

(12 marks)

(b) A 3 m column which is pinned at both ends and with the cross section shown in **Figure Q3(b)** is constructed from two pieces of timber, that act as a unit. If the modulus of elasticity of timber is E=13 GPa, determine;

(i) The slenderness ratio of the column.

(3 marks)

(ii) The critical buckling load (Pcr).

(5 marks)

(iii) Axial stress in the column when the critical load is applied.

(5 marks)

Q4 (a) List **FOUR (4)** asumptions in Yield Line theory.

(8 marks)

(b) Determine the maximum ultimate moment, m, for the rectangular slab in **Figure Q4(b)** with dimension 10 m x 14 m. The slab is simply supported at three edges with isotropic reinforcement subjected to distributed load, $q = 15 kN/m^2$, over its surface area and horizontal line load, w = 3 kN/m.

(17 marks)

Q5 (a) Draw the stress distribution for the cross section in **Figure Q5(a)** in its elastic and lastic condition, if its centroid from the bottom is y_c.

(7 marks)

(b) A 2-bay frame shown in **Figure Q5(b)** is loaded with vertical point load of 10 kN at mid-span of beam BC and CD, and horizontal point load of 20 kN at B. Determine the maximum plastic moment for the frame structure.

(18 marks)

– END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER/SESSION	: SEM I / 2019/2020	PROGRAMME CODE	: 4 BFF
COURSE NAME	: ADVANCED STRUCTURE ANALYSIS	COURSE CODE	: BFS40103

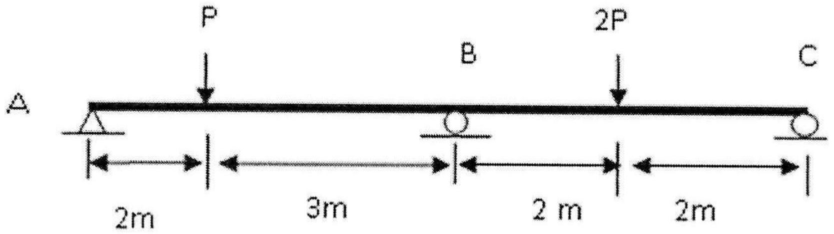

FIGURE Q1(b)

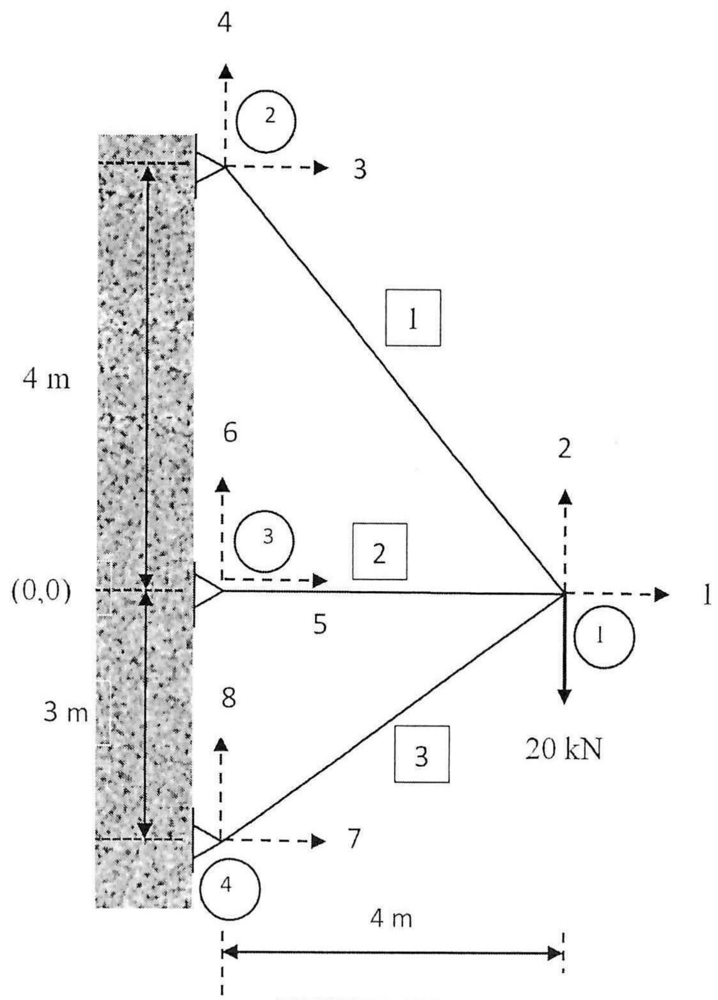

FIGURE Q2

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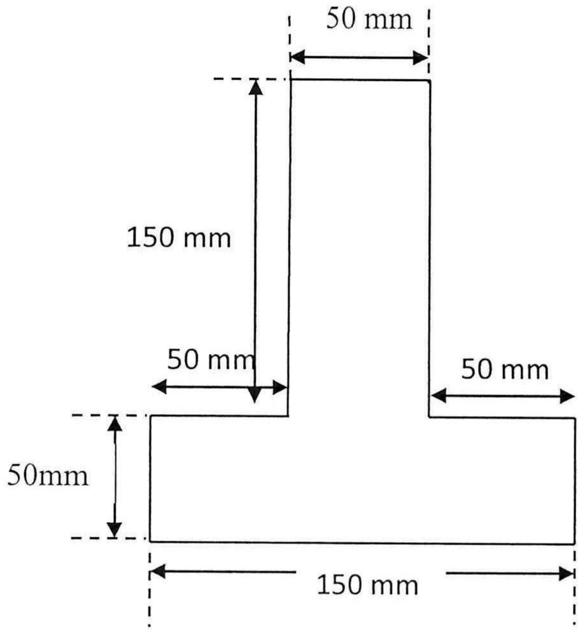

FIGURE Q3(b)

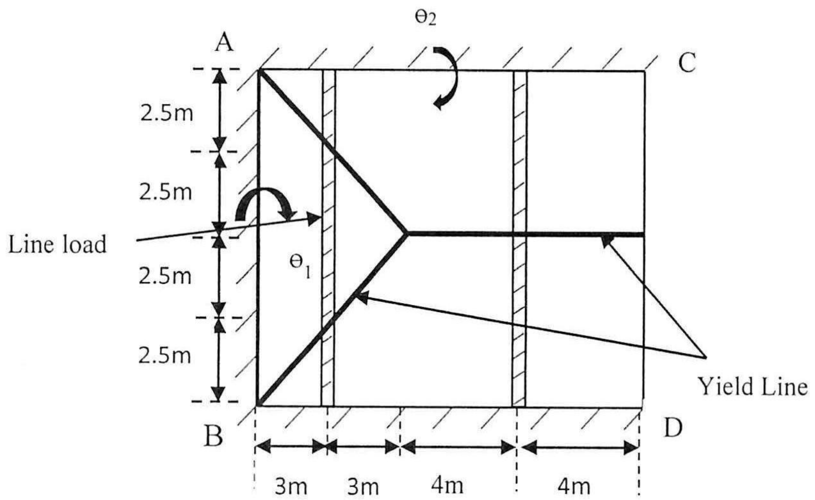

FIGURE Q4(b)

FINAL EXAMINATION

SEMESTER/SESSION	: SEM I / 2019/2020	PROGRAMME CODE	: 4 BFF
COURSE NAME	: ADVANCED STRUCTURE ANALYSIS	COURSE CODE	: BFS40103

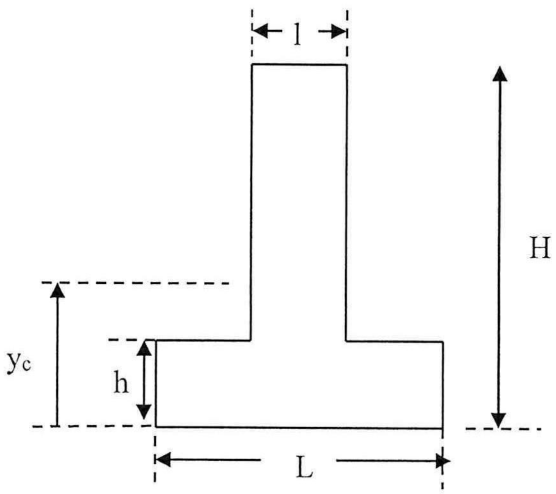

FIGURE Q5(a)

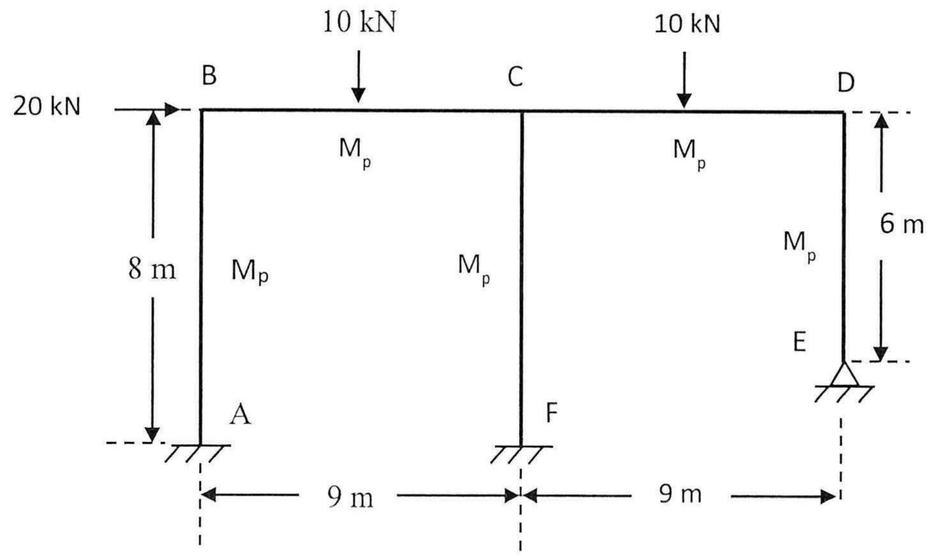

FIGURE Q5(b)

FINAL EXAMINATION

SEMESTER/SESSION	: SEM I / 2019/2020	PROGRAMME CODE	: 4 BFF
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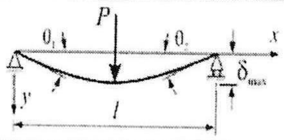
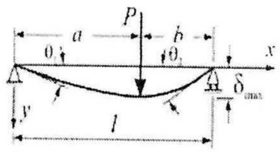
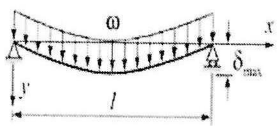
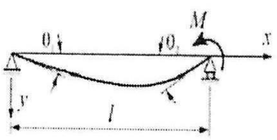
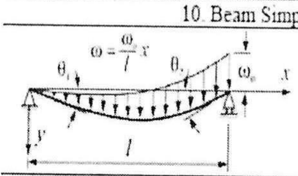
FORMULA

Stiffness for truss:

$$k = \frac{EA}{L}\begin{bmatrix} \lambda_x^2 & \lambda_x\lambda_y & -\lambda_x^2 & -\lambda_x\lambda_y \\ \lambda_x\lambda_y & \lambda_y^2 & -\lambda_x\lambda_y & -\lambda_y^2 \\ -\lambda_x^2 & -\lambda_x\lambda_y & \lambda_x^2 & \lambda_x\lambda_y \\ -\lambda_x\lambda_y & -\lambda_y^2 & \lambda_x\lambda_y & \lambda_y^2 \end{bmatrix}$$

BEAM DEFLECTION FORMULAS

BEAM TYPE	SLOPE AT ENDS	DEFLECTION AT ANY SECTION IN TERMS OF x	MAXIMUM AND CENTER DEFLECTION
6. Beam Simply Supported at Ends – Concentrated load P at the center			
	$\theta_1 = \theta_2 = \frac{Pl^2}{16EI}$	$y = \frac{Px}{12EI}\left(\frac{3l^2}{4} - x^2\right)$ for $0 < x < \frac{l}{2}$	$\delta_{max} = \frac{Pl^3}{48EI}$
7. Beam Simply Supported at Ends – Concentrated load P at any point			
	$\theta_1 = \frac{Pb(l^2-b^2)}{6lEI}$ $\theta_2 = \frac{Pab(2l-b)}{6lEI}$	$y = \frac{Pbx}{6lEI}(l^2 - x^2 - b^2)$ for $0 < x < a$ $y = \frac{Pb}{6lEI}\left[\frac{l}{b}(x-a)^3 + (l^2-b^2)x - x^3\right]$ for $a < x < l$	$\delta_{max} = \frac{Pb(l^2-b^2)^{3/2}}{9\sqrt{3}lEI}$ at $x = \sqrt{(l^2-b^2)/3}$ $\delta = \frac{Pb}{48EI}(3l^2 - 4b^2)$ at the center, if $a > b$
8. Beam Simply Supported at Ends – Uniformly distributed load ω (N/m)			
	$\theta_1 = \theta_2 = \frac{\omega l^3}{24EI}$	$y = \frac{\omega x}{24EI}(l^3 - 2lx^2 + x^3)$	$\delta_{max} = \frac{5\omega l^4}{384EI}$
9. Beam Simply Supported at Ends – Couple moment M at the right end			
	$\theta_1 = \frac{Ml}{6EI}$ $\theta_2 = \frac{Ml}{3EI}$	$y = \frac{Mlx}{6EI}\left(1 - \frac{x^2}{l^2}\right)$	$\delta_{max} = \frac{Ml^2}{9\sqrt{3}EI}$ at $x = \frac{l}{\sqrt{3}}$ $\delta = \frac{Ml^2}{16EI}$ at the center
10. Beam Simply Supported at Ends – Uniformly varying load: Maximum intensity ω_o (N/m)			
	$\theta_1 = \frac{7\omega_o l^3}{360EI}$ $\theta_2 = \frac{\omega_o l^3}{45EI}$	$y = \frac{\omega_o x}{360lEI}(7l^4 - 10l^2x^2 + 3x^4)$	$\delta_{max} = 0.00652\frac{\omega_o l^4}{EI}$ at $x = 0.519l$ $\delta = 0.00651\frac{\omega_o l^4}{EI}$ at the center