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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	ADVANCED STRUCTURE ANALYSIS
COURSE CODE	:	BFS 40103
PROGRAMME	:	4 BFF
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **NINE** (9) PAGES

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Q1 (a) A statically indeterminate beam shown in Figure **Q1 (a)** is subjected to uniform load of 8 kN/m and point load of 10 kN at a distance of 2 m from point C. Taking EI as constant, and by using the principle of superposition from the Force Method;

(i) Determine the reactions of supports A, B and C.

(14 marks)

(ii) Draw the shear force and bending moment diagram of the beam.

(6 marks)

(b) Figure **Q1 (b)** shows determinate and indeterminate beams subjected to a point load at the mid span. Describe briefly **TWO (2)** differences in term of settlement and deflection of the beams. Support your answer by using sketches.

(5 marks)

Q2 (a) Figure **Q2** shows the statically indeterminate frame loaded with uniformly distributed load of 10 kN/m. Determine:

(i) The degree of indeterminacy and draw the deflection curve.

(4 marks)

(ii) Derive the compatibility equation.

(2 marks)

(iii) Using the Force Method and compatibility equation, determine the reactions at each support.

(14 marks)

(iv) Draw the shear force and bending moment diagram for the frame. EI is constant.

(5 marks)

Q3 Figure **Q3** shows a truss pinned at the column. Determine:

i. Global Stiffness matrix, K

(8 marks)

ii. Develop the matrix equation $\{Q\} = [K]\{D\}$

(7 marks)

iii. Vertical displacement at node 3 if given $A = 0.5\ cm^2$ and $E = 29000\ N/cm^2$ for each member

(10 marks)

Q4. (a) Construct the yield line pattern for the slabs shown in Figure **Q4(a)**.

(4 marks)

(b) Figure **Q4(b)** shows a triangular slab, simply supported along all three edges, is isotropically reinforced to give a yield moment of 27kN/m. By considering a reasonable collapse mode, calculate the value of the uniformly distributed load q that could cause collapse.

(10 marks)

(c) Prove that the equation for critical load of fixed-fixed column is $Pcr = 4\pi^2 EI/L^2$.

(6 marks)

(d) Determine the allowable stress for the column which is fixed at both ends as shown in Figure **Q4(c)**.

(5 marks)

Q5. (a) List down the assumptions in the theory of bending beyond its yield point.

(4 marks)

(b) Explain the following terms;

(i) Plastic hinge

(2 marks)

(ii) Load factor

(2 marks)

(c) The frame shown in Figure **Q5** is pinned to its foundation and has relative plastic moments of resistance, M. If M has the value of 100 kNm, calculate the value of load, W, that will just cause the frame to collapse.

(17 marks)

- END OF QUESTION -

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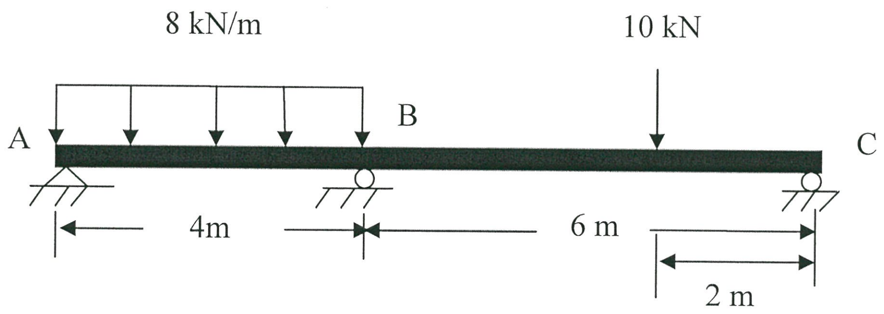

FIGURE Q1(a)

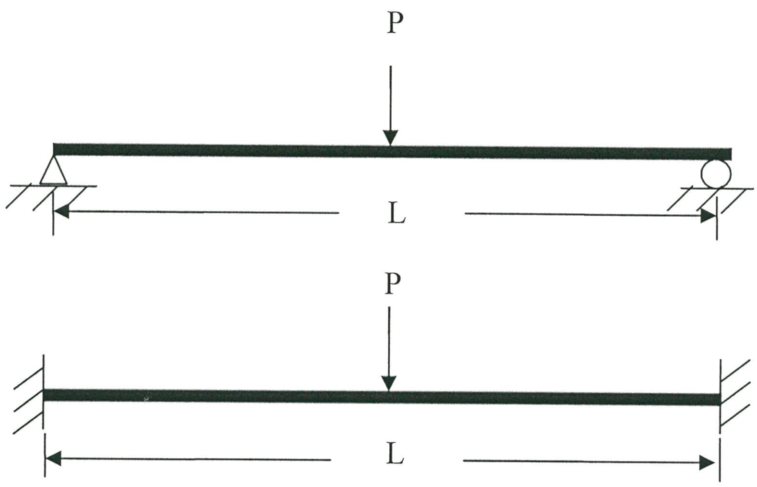

FIGURE Q1(b)

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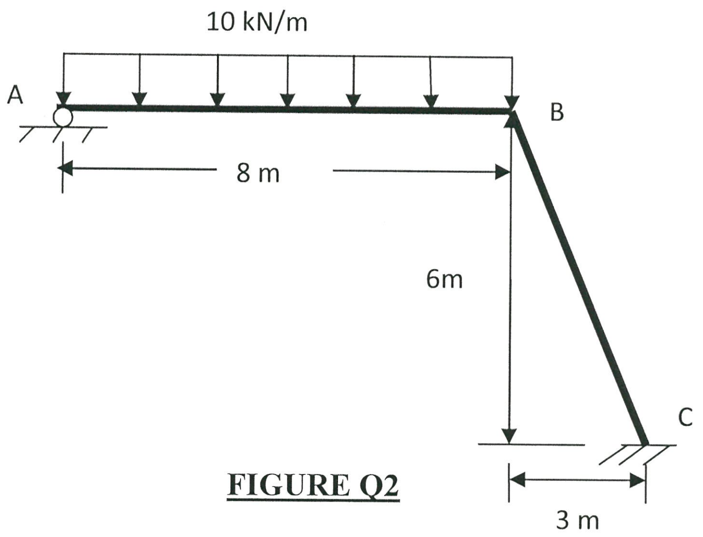

FIGURE Q2

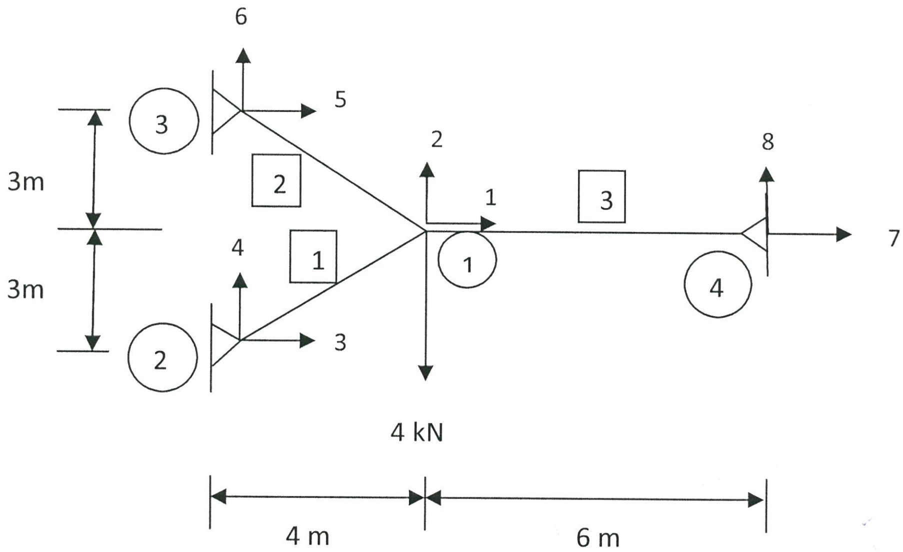

FIGURE Q3

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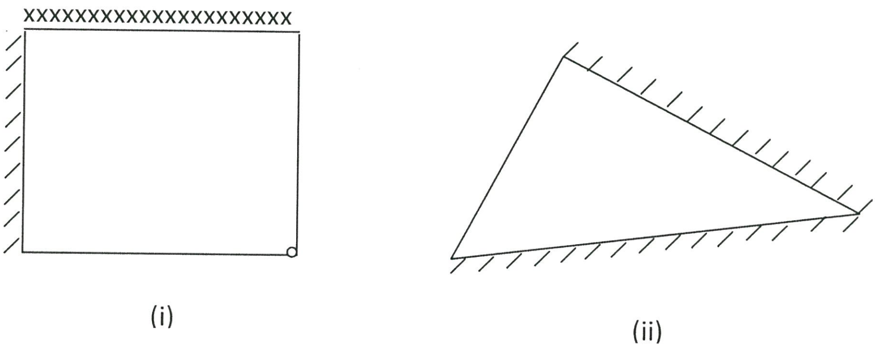

FIGURE Q4(a)

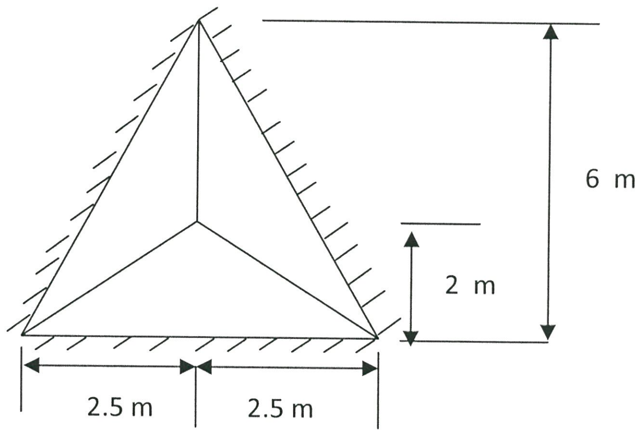

FIGURE Q4(b)

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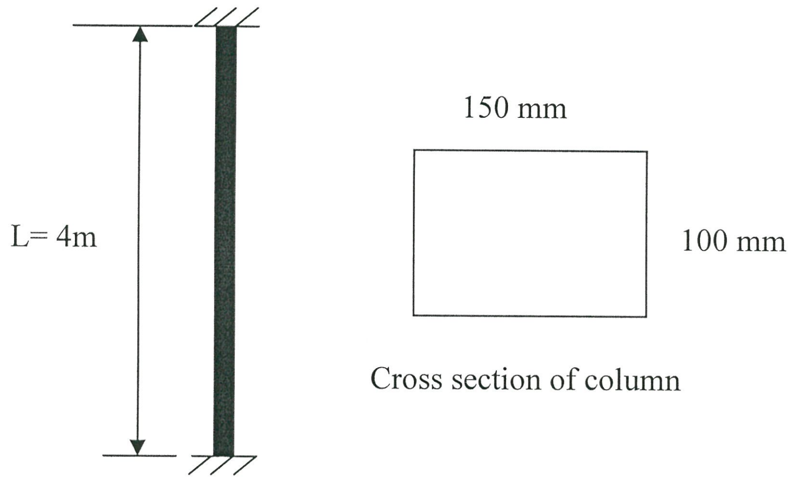

FIGURE Q4(c)

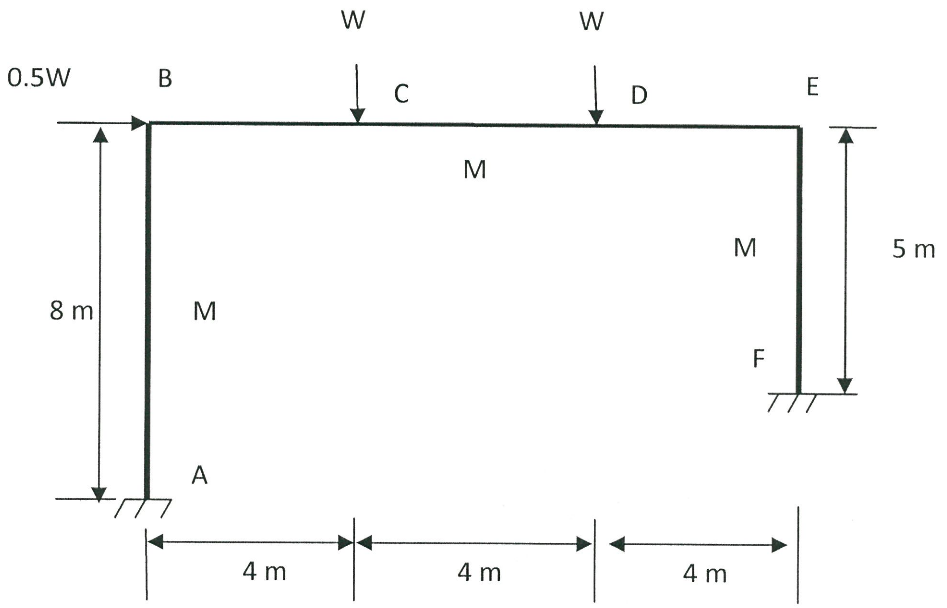

FIGURE Q5

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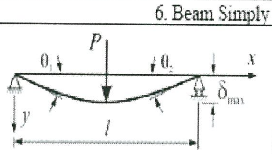
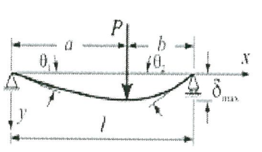
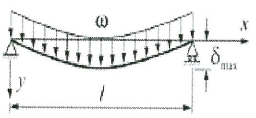
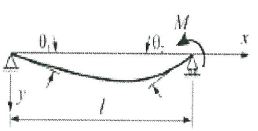
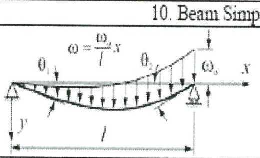
a) Beam Deflection equation

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

b) Stiffness matrix formula

$$K = AE/L \begin{Bmatrix} \lambda_x^2 & \lambda_x\lambda_y & -\lambda_x^2 & -\lambda_x\lambda_y \\ \lambda_x\lambda_y & \lambda_y^2 & -\lambda_x\lambda_y & -\lambda_y^2 \\ -\lambda_x^2 & -\lambda_x\lambda_y & \lambda_x^2 & \lambda_x\lambda_y \\ -\lambda_x\lambda_y & -\lambda_y^2 & \lambda_x\lambda_y & \lambda_y^2 \end{Bmatrix}$$