UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	ADVANCED STRUCTURAL ANALYSIS
COURSE CODE	:	BFS 4013 / BFS 40103
PROGRAMME	:	BFF
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) What are the causes of instability of a structure?

(5 marks)

(b) Give **Two (2)** advantages of using the indeterminate structure in the construction industry.

(5 marks)

(c) For the system shown in Figure **Q1**, generate the [b] matrix such that {P} = [b]{F}.

(15 marks)

Q2 For the two member truss shown in Figure **Q2**;

(a) Determine the global stiffness matrix, K.

(8 marks)

(b) Determine the displacements at joint 2.

(9 marks)

(c) Determine the reactions at each support.

(8 marks)

Q3 (a) Using the basic equation for the curvature of an elastic beam expressed below, derive the formula for critical load of axially loaded simply supported beam as shown in Figure **Q3**.

$$\frac{d^2y}{dx^2} = \frac{M}{EI}$$

(13 marks)

(b) Derive the Euler equation for:

i. Column with one end fixed and one end pinned
ii. Column with both end fixed.

Use sketches to support your answer.

(12 marks)

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

(6 marks)

(b) The reinforced concrete slab shown in Figure **Q4(b)** is designed to have an ultimate load capacity of 11.3 kN/m^2 across its complete area. Based on the yield line pattern given, determine the ultimate resistance moment.

(19 marks)

Q5 (a) What are the differences between the shape factor and load factor?

(5marks)

(b) Figure **Q5** shows a simply supported beam which carries the load at points B and C. Determine the collapse load of the beam by using virtual work method.

(20 marks)

S1 (a) Apakah sebab berlakunya ketidakseimbangan struktur?

(5 markah)

(b) Berikan **Dua (2)** kelebihan menggunakan struktur tidaktentu statik dalam industri pembinaan.

(5 markah)

(c) Bagi sistem rangka dalam Rajah **Q1**, dapatkan matriks [b] supaya {P}=[b]{F}

(15 markah)

S2 Bagi kekuda dengan dua anggota kekuda seperti dalam Rajah **Q2**;

(a) Dapatkan matriks kekukuhan global, K.

(8 markah)

(b) Dapatkan anjakan pada joint 2.

(9 markah)

(c) Dapatkan daya-daya tindakbalas pada setiap penyokong.

(8 markah)

S3 (a) Dengan menggunakan formula asas lenturan elastik bagi rasuk dibawah, terbitkan formula bagi bean kritikal untuk rasuk mudah yang dibebankan dengan beban paksi seperti dalam Rajah **Q3**.

$$\frac{d^2y}{dx^2} = \frac{M}{EI}$$

(13 markah)

(b) Terbitkan persamaan Euler bagi:

i. Tiang dengan satu hujung pin dan satu hujung terikat tegar
ii. Tiang dengan kedua-dua hujung terikat tegar

Gunakan lakaran bagi menyokong jawapan anda.

(12 markah)

S4 (a) Lakarkan bentuk garisan alah bagi setiap papak dalam Rajah **Q4(a)**

(6 markah)

(b) Rajah **Q4(b)** menunjukkan papak konkrit bertetulang yang direkabentuk untuk menampung kapasiti beban muktamad 11.3 kN/m^2. Berdasarkan bentuk garisan alah yang diberikan, tentukan momen rintangan muktamad.

(19 markah)

S5 (a) Apakah perbezaan antara faktor bentuk dan faktor beban?

(5 markah)

(b) Rajah **Q5** menunjukkan satu rasuk disokong mudah yang dikenakan beban tumpu pada titik B dan C. Dengan menggunakan kaedah kerja maya, tentukan beban musnah bagi rasuk tersebut.

(20 markah)

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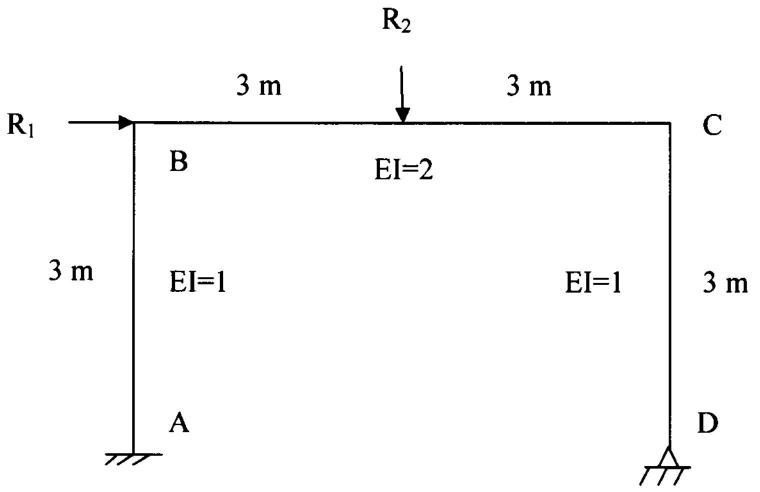

FIGURE Q1

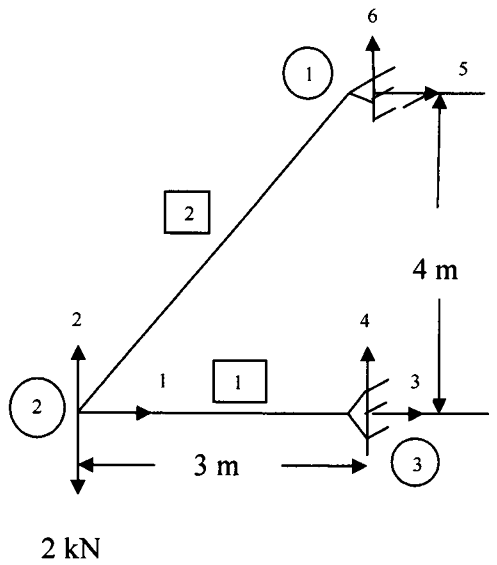

FIGURE Q2

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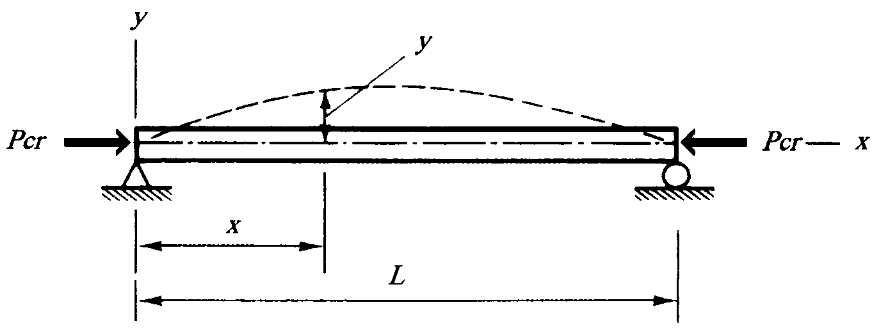

FIGURE Q3

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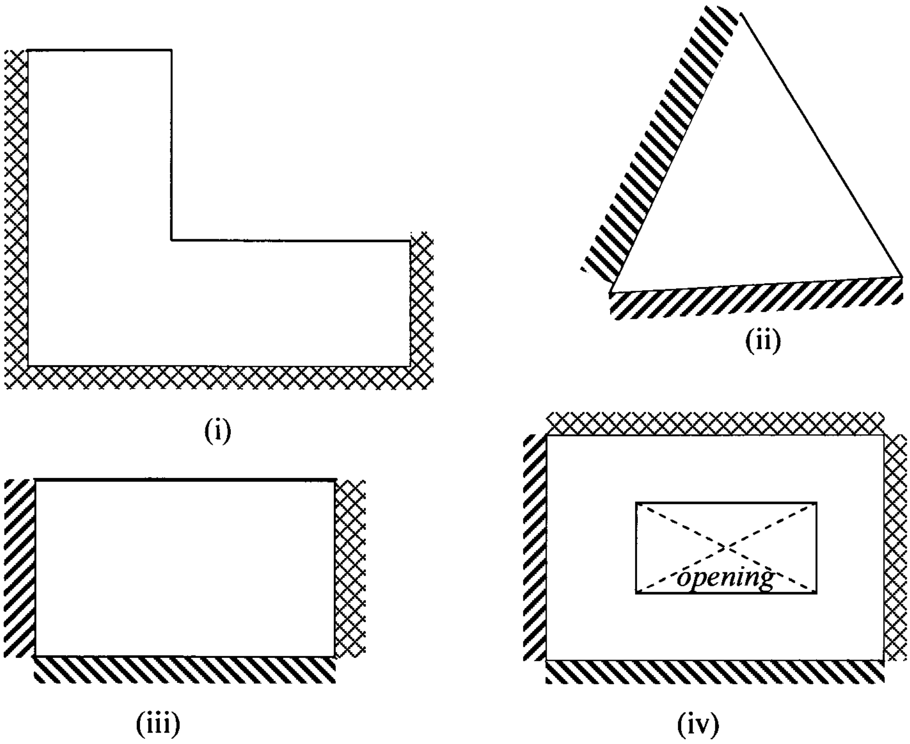

FIGURE Q4(a)

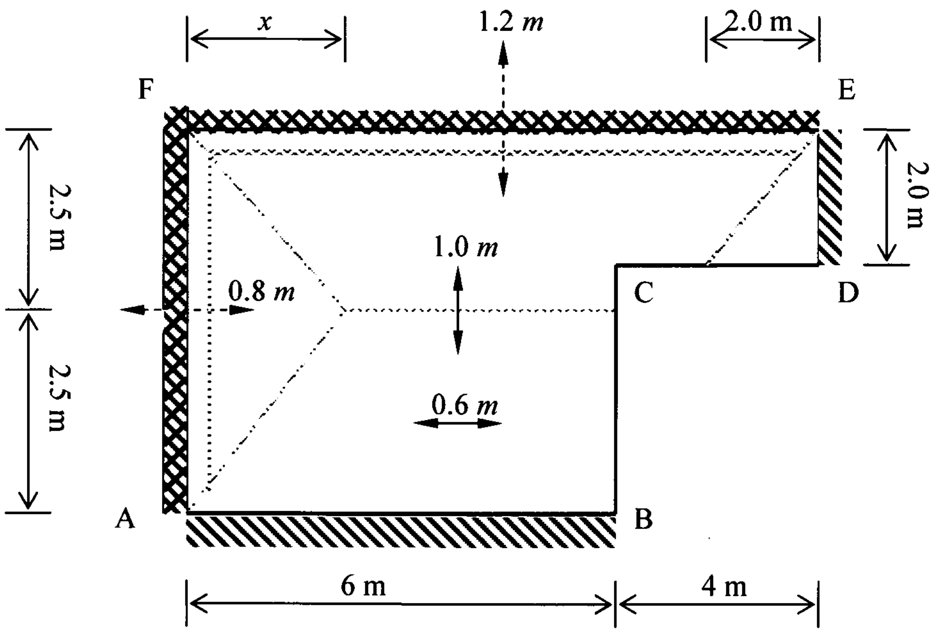

FIGURE Q4(b)

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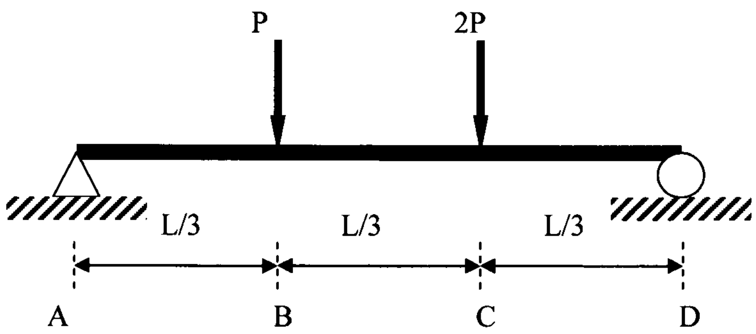
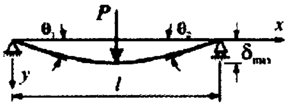
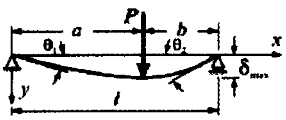
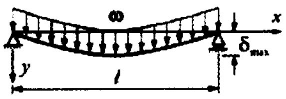
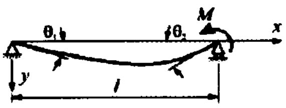
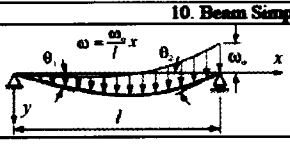
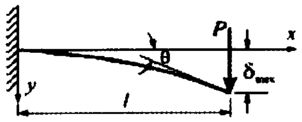
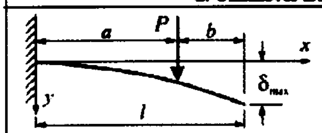
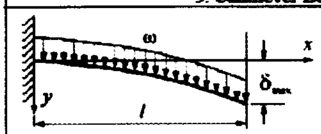
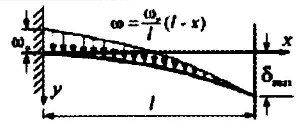
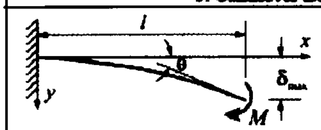


FIGURE Q5

BFS 40103: ADVANCED STRUCTURE ANALYSIS

1)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

BEAM TYPE	SLOPE AT FREE END	DEFLECTION AT ANY SECTION IN TERMS OF x	MAXIMUM DEFLECTION
1. Cantilever Beam – Concentrated load P at the free end			
	$\theta = \frac{Pl^2}{2EI}$	$y = \frac{Px^2}{6EI}(3l - x)$	$\delta_{max} = \frac{Pl^3}{3EI}$
2. Cantilever Beam – Concentrated load P at any point			
	$\theta = \frac{Pa^2}{2EI}$	$y = \frac{Px^2}{6EI}(3a - x)$ for $0 < x < a$ $y = \frac{Pa^2}{6EI}(3x - a)$ for $a < x < l$	$\delta_{max} = \frac{Pa^2}{6EI}(3l - a)$
3. Cantilever Beam – Uniformly distributed load ω (N/m)			
	$\theta = \frac{\omega l^3}{6EI}$	$y = \frac{\omega x^2}{24EI}(x^2 + 6l^2 - 4lx)$	$\delta_{max} = \frac{\omega l^4}{8EI}$
4. Cantilever Beam – Uniformly varying load: Maximum intensity ω_o (N/m)			
	$\theta = \frac{\omega_o l^3}{24EI}$	$y = \frac{\omega_o x^2}{120lEI}(10l^3 - 10l^2x + 5lx^2 - x^3)$	$\delta_{max} = \frac{\omega_o l^4}{30EI}$
5. Cantilever Beam – Couple moment M at the free end			
	$\theta = \frac{Ml}{EI}$	$y = \frac{Mx^2}{2EI}$	$\delta_{max} = \frac{Ml^2}{2EI}$

BFS 40103: ADVANCED STRUCTURE ANALYSIS

2) STIFFNESS MATRIX FORMULA

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