UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2011/2012

COURSE NAME	:	STRUCTURAL ANALYSIS
COURSE CODE	:	BFC 3023 / BFC 21403
PROGRAMME	:	BFF
EXAMINATION DATE	:	JANUARY 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS PAPER CONSISTS OF FOURTEEN (14) PAGES

Q1 (a) Describe briefly the Principle of Virtual Work Method.

(3 marks)

(b) For the truss ABCD which is loaded as shown in Figure **Q1**, determine the determinacy and stability.

(2 marks)

(c) Find the horizontal and vertical deflection at joint C of the truss. The cross sectional area for all truss members and the Modulus of Elasticity is constant.

(20 marks)

Q2 (a) List **Three (3)** classification of statically indeterminate truss.

(2 marks)

(b) Figure **Q2** shows a pin connected truss subjected to horizontal load of 12 kN at joint A and C. Take Young's Modulus, E for all members is 200 GPa, cross section area, $A_{(tension)} = 1500\ mm^2$ and $A_{(comp)} = 2000\ mm^2$.

(i) Determine the internal force for member AC.

(15 marks)

(ii) Determine the actual internal forces for all members.

(6 marks)

(c) Give **Two (2)** significant reasons for the stability and determinacy concept for truss structure.

(2 marks)

Q3 (a) State and sketch **Four (4)** cases that will cause sway on the rigid frame.

(4 marks)

(b) Briefly explain the procedures to determine the end moments for rigid sway frame.

(6 marks)

(c) Figure **Q3** shows an overhang beam subjected to a point load 8 kN at A. The support at B is settles (Δ) 80 mm. Determine the moment at B and C for the beam by using Slope Deflection Equation. Take $EI = 1000\ kNm^2$.

(15 marks)

Q4 (a) Briefly explain the importance of influence line in structural analysis.
(2 marks)

(b) Figure **Q4(a)** shows a simply supported beam with span L. Prove the influence line equations for shear force and bending moment at point C as shown in Figure **Q4(b)**.
(6 marks)

(c) Figure **Q4(c)** shows a two span beam with hinge located in between A and B. By using Muller Breslau Principle, sketch the influence line of the followings.

(i) Vertical reaction at point A, B and D.
(3 marks)

(ii) Shear force and bending moment at point C.
(2 marks)

(d) Figure **Q4(d)** shows a simply supported beam with span 15 m which subjected to a moving load from right to the left.

(i) Calculate the maximum positive and negative shear force due to moving load at point C.
(5 marks)

(ii) Calculate absolute maximum shear force of the beam.
(7 marks)

Q5 (a) Explain and define the correlation between Yield Moment, M_y and Plastic Moment, M_p.
(5 marks)

(b) Figure **Q5(a)** shows a frame subjected to inclined force of 90 kN.

(i) Determine the maximum plastic moment for all mechanism.
(12 marks)

(ii) Determine the yield stress, σ_y at the plastic condition if the cross section area of frame as shown in Figure **Q5(b)**.
(8 marks)

Q6 (a) List **Two (2)** modes of failure with aid of sketches.

(4 marks)

(b) A rigid jointed steel frame ABC carry a vertical load P at as shown in Figure **Q6**. Formulate the instability equation and find the critical load (P_{cr}) for the frame. Take $I_{AB} = 1200\ cm^4$ and $I_{BC} = 1000\ cm^4$.

(18 marks)

(c) By your understanding, what is the elastic instability of column?

(3 marks)

S1 (a) Terangkan secara ringkas Prinsip Kaedah Kerja Maya.

(3 markah)

(b) Kekuda ABCD dengan bebanan ditunjukkan dalam Rajah **Q1**, tentukan kestabilan dan kebolehtentuan kekuda.

(3 markah)

(c) Tentukan pesongan ufuk pada sambungan C. Luas keratan rentas dan Modulus Keanjalan semua anggota kekuda adalah malar.

S2 (a) Senaraikan **Tiga (3)** klasifikasi kekuda tidak boleh tentu statik.

(2 markah)

(b) Rajah **Q2** menunjukkan kekuda sambungan pin yang dikenakan daya ufuk 12 kN di sambungan A dan C. Dengan Modulus Keanjalan, E untuk semua anggota adalah 200 GPa, luas keratan rentas, $A_{(tegangan)}$ = 1500 mm^2 dan $A_{(mampatan)}$ = 2000 mm^2.

(i) Tentukan daya dalaman anggota AC.

(15 markah)

(ii) Tentukan daya dalaman sebenar semua anggota kekuda.

(6 markah)

(c) Berikan **Dua (2)** kepentingan konsep kestabilan dan kebolehtentuan bagi struktur kekuda.

(2 markah)

S3 (a) Senarai dan lakarkan **Empat (4)** keadaan yang boleh menyebabkan huyung pada rasuk

(4 markah)

(b) Terangkan secara ringkas kaedah bagi menentukan Momen Akhir bagi kerangka huyung.

(6 markah)

(c) Rajah **Q3** menunjukkan satu rasuk tergantung yang dikenakan beban 8 kN di A. Rasuk B terenap (Δ) 80 mm. Tentukan momen di B dan C dengan menggunakan kaedah Persamaan Cerun Pesongan. Ambil EI = 1000 kNm^2.

(15 markah)

S4 (a) Terangkan secara ringkas kepentingan garis imbas di dalam analisis struktur.
(2 markah)

(b) Rajah **Q4(a)** menunjukkan rasuk sokong mudah dengan rentang L. Buktikan persamaan garis imbas bagi daya ricih dan momen lentur pada titik C seperti yang ditunjukkan pada Rajah **Q4(b)**.
(6 markah)

(c) Rajah **Q4(c)** menunjukkan 2 rentang rasuk dengan kedudukan engsel berada diantara titik A dan B. Dengan menggunkan Prinsip Muller Breslau, lakarkan garis imbas bagi yang berikut.

(i) Tindakbalas tegak pada titik A, B dan D.
(3 markah)

(ii) Daya ricih dan momen lentur pada titik C.
(2 markah)

(d) Rajah **Q4(d)** menunjukkan rasuk sokong mudah dengan rentang 15 m yang dikenakan beban bergerak daripada kanan ke kiri.

(i) Kirakan daya ricih maksimum positif dan negatif pada titik C akibat daripada beban bergerak.
(5 markah)

(ii) Kirakan daya ricih mutlak maksimum rasuk berkenaan.
(7 markah)

S5 (a) Terangkan hubungkait di antara Momen Alah, M_y dan Momen Plastik, M_p.
(5 markah)

(b) Rajah **Q5(a)** menunjukkan sebuah kerangka yang dikenakan daya condong 90 kN.

(i) Tentukan momen plastik maksimum untuk semua mekanisma.
(12 markah)

(ii) Tentukan tegasan alah, σ_y dalam keadaan plastik sekiranya keratan rentas kerangka adalah seperti dalam Rajah **Q5(b)**.
(8 markah)

S6 (a) Senaraikan **Dua (2)** mod kegagalan beserta lakaran.

(4 markah)

(b) Sebuah kerangka keluli ABC terikat tegar dikenakan beban pugak P seperti yang ditunjukkan dalam Rajah **Q6**. Dapatkan persamaan ketidakstabilan kerangka dan tentukan beban kritikal (P_{cr}) bagi kerangka. Ambil I_{AB} = 1200 cm^4 dan I_{BC} = 1000 cm^4.

(18 markah)

(c) Dari kefahaman anda, apakah ketidakstabilan elastik bagi tiang?

(3 markah)

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SUBJECT	STRUCTURAL ANALYSIS	COURSE CODE	: BFC 3023 / BFC 21403

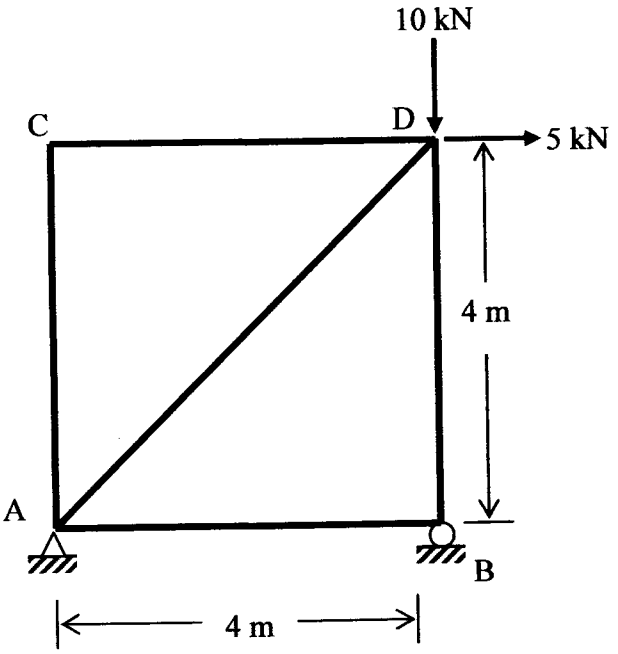

FIGURE Q1

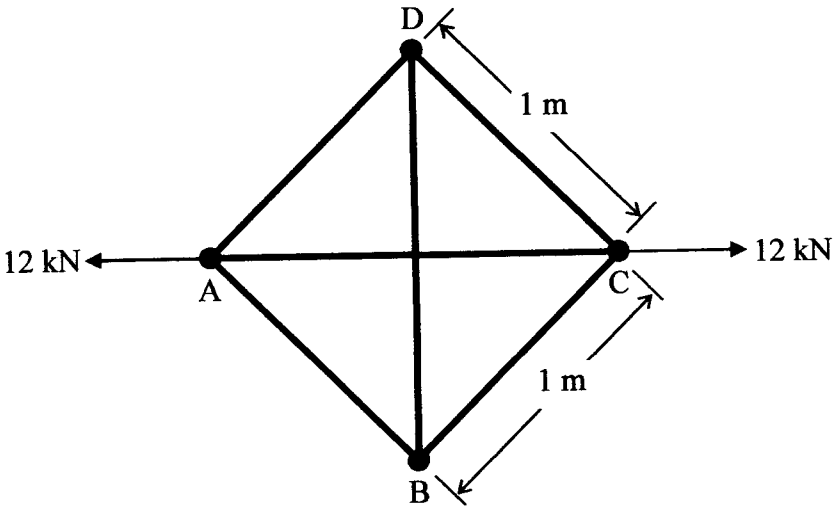

FIGURE Q2

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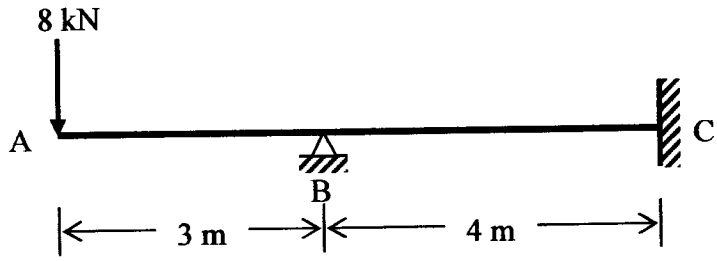


FIGURE Q3

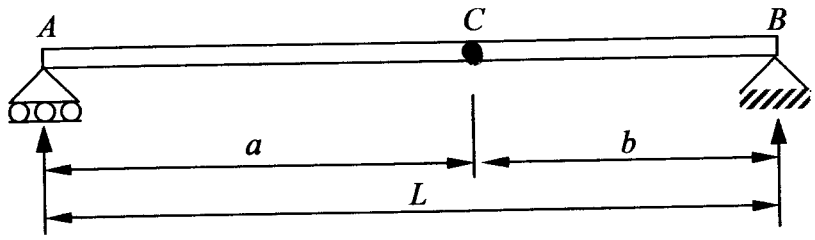
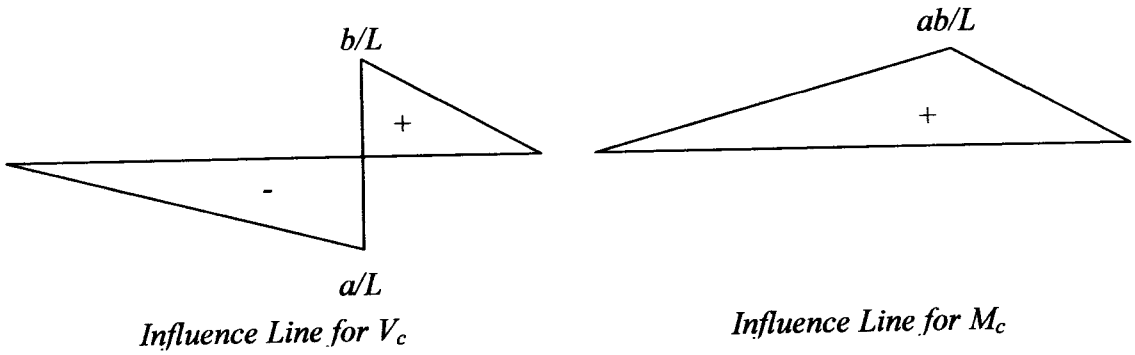


FIGURE Q4(a)



Influence Line for V_c

Influence Line for M_c

FIGURE Q4(b)

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SUBJECT	STRUCTURAL ANALYSIS	COURSE CODE	: BFC 3023 / BFC 21403

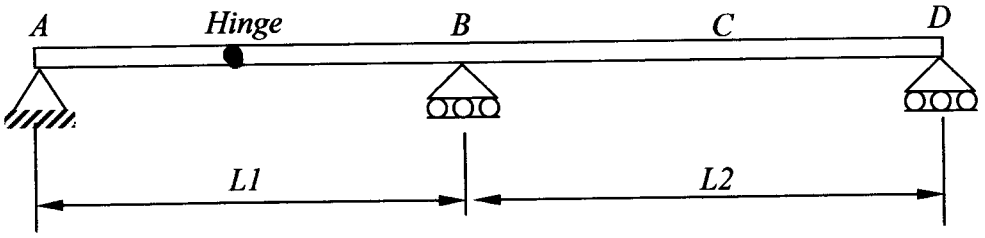

FIGURE Q4(c)

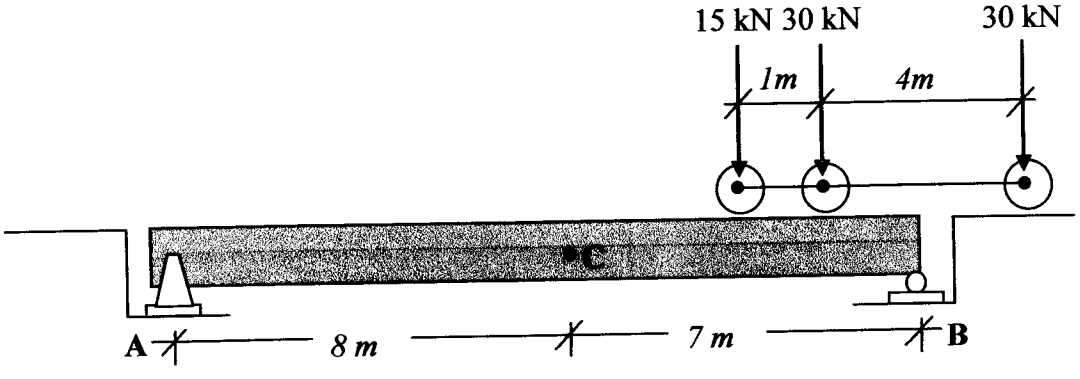

FIGURE Q4(d)

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SUBJECT	STRUCTURAL ANALYSIS	COURSE CODE	: BFC 3023 / BFC 21403

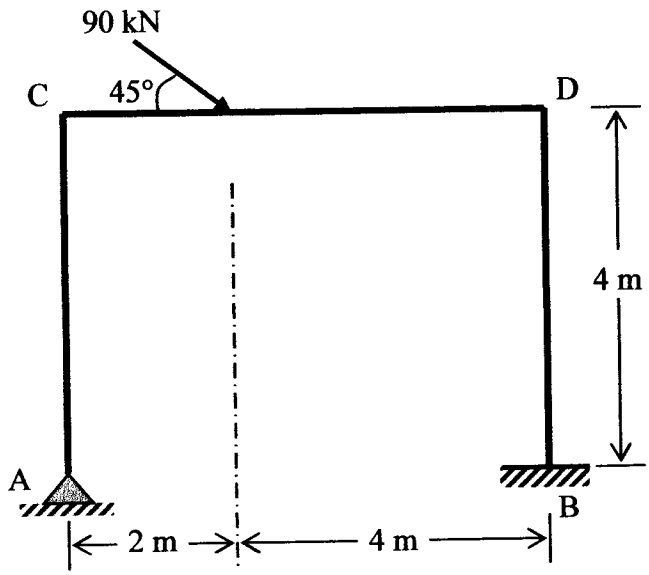

FIGURE Q5(a)

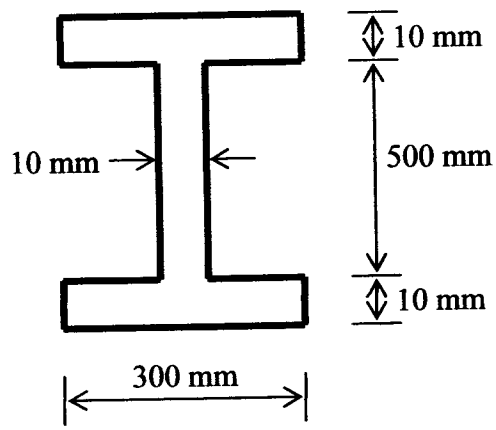

FIGURE Q5(b)

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SEMESTER/SESSION	: I / 2011-2012	COURSE NAME	: BFF
SUBJECT	STRUCTURAL ANALYSIS	COURSE CODE	: BFC 3023 / BFC 21403

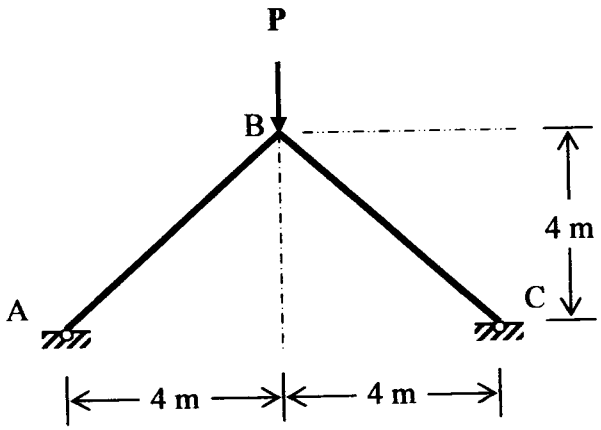

FIGURE Q6

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SEMESTER/SESSION	: I / 2011-2012	COURSE NAME	: BFF
SUBJECT	STRUCTURAL ANALYSIS	COURSE CODE	: BFC 3023 / BFC 21403

Table 1: Value for ρ and s for the stability function

ρ	s
0.00	4.000
0.04	3.947
0.08	3.894
0.12	3.840
0.16	3.785
0.20	3.730
0.24	3.674
0.28	3.617
0.32	3.650
0.36	3.502
0.40	3.444
0.44	3.385
0.48	3.325
0.52	3.264
0.56	3.203
0.60	3.140
0.64	3.077
0.68	3.013
0.72	2.948
0.76	2.883
0.80	2.816
0.84	2.748
0.88	2.680
0.92	2.610
0.96	2.539

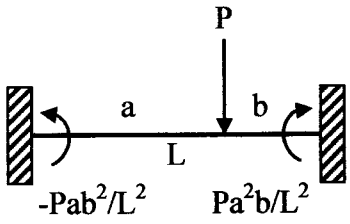
ρ	s
1.00	2.467
1.04	2.394
1.08	2.320
1.12	2.245
1.16	2.168
1.20	2.090
1.24	2.011
1.28	1.930
1.32	1.848
1.36	1.764
1.40	1.678
1.44	1.591
1.48	1.502
1.52	1.411
1.56	1.319
1.60	1.224
1.64	1.127
1.68	1.028
1.72	0.927
1.76	0.823
1.80	0.717
1.84	0.608
1.88	0.496
1.92	0.382
1.96	0.264

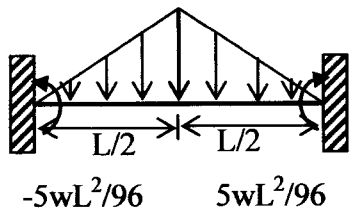
ρ	s
2.00	0.143
2.04	0.018
2.08	-0.110
2.12	-0.242
2.16	-0.379
2.20	-0.519
2.24	-0.665
2.28	-0.815
2.32	-0.971
2.36	-1.133
2.40	-1.301
2.44	-1.475
2.48	-1.656
2.52	-1.845
2.56	-2.043
2.60	-2.249
2.64	-2.465
2.68	-2.692
2.72	-2.930
2.76	-3.180
2.80	-3.445
2.84	-3.725
2.88	-4.021
2.92	-4.337
2.96	-4.673
3.00	-5.032

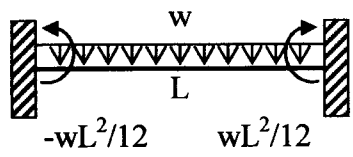
FINAL EXAMINATION

SEMESTER/SESSION	: I / 2011-2012	COURSE NAME	: BFF
SUBJECT	STRUCTURAL ANALYSIS	COURSE CODE	: BFC 3023 / BFC 21403

Fixed End Moment (FEM):







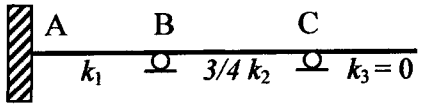
Unit Load Method:

$$\Delta = \frac{\sum F\mu L}{AE}$$

$$X = -\frac{\sum F'\mu L / AE}{\sum \mu^2 L / AE}$$

$$\text{New } F = F + X\mu$$

Distribution Factor, DF:



$k_1 = k_2 = 4EI/L$

B

BA	BC
$\frac{k_1}{k_1 + k_2}$	$\frac{k_2}{k_1 + k_2}$