UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2010/2011

COURSE NAME	:	STRUCTURAL ANALYSIS
COURSE CODE	:	BFC 3023
PROGRAMME	:	3 BFF
EXAMINATION DATE	:	NOVEMBER/DECEMBER 2010
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS PAPER CONSISTS OF THIRTEEN (13) PAGES

Q1 (a) With the aid of suitable diagram, explain the relation between axial force and elongation.

(3 marks)

(b) Figure **Q1** shows a statically determinate plane truss subjected to a concentrated load of 60 kN at B to member BC. All members are made from steel with the Young's Modulus of 205 GPa and the cross sectional area is constant.

(i) Determine all the reactions and internal member forces.

(6 marks)

(ii) Determine the displacement of joint B in the direction of the concentrated load. Use Method of Conservation Energy.

(11 marks)

(iii) If the allowable vertical displacement at point B is limited to 10 mm, determine the minimum cross sectional area for the truss.

(5 marks)

Q2 (a) List **Three (3)** advantages of redundant structures in construction.

(3 marks)

(b) Figure **Q2** shows a truss is supported by pin connection at A, and roller support at C and D. Given modulus of elasticity and cross-sectional area of each member are 200 kN/mm^2 and 400 mm^2,respectively. Determine the

(i) Stability and determinancy of the truss

(2 marks)

(ii) internal forces for each member by considering support C as redundant.

(20 marks)

Q3 (a) State **Five (5)** cases which cause framework to sway.

(5 marks)

(b) Figure **Q3** shows a non-sway rigid frame which pinned at A and D and fixed at C.

(i) Calculate moment at all joints using moment distribution method.

(10 marks)

(ii) Calculate reactions at support A, C and D.

(10 marks)

Q4 Figure **Q4(a)** shows a beam which is pinned at support A and roller at support B. The beam is subjected to a series of concentrated moving loads as shown in Figure **Q4(b).**

(a) Sketch the beam's influence lines.

(i) Reaction at A, R_A

(2 marks)

(ii) Reaction at B, R_B

(2 marks)

(iii) Shear force at section x-x, V_X

(2 marks)

(iv) Bending moment at section x-x, M_X

(2 marks)

(b) Determine the maximum values of V_X and M_X if the moving loads shown in Figure **Q4(b)** move from A to C.

(10 marks)

(c) Determine the absolute maximum bending moment for span AB when the moving load move along AB.

(7 marks)

Q5 (a) Calculate the plastic moment for cross section as shown in Figure **Q5(a)** if the yield stress of the material is 210 N/mm^2.

(10 marks)

(b) An overhang beam is loaded with various load as shown in Figure **Q5(b).** Determine the plastic moment of the beam.

(10 marks)

(c) If beam in Figure **Q5(b)** has a cross-section in Figure **Q5(a),** state which part of the beam is safe.

(5 marks)

Q6 (a) With aid of sketches, list **Two (2)** failure modes of a column.

(4 marks)

(b) A rigid jointed steel frame ABC carry a vertical load W as shown in Figure **Q6.** Derive the instability equation and find the critical load (P_{cr}) for the frame by referring to Table 1. Take $I_{AB} = 10 \times 10^6$ mm^4 and $I_{BC} = 12 \times 10^6$ mm^4.

(18 marks)

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

(3 marks)

S1 (a) Dengan bantuan gambarajah yang sesuai, terangkan hubungan antara daya paksi dan pemanjangan.

(3 markah)

(b) Rajah **Q1** menunjukkan satu kekuda satah yang boleh tentu statik dikenakan beban tumpu 60 kN di B selari dengan anggota BC. Semua anggota dibuat daripada keluli dengan Young Modulus 205 GPa dan luas keratan adalah seragam.

(i) Tentukan semua tindakbalas dan daya dalam anggota.

(6 markah)

(ii) Tentukan pesongan di titik B sama arah dengan beban tumpu. Guna Kaedah Pengabadian Tenaga.

(11 markah)

(iii) Sekiranya pesongan pugak di titik B dihadkan kepada 10 mm, tentukan luas keratan minimum yang diperlukan untuk kekuda tersebut.

(5 markah)

S2 (a) Senaraikan **Tiga (3)** kelebihan struktur lelebih dalam pembinaan.

(3 markah)

(b) Rajah **S2** menunjukkan satu kekuda yang disokong pin di A, dan sokong pin pada C dan D. Diberi nilai modulus keanjalan dan luas keratan rentas untuk semua anggota adalah 200 kN/mm^2 dan 400 mm^2. Tentukan,

(i) kestabilan dan kebolententuan kekuda tersebut.

(2 markah)

(ii) daya dalaman semua anggota dengan mengambil sokong C sebagai lebihan.

(20 markah)

S3 (a) Nyatakan **Lima (5)** kes yang boleh menyebabkan kerangka huyung

(5 markah)

(b) Rajah **Q3** menunjukkan kerangka tidak huyung yang di sokong pin pada A dan D dan do sokong tegar pada C.

(i) Kirakan momen bagi semua sambungan dengan menggunakan kaedah agihan momen.

(10 markah)

(ii) Kirakan tindakbalas pada sokong A,C dan D

(10 markah)

S4 Rajah **Q4(a)** menunjukkan rasuk yang di sokong pin pada A dan disokong rola pada B. Rasuk tersebut di kenakan satu rangkaian beban tumpu bergerak seperti dalam Rajah **Q4(b).**

(a) Lakarkan garis imbas rasuk bagi

(i) Tindakbalas A, R_A

(2 markah)

(ii) Tindakbalas B, R_B

(2 markah)

(iii) Daya ricih pada keratan x-x, V_x

(2 markah)

(iv) Momen Lentur pada keratan x-x, M_x

(2 markah)

(b) Tentukan nilai V_x dan M_x maksimum sekirannya beban bergerak seperti dalam Rajah **Q4(b)** bergerak dari A hingga C.

(10 markah)

(c) Tentukan momen lentur mutlak bagi rentang AB apabila beban bergerak sepanjang rentang.

(7 markah)

S5 (a) Kira momen plastik bagi keratan rentas seperti yang ditunjukkan dalam Rajah **Q5(a)** jika tegasan alah bahan ialah 210 N/mm^2.

(10 markah)

(b) Sebatang rasuk tergantung dikenakan beban seperti yang ditunjukkan dalam Rajah **Q5(b)**. Kira momen plastik bagi rasuk.

(10 markah)

(c) Sekiranya rasuk dalam Rajah **Q5(b)** menggunakan keratan rentas seperti dalam Rajah **Q5(a)**, nyatakan bahagian rasuk yang selamat.

(5 markah)

S6 (a) Dengan bantuan lakaran, senaraikan **Dua (2)** mod kegagalan bagi sebatang tiang.

(4 markah)

(b) Sebuah kerangka keluli ABC terikat tegar dikenakan beban pugak F seperti yang ditunjukkan dalam Rajah **Q6**. Terbitkan persamaan ketidakstabilan kerangka dan tentukan beban kritikal (P_{cr}) bagi kerangka dengan merujuk Jadual 1. Ambil $I_{AC} = 10 \times 10^6$ mm^4 dan $I_{BC} = 12 \times 10^6$ mm^4.

(18 markah)

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

(3 markah)

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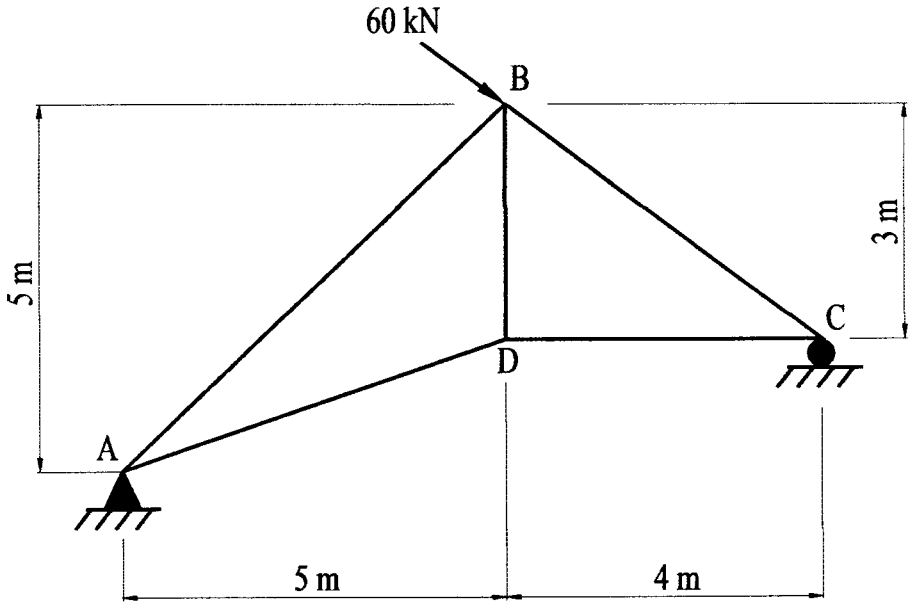

FIGURE Q1

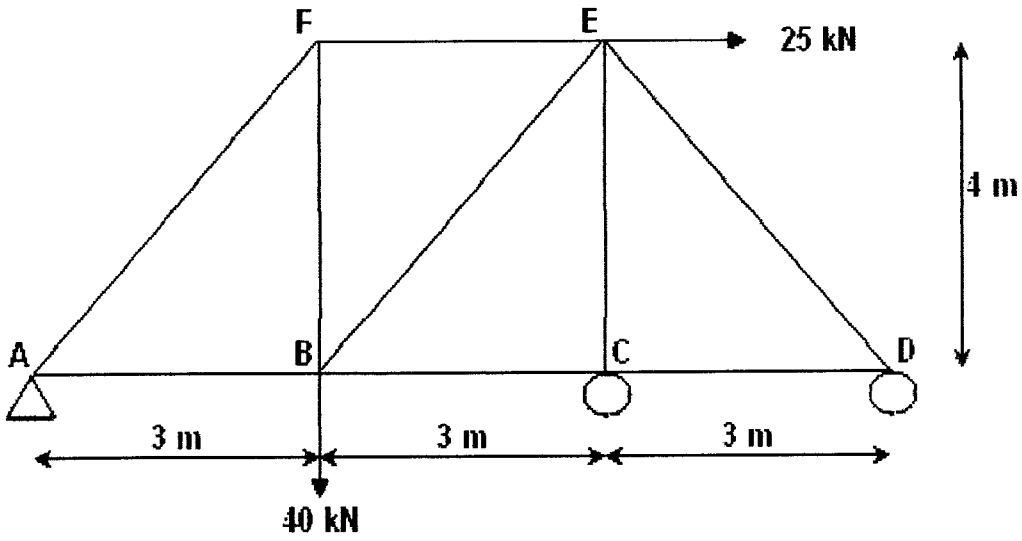

FIGURE Q2

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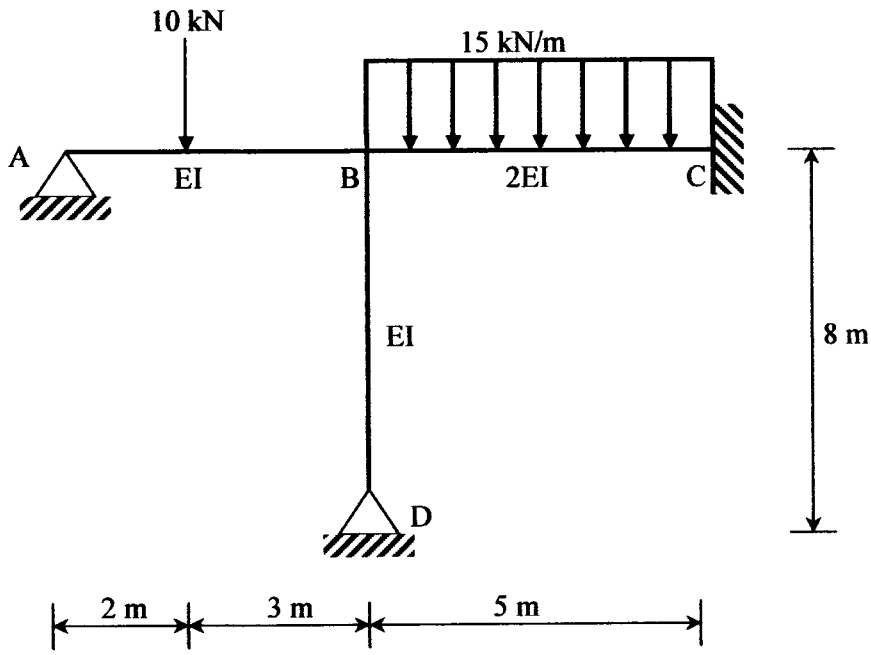

FIGURE Q3

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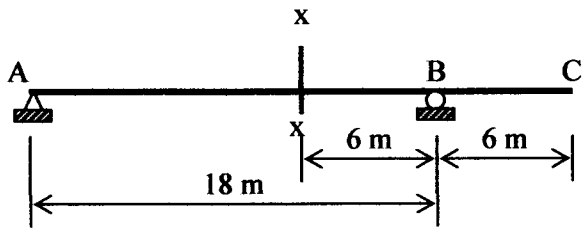

FIGURE Q4(a)

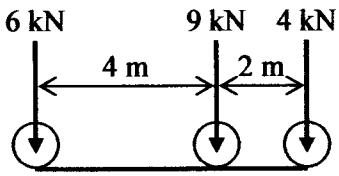

FIGURE Q4(b)

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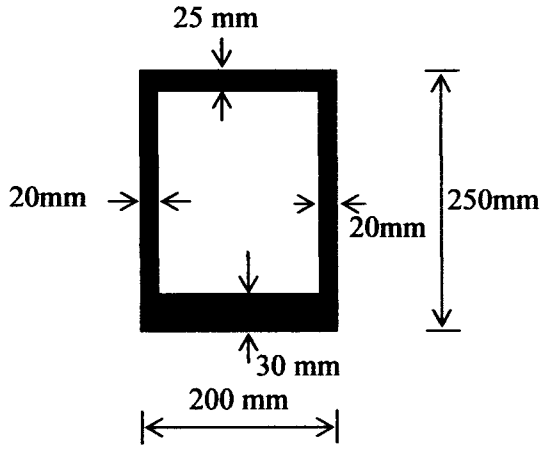

FIGURE 5(a)

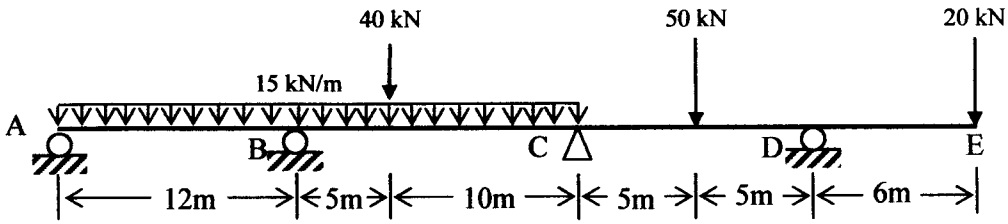

FIGURE 5 (b)

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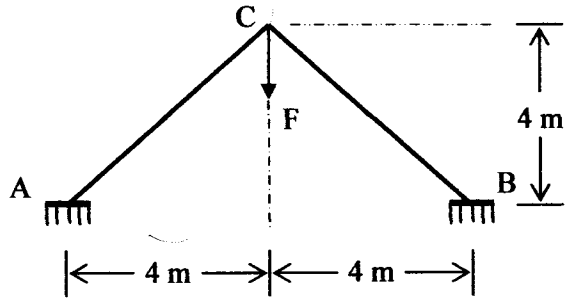

FIGURE Q6

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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

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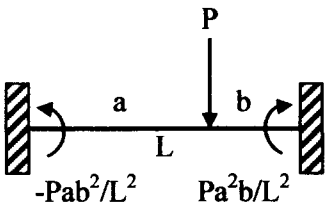
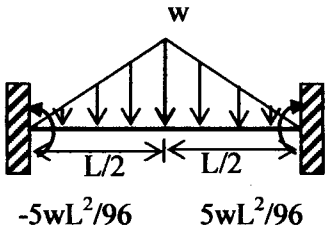
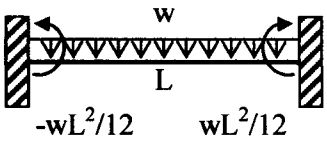
Fixed End Moment (FEM):







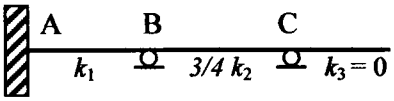
Unit Load Method:

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

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

New F = F + Xμ

Distribution Factor, DF:



$k_1 = k_2 = 4EI/L$

B

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