UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

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

THIS QUESTION PAPER CONSISTS OF **THIRTEEN (13)** PAGES

Q1 The truss shown in Figure **Q1** is comprised entirely of equilateral triangles. The wind loads of 6 kN at D and E act perpendicularly to the member ED.

(a) Prove that the truss is a statistically determinate structure.

(3 marks)

(b) Using the virtual work method, determine the vertical deflection of joint B. The cross section area and Modulus of Elasticity for all members are 1800 mm^2 and 200 000 N/mm^2.

(22 marks)

Q2 (a) Briefly explain with the aid of diagram and calculation for the terms below.

(i) External indeterminate truss

(ii) Internal indeterminate truss

(5 marks)

(b) Figure **Q2** shows a pinned connected truss and supported at A and B. The Modulus of Elasticity and cross section area for all members are constant. If the horizontal reaction at support B as a redundant,

(i) Determine all support reactions.

(ii) Determine all internal forces for all truss members.

(20 marks)

Q3 Figure **Q3** shows a pinned connected sway frame subjected to horizontal force at B and vertical force at mid span BC. The Modulus of Elasticity for all members are constant.

(a) Sketch the sway mechanism for analysis.

(3 marks)

(b) Determine all end moments when the joint C is restrained.

(11 marks)

(c) Determine all end moments when the joint C is unrestrained.

(11 marks)

Q4 (a) Muller Breslau Principle provides a simplified method for establishing the influence line. Referring to the principle;

(i) Sketch the Influence Line for vertical reaction at B for Figure **Q4(a)** and **(b).**

(2 marks)

(ii) Sketch the Influence Line for shear force at C for Figure **Q4(c)** and **(d).**

(2 marks)

(b) Figure **Q4 (e)** shows a bridge truss supported by pin and roller at A and E respectively.

(i) Prove the vertical reaction at E = $\frac{x}{24}$.

(3 marks)

(ii) Determine the maximum force that can be develop in member BC of the bridge truss due to the moving force of 100 kN and a moving distributed load of 5 kN/m. The loading is applied at the top chord. Consider the right system.

(15 marks)

(c) What do you understand with the application of influence line in bridge design due to the moving loads?

(3 marks)

Q5 (a) Figure **Q5(a)** shows a T beam cross section. Determine;

(i) Elastic Modulus, Z

(7 marks)

(ii) Plastic Modulus, Z_p

(6 marks)

(iii) Plastic Moment, M_p if σ_y is 275 N/mm^2

(2 marks)

(b) Figure **Q5(b)** shows a beam subjected to uniformly distributed load of $4w$ kN/m. Determine the collapse load for all beam mechanism with using virtual work method.

(10 marks)

Q6 Figure **Q6** shows a I steel beam with approximately 4 meters from the steel floor. Steel bracing systems installed in the middle of I-beam with $\alpha°$ of angle to avoid flexural buckling in I steel beam. Both ends of the steel bracing system that holds the I beam are welded. The other end is welded on to steel floor.

Data of steels bracing systems:

Length AC = BC = 5 meters,
Moment Inertia cross section AC =1200cm^4
Moment Inertia cross section BC =1400cm^4
Modulus of Elasticity AC = BC = 210 KN/mm^2

(a) Explain the instability condition and classify the instability of structure
(3 marks)

(b) How much is a critical loading that carried by each steels bracing systems.
(22 marks)

S1 Kekuda bumbung pada Rajah **Q1** terdiri daripada segitiga sama sisi sepenuhnya. Beban angin 6 kN pada sambungan D dan E bertindak serenjang dengan anggota ED.

(a) Buktikan kekuda adalah bolehtentu statik.

(3 markah)

(b) Kirakan anjakan pugak pada sambungan B. Luas keratan keratan rentas dan Modulus Keanjalan untuk semua anggota adalah 1800 mm^2 dan 200 000 N/mm^2.

(22 markah)

S2 (a) Terangkan secara ringkas dengan bantuan gambarajah dan pengiraan bagi terma-terma di bawah.

(i) Kekuda tidak boleh tentu statik luaran

(ii) Kekuda tidak boleh tentu statik dalaman

(5 markah)

(b) Rajah **Q2** menunjukkan satu kekuda sambungan pin yang disokong di A dan B. Modulus Keanjalan dan luas keratan rentas semua anggota adalah malar. Sekiranya tidak balas ufuk sokong B adalah lebihan,

(i) Tentukan daya tindak balas bagi semua penyokong.

(ii) Tentukan daya dalaman bagi semua anggota kekuda.

(20 markah)

S3 Rajah **Q3** menunjukkan satu kerangka huyung yang dikenakan daya ufuk di B dan daya pugak di pertengahan rentang BC. Modulus Keanjalan untuk semua anggota adalah malar.

(a) Lakar mekanisma kerangka hujung untuk analisis.

(3 markah)

(b) Tentukan semua nilai momen akhir apabila sambungan C dikekang.

(11 marks)

(c) Tentukan semua nilai momen akhir apabila sambungan C tidak dikekang.

(11 marks)

S4 (a) Prinsip Muller Breslau menyediakan satu kaedah yang ringkas bagi membina garis imbas. Merujuk kepada prinsip;

(i) Lakarkan garis imbas tindak balas pugak di B bagi Rajah **Q4(a)** dan **(b).**

(2 markah)

(ii) Lakarkan garis imbas daya ricih di C bagi Rajah **Q4(c)** dan **(d).**

(2 markah)

(b) Rajah **Q4(e)** menunjukkan satu jambatan yang disokong pin dan rola di A dan E.

(i) Buktikan tindak balas pugak di E = $\frac{x}{24}$.

(3 markah)

(ii) Tentukan daya maksimum yang boleh dihasilkan oleh anggota BC bagi kekuda jambatan yang disebabkan oleh daya pugak 100 kN dan beban teragih seragam 5 kN/m. Beban dikenakan dibahagian atas kekuda. Pertimbangkan sistem sebelah kanan.

(15 markah)

(c) Apakah yang anda faham dengan pengaplikasian garis imbas dalam rekabentuk jambatan yang disebabkan oleh beban yang bergerak.

(3 markah)

S5 (a) Rajah **Q5(a)** menunjukkan satu keratan rentas rasuk T. Tentukan;

(i) Modulus Elastik, Z

(7 markah)

(ii) Modulus Plastik, Z_p

(6 markah)

(iii) Momen Plastik, M_p jika σ_y adalah 275 N/mm^2

(2 markah)

(b) Rajah **Q5(b)** menunjukkan rasuk yang dikenakan beban teragih seragam $4w$ kN/m. Tentukan beban runtuh bagi semua mekanisma rasuk dengan menggunakan kaedah kerja maya.

(10 markah)

S6 Rajah **Q6** menunjukkan satu rasuk keluli I yang dianggarkan 4 m daripada lantai keluli. Perembat keluli dipasang di tengah rasuk-I dengan sudut $\alpha°$ dengan untuk menampung lengkokan rasuk I. Kedua-dua prembat keluli tersebut dikimpal di rasuk-I tersebut termasuk anggota-anggota lain ke lantai keluli.

Data bagi perembat besi:

Panjang AC = BC = 5 meter,
Momen Inertia keratan rentas AC = 1200 cm^4
Momen Inertia keratan rentas BC = 1400 cm^4
Momen Elastik AC = 210 kN/mm^2

(a) Terangkan keadaan ketidakstabilan dan tentukan ketidakstabilan struktur.
(3 markah)

(b) Berapakah beban kritikal yang boleh ditampung oleh setiap perembat besi.
(22 markah)

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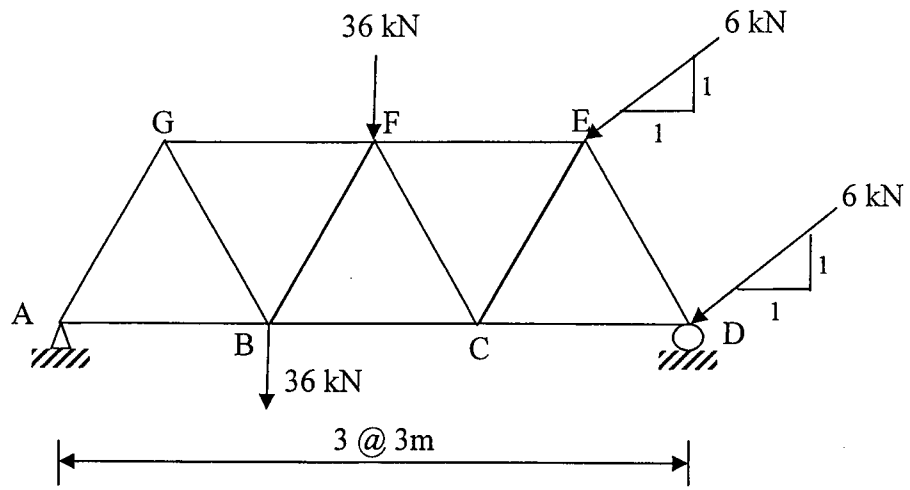

FIGURE Q1

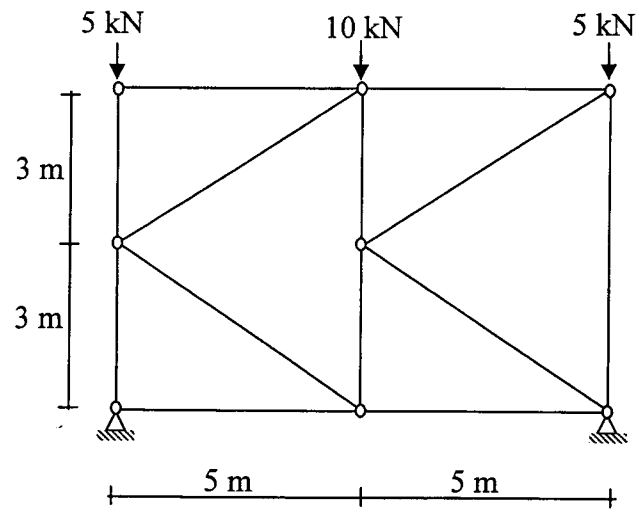

FIGURE Q2

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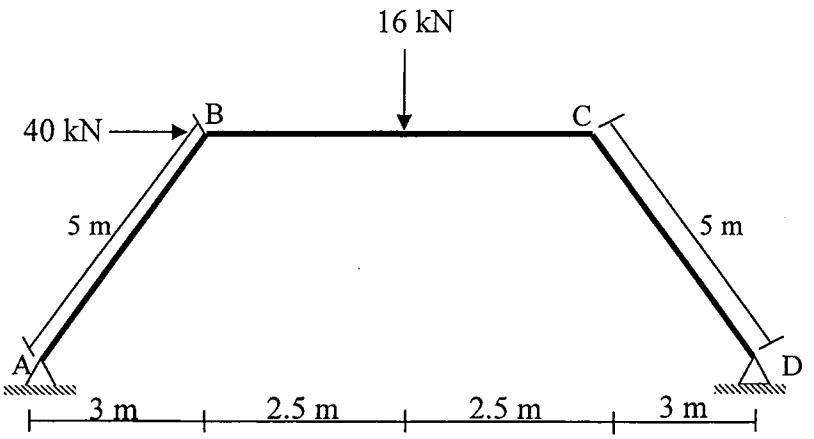

FIGURE Q3

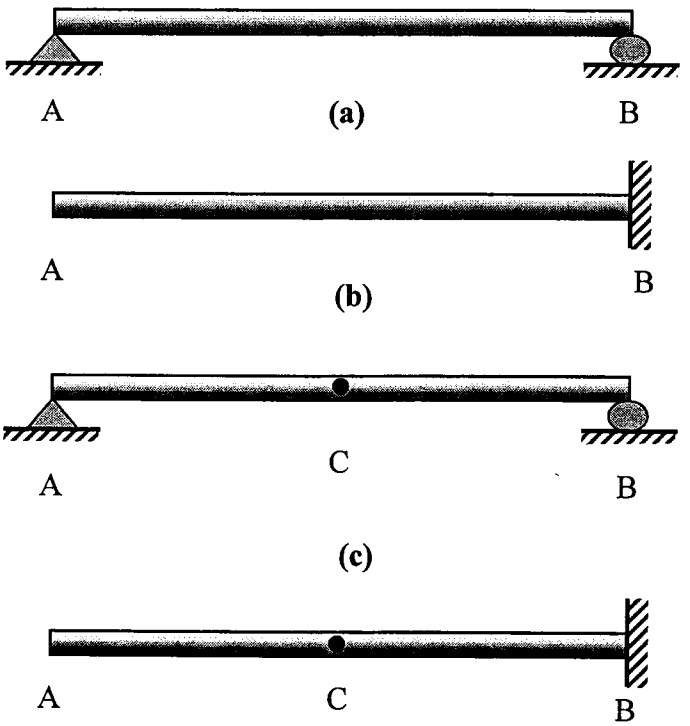

FIGURE Q4

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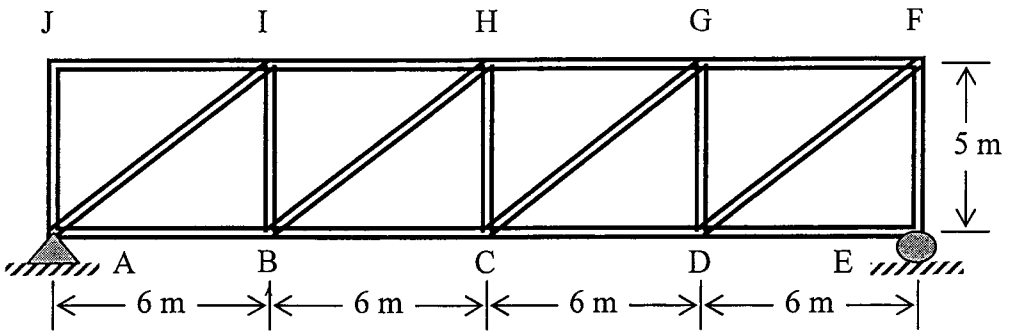
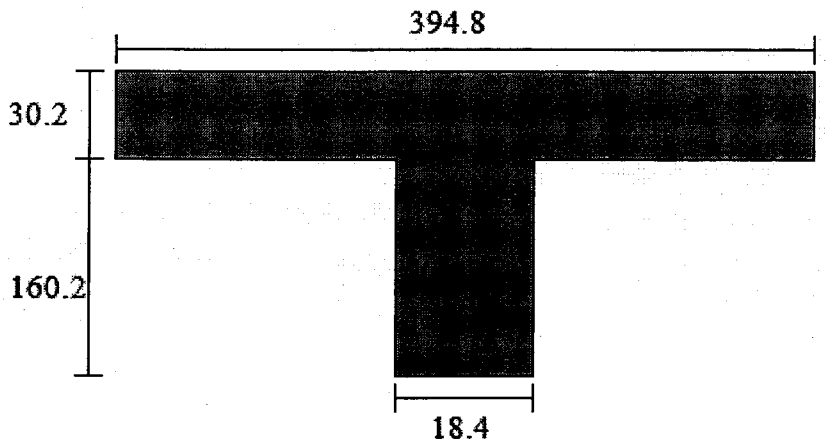


FIGURE Q4 (e)



All units in mm

FIGURE Q5 (a)

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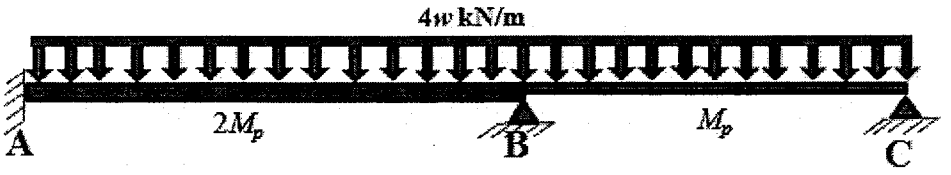

FIGURE Q5(b)

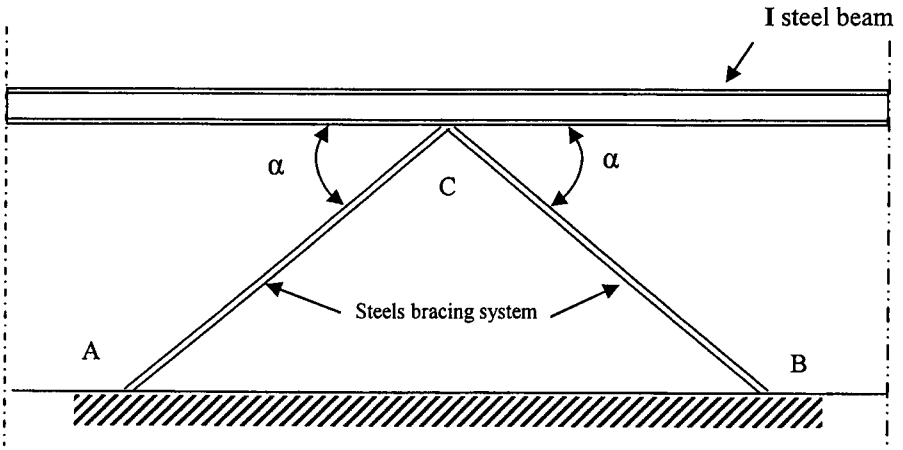

FIGURE Q6

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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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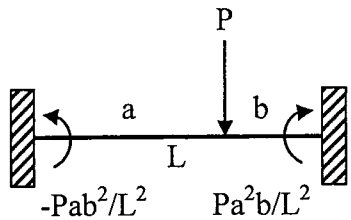
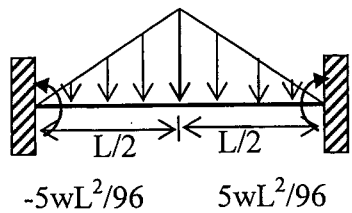
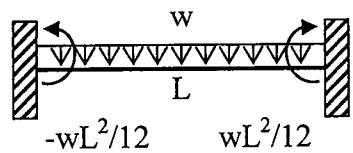
Fixed End Moment (FEM):







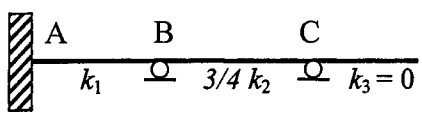
Unit Load Method:

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

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

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

Distribution Factor, DF:



$k_1 = k_2 = 4EI/L$

B

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