Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	STRUCTURAL ANALYSIS
COURSE CODE	:	BFC 3023/BFC21403
PROGRAMME	:	3 BFF/2 BFF
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

Q1 Figure **Q1** shows a plane truss that is pinned at A and roller at B. The truss is subjected to horizontal loads of 15kN and 30kN at point D and E respectively. Given A = 1800mm^2 and E = 200GPa.

(a) Proof that the truss is statically determinate.

(2 marks)

(b) Determine the axial forces for all members of truss.

(10 marks)

(c) Using the virtual work method, determine the horizontal displacement at joint E.

(13 marks)

Q2 (a) Describe the differences between external and internal redundancy of statically indeterminate. Give one example for each truss system and explain whether the truss can be classified as external or internal statically indeterminate.

(6 marks)

(b) The truss system as shown in Figure **Q2** is pinned support at E and roller at C. The modulus elasticity of each member is 200kN/mm^2 and the cross-sectional area of each member is 1800mm^2.

(i) Determine the classification of truss.

(3 marks)

(ii) Determine the reactions and internal forces for each member with assumption that member EB is redundant.

(16 marks)

Q3 (a) Figure **Q3(a)** shows a continuous beam with concentrated load at A and uniformly distributed load at span CD. Using moment distribution method, determine:

(i) Internal moment at B, C and D.

(8 marks)

(ii) Reaction at support B, C and D.

(3 marks)

(iii) Draw shear and bending moment diagrams for the beam.

(3 marks)

(b) Figure **Q3(b)** shows a beam with uniformly distributed load at span AB and point load at C. Using slope deflection method, determine:

(i) Moment at A and B

(8 marks)

(ii) Draw shear and bending moment diagrams for the beam.

(3 marks)

Q4 (a) Describe briefly **three (3)** main procedures in constructing the influence lines using the principle of Muller-Breslau for a simply supported beam AB as shown in Figure **Q4(a)**.

(3 marks)

(b) Consider the Pratt truss as shown in Figure **Q4(b)** with a unit point load moves from left to right. Draw the influence lines for reactions at support A and B, as well as internal forces for members DJ and IJ.

(14 marks)

(c) If a vehicles as illustrated in Figure **Q4(c)** is move from A to L with maximum capacity of 5000kg, draw the possible positions of the loadings and determine the maximum axial force for member IJ.

(8 marks)

Q5 (a) Sketch possible collapse mechanisms for the three-span continuous beam as in Figure **Q5(a)**.

(5 marks)

(b) A continuous steel beam as shown in Figure **Q5(b)** has fixed support at A and roller support at joints B and C. Joint C is real plastic hinge, where $M_p = 0$. The beam is subjected to three point loads of 20kN. Determine the plastic moment of the beam, including the failure mode.

(20 marks)

Q6 (a) Describe the stability and equilibrium of a compression structure at initial state, under applied load and post-loading.

(6 marks)

(b) A rigid jointed steel frame ABC carry load of 3.5W as can be seen in **Figure Q6**. Members AB and BC have square dimension with size 110mm × 110mm and 100mm × 100mm respectively. The Young's modulus of steel is 210GPa.

(i) Using the equilibrium moment at point B, formulate the required instability for the critical condition of frame ABC.

(3 marks)

(ii) Calculate the strength ratio and instability criteria of frame ABC.

(10 marks)

(iii) Determine the critical load, W that can be hold by the frame ABC. Consider **six (6)** trials only with $\rho = 0$, 1.0, 2.0, 2.20, 2.36 and 2.40.

(6 marks)

- END OF QUESTION -

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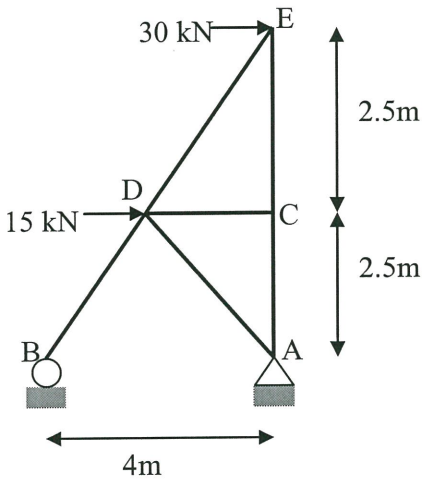

FIGURE Q1

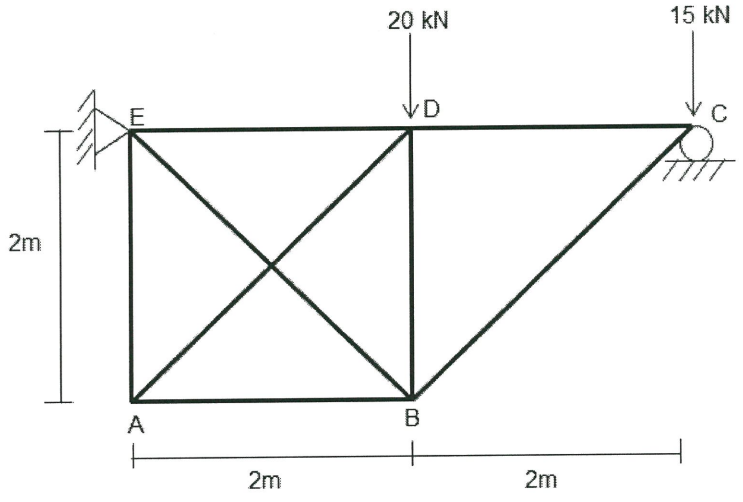

FIGURE Q2

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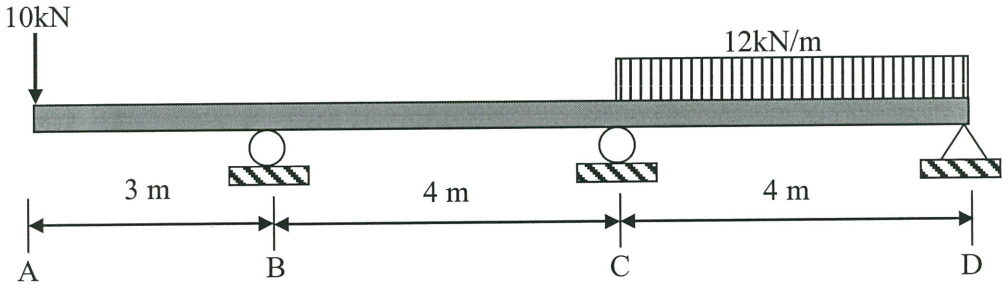

FIGURE Q3(a)

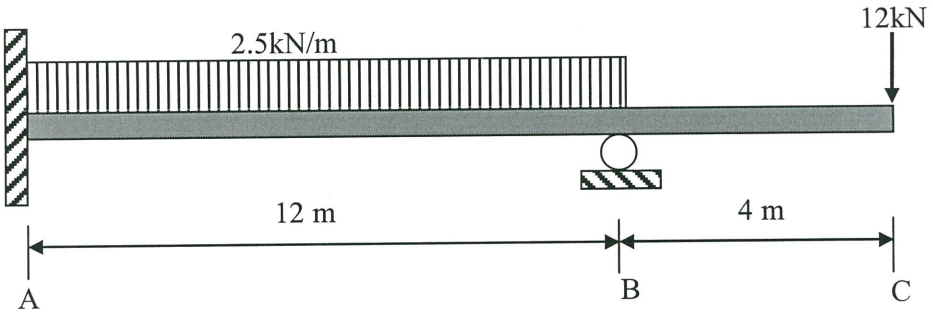

FIGURE Q3(b)

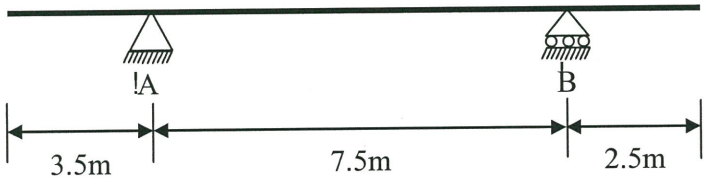

FIGURE Q4(a)

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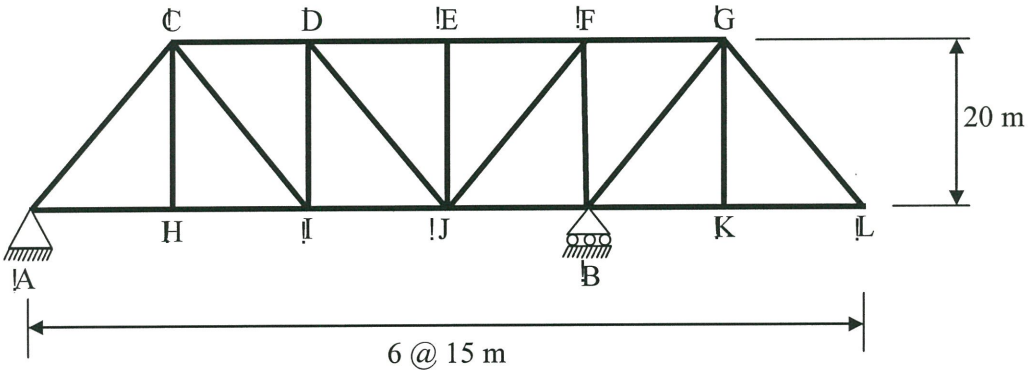

FIGURE Q4(b)

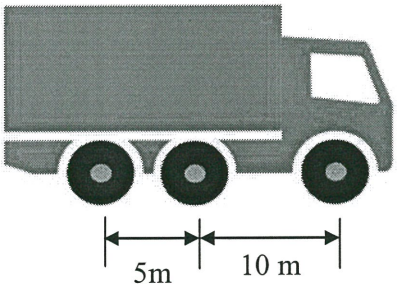

FIGURE Q4(c)

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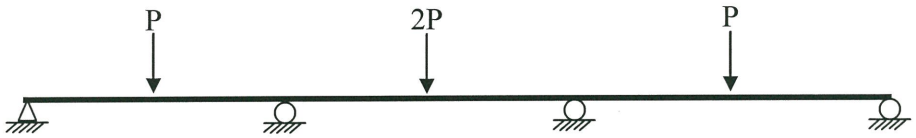

FIGURE Q5(a)

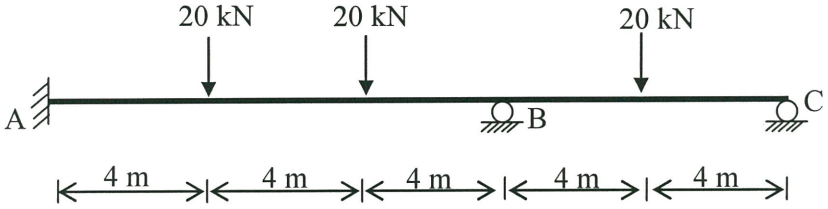

FIGURE Q5(b)

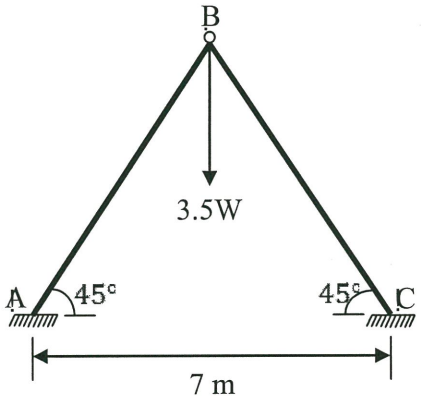

FIGURE Q6

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APPENDIX:

Table 1: Fixed End Moment

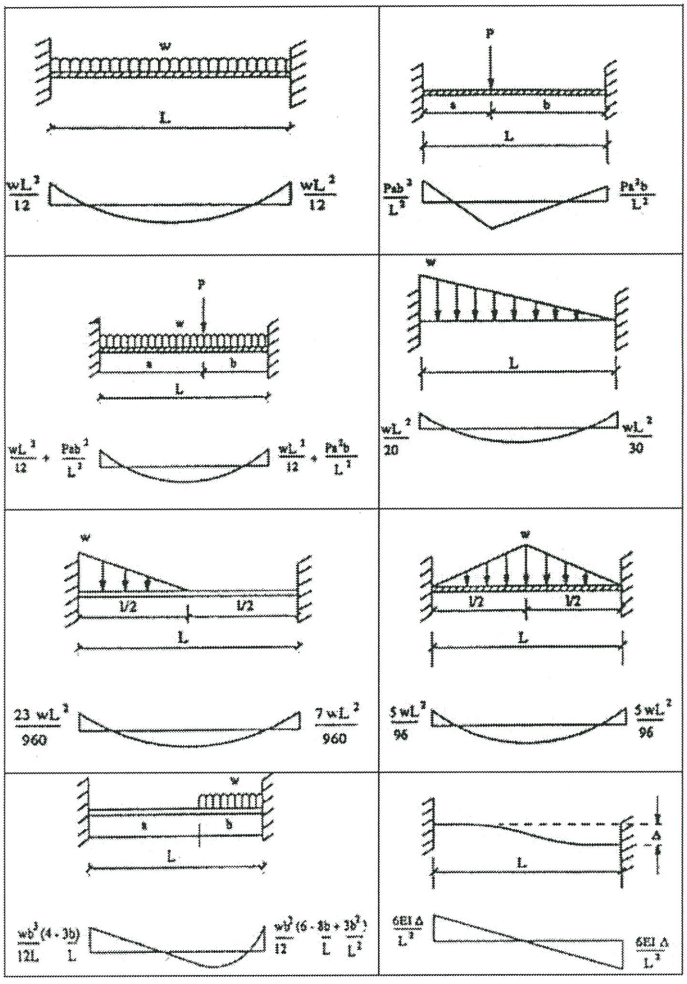

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Table 2: Tabulated Selected Values of Stability Function (Compression)

ρ	s	c	$s(1-c^2)$	$(sc)^2$
0·00	4·000	0·500	3·000	4·000
0·04	3·947	0·510	2·920	4·053
0·08	3·894	0·521	2·838	4·109
0·12	3·840	0·532	2·755	4·166
0·16	3·785	0·543	2·669	4·224
0·20	3·730	0·555	2·581	4·285
0·24	3·674	0·568	2·490	4·348
0·28	3·617	0·581	2·397	4·413
0·32	3·560	0·595	2·302	4·480
0·36	3·502	0·609	2·204	4·549
0·40	3·444	0·624	2·102	4·621
0·44	3·385	0·640	1·997	4·695
0·48	3·325	0·657	1·889	4·773
0·52	3·264	0·675	1·777	4·852
0·56	3·203	0·694	1·662	4·935
0·60	3·140	0·714	1·541	5·021
0·64	3·077	0·735	1·417	5·110
0·68	3·013	0·757	1·287	5·202
0·72	2·948	0·781	1·151	5·299
0·76	2·883	0·806	1·010	5·398
0·80	2·816	0·833	0·862	5·502
0·84	2·748	0·862	0·707	5·610
0·88	2·680	0·893	0·544	5·722
0·92	2·610	0·926	0·373	5·839
0·96	2·539	0·962	0·192	5·961
1·00	2·467	1·000	−0·000	6·088
1·04	2·394	1·042	−0·204	6·221
1·08	2·320	1·087	−0·420	6·359
1·12	2·245	1·136	−0·652	6·503
1·16	2·168	1·190	−0·901	6·654
1·20	2·090	1·249	−1·169	6·812
1·24	2·011	1·314	−1·459	6·977
1·28	1·930	1·386	−1·775	7·150
1·32	1·848	1·465	−2·120	7·331
1·36	1·764	1·555	−2·501	7·521
1·40	1·678	1·656	−2·922	7·720
1·44	1·591	1·770	−3·393	7·930
1·48	1·502	1·900	−3·923	8·150
1·52	1·411	2·051	−4·527	8·381
1·56	1·319	2·227	−5·222	8·625
1·60	1·224	2·435	−6·032	8·881
1·64	1·127	2·684	−6·992	9·152
1·68	1·028	2·988	−8·150	9·438
1·72	0·927	3·367	−9·580	9·739
1·76	0·823	3·852	−11·395	10·059
1·80	0·717	4·497	−13·783	10·397
1·84	0·608	5·393	−17·078	10·755
1·88	0·496	6·722	−21·935	11·135
1·92	0·382	8·899	−29·847	11·538
1·96	0·264	13·109	−45·084	11·967
2·00	0·143	24·684	−86·864	12·424
2·04	0·018	197·386	−709·240	12·911
2·08	−0·110	−33·292	121·901	13·431
2·12	−0·242	−15·436	57·487	13·987
2·16	−0·379	−10·085	38·132	14·582
2·20	−0·519	−7·511	28·781	15·219
2·24	−0·665	−5·998	23·254	15·904
2·28	−0·815	−5·003	19·592	16·640
2·32	−0·971	−4·299	16·977	17·433
2·36	−1·133	−3·775	15·011	18·288

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Table 3: Tabulated Selected Values of Stability Function (Compression)

ρ	s	c	$s(1-c^2)$	$(sc)^2$
2·40	−1·301	−3·370	13·472	19·213
2·44	−1·475	−3·048	12·231	20·215
2·48	−1·656	−2·787	11·205	21·302
2·52	−1·845	−2·570	10·339	22·484
2·56	−2·043	−2·387	9·595	23·773
2·60	−2·249	−2·231	8·948	25·181
2·64	−2·465	−2·097	8·376	26·723
2·68	−2·692	−1·981	7·866	28·417
2·72	−2·930	−1·878	7·407	30·281
2·76	−3·180	−1·788	6·989	32·341
2·80	−3·445	−1·708	6·606	34·623
2·84	−3·725	−1·637	6·252	37·160
2·88	−4·021	−1·573	5·923	39·990
2·92	−4·337	−1·515	5·616	43·159
2·96	−4·673	−1·463	5·326	46·722

Table 4: Tabulated Selected Values of Stability Function (Tension)

ρ	s	c	$s(1-c^2)$	$(sc)^2$
0·00	4·000	0·500	3·000	4·000
−0·20	4·257	0·455	3·374	3·756
−0·40	4·501	0·418	3·714	3·545
−0·60	4·735	0·387	4·025	3·362
−0·80	4·959	0·361	4·314	3·202
−1·00	5·175	0·338	4·583	3·060
−1·20	5·382	0·318	4·837	2·935
−1·40	5·583	0·301	5·077	2·824
−1·60	5·777	0·286	5·305	2·724
−1·80	5·965	0·272	5·523	2·635
−2·00	6·147	0·260	5·731	2·554
−2·20	6·324	0·249	5·932	2·481
−2·40	6·496	0·239	6·125	2·414
−2·60	6·664	0·230	6·311	2·354
−2·80	6·828	0·222	6·491	2·298
−3·00	6·988	0·215	6·666	2·247
−3·20	7·144	0·208	6·836	2·200
−3·40	7·297	0·201	7·001	2·157
−3·60	7·446	0·195	7·162	2·117
−3·80	7·593	0·190	7·319	2·080