UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER 1
SESSION 2014/2015

COURSE NAME	:	STRUCTURAL ANALYSIS
COURSE CODE	:	BFC21403
PROGRAMME	:	3 BFF/2 BFF
EXAMINATION DATE	:	DECEMBER 2014/ JANUARY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) Explain the principle of virtual work method in truss application.

(4 marks)

(b) Figure **Q1** shows a plane truss that is roller at A and pinned at D. The truss is subjected to vertical loads of 10 kN at point F and E. Given A = 2000mm^2 and E = 210GPa.

(i) State the type of truss system.

(2 marks)

(ii) Calculate the reaction at the support A and D.

(3 marks)

(iii) Using the virtual work method, analyse the vertical displacement at joint F.

(16 marks)

Q2 (a) Explain the differences between external and internal redundancy of statically indeterminate.

(6 marks)

(b) The truss system as shown in Figure **Q2** is pinned support at A and roller at F. The modulus elasticity of each member is 210 kN/mm^2 and the cross-sectional area of each member is 1800 mm^2. Assume that member DB is redundant.

(i) Define the classification of truss.

(3 marks)

(ii) Calculate the reactions at supports A and F.

(3 marks)

(iv) Determine the internal forces for each member.

(13 marks)

Q3 (a) For the statically indeterminate structure, the end moments for any member are developed due to the fixed end moment, slope and displacement. Using a related diagram, discuss all types of moment sources.

(9 marks)

(b) Figure **Q3** shows a continuous beam which carries a triangle load 20 kN/m on span AB, uniform distributed load 10 kN/m on span BD and axial load 80 kN at point C. The beam is supported with fixed support at A, roller at B and pin at D. Assume EI is constant. Using slope deflection method, determine:

(i) The moments for each support of the beam.

(10 marks)

(ii) Draw the shear force diagram for the beam

(3 marks)

(iii) Draw the bending moment diagram for the beam.

(3 marks)

Q4 (a) Figure **Q4(a)** shows a simply supported beam AB with span 7 m. Calculate and construct the variation of influence line for shear force and moment at point C.

(8 marks)

(b) Figure **Q4(b)** shows an indeterminate beam consists of 3 spans AB, BC and CD with two points hinge located at E and G. Using the qualitative method of Muller-Breslau,

(i) State **four (4)** principles to construct the influence lines.

(4 marks)

(ii) Draw the influence lines for the vertical reaction at all supports.

(6 marks)

(iii) Compute the maximum shear force and bending moment at point G which located at 3 m from support B when uniform load w = 30 kN/m is imposed along span AC, while w = 17 kN/m along span BC and CD.

(7 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 (a) Instability is a condition wherein a compression member loses the ability to resist increasing loads and exhibits instead a decrease in load carrying capacity. Describe the type and classification of instability.

(6 marks)

(b) A concrete block is supported by a rigid steel frame ABC and a spring-cable DE, as can be seen in Figure **Q6**. The joint B of frame is located at the centre of the concrete block. Members AB and BC have square dimension with size 100 mm $\times$ 100 mm and 110 mm $\times$ 110 mm respectively. The Young's modulus of steel is 210 GPa.

(i) Calculate the internal force of members AB and BC.

(4 marks)

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

(8 marks)

(iii) Determine the maximum weight of concrete block that can be held by the frame ABC. Consider ρ_n between 1.5 to 2.0 only.

(7 marks)

-END OF QUESTION -

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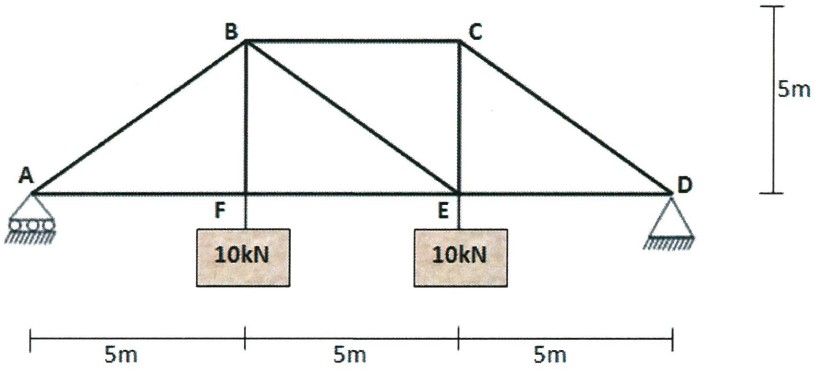

FIGURE Q1

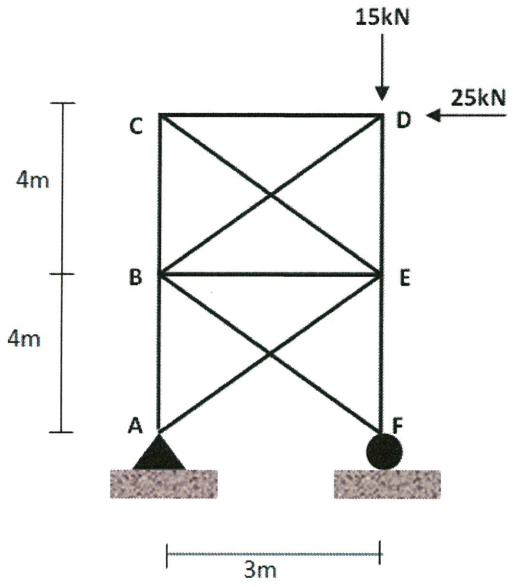

FIGURE Q2

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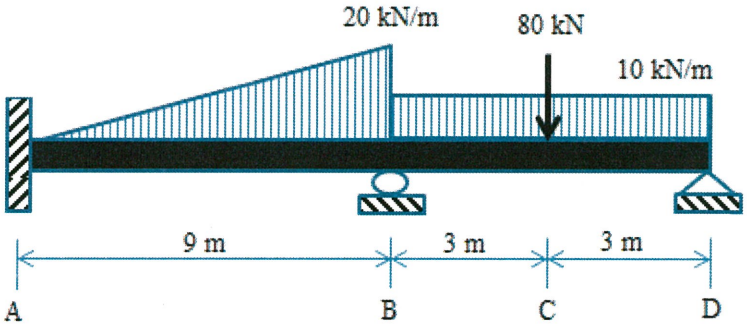

FIGURE Q3

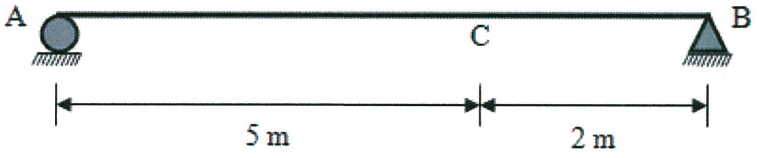

FIGURE Q4(a)

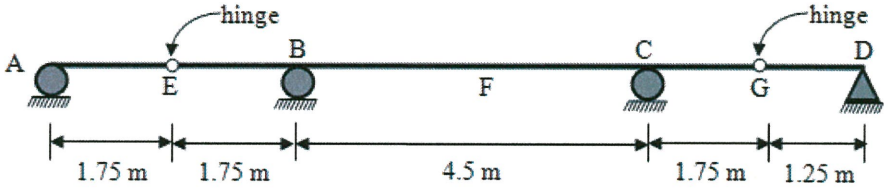

FIGURE Q4(b)

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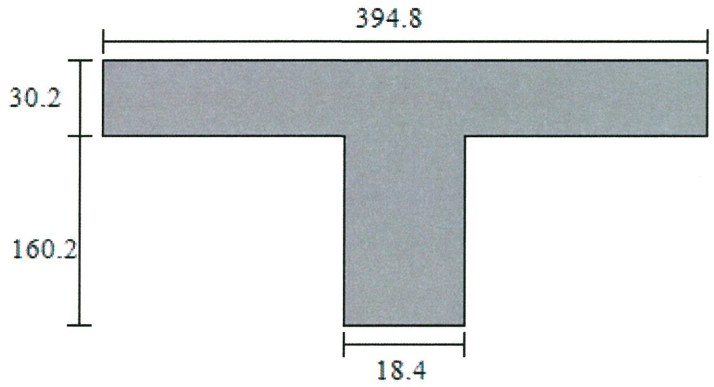

All units in mm

FIGURE Q5 (a)

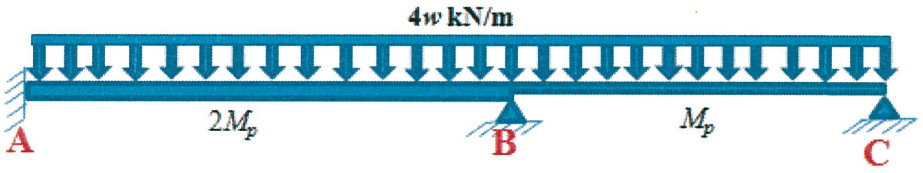

FIGURE Q5(b)

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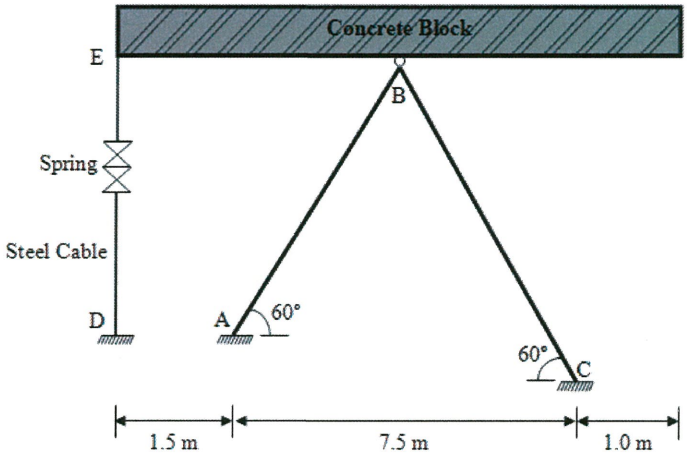

FIGURE Q6

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APPENDIX:

Table 1: Fixed End Moment

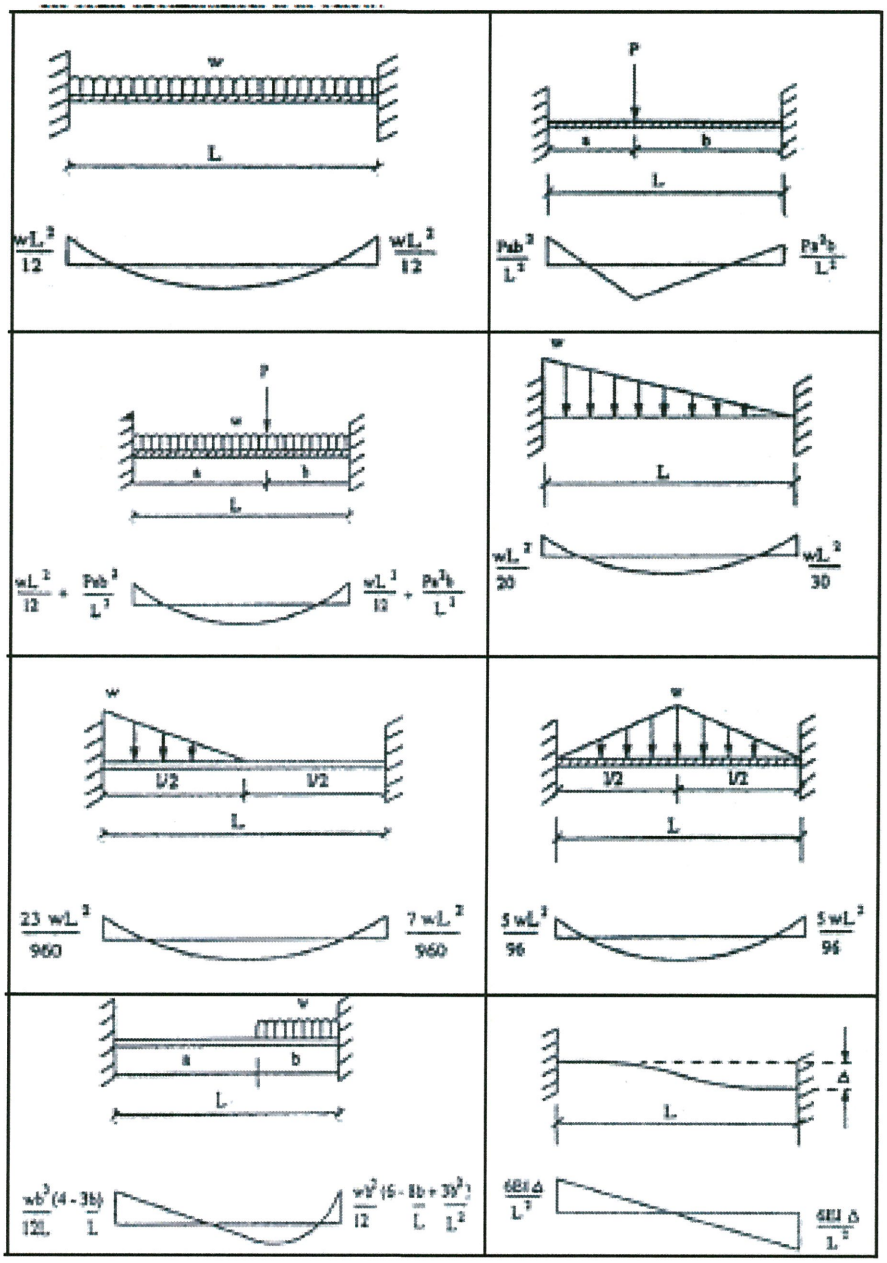

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Table 2: Tabulated Selected Values of Stability Function (Compression)

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