UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2011/2012

COURSE NAME	:	ADVANCED STRUCTURE ANALYSIS
COURSE CODE	:	BFS 4013
PROGRAMME	:	4 BFF
EXAMINATION DATE	:	JANUARY 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS PAPER CONSISTS OF **TWELVE (12)** PAGES

Answer **any FOUR (4)** questions.

Q1 (a) What is the most important reason for choosing statically indeterminate structure over the statically determinate one for design purpose?

(3 marks)

(b) Using Stiffness Method, determine the global stiffness, K, for the pin jointed frame shown in Figure **Q1.**

(10 marks)

(c) Determine the support reactions of the frame. Assume AE is constant

(12 marks)

Q2 (a) Failure in a column is generally caused by buckling and crushing. Briefly explain these two failure modes.

(5 marks)

(b) Critical load equation for pin-pin column is $P_{cr} = \pi^2 EI/L^2$. Show that the critical equation for fixed-free column is $P_{cr} = 0.25\ \pi^2 EI/L^2$. Provide drawings to support your work.

(5 marks)

(c) A rigid jointed steel frame ABC carries a vertical load W at B as shown in Figure **Q2**. Formulate the instability equation and find the critical load for the frame.

Given : $I_{AB} = I_{BC} = 1200\ cm^4$
$E = 200\ kN/mm^2$

(15 marks)

Q3. (a) State the definition for:
i. Dynamic
ii. Vibration
iii. Static

(6 marks)

(b) Draw the response of a simple spring system to an initial displacement 0.5 mm and initial velocity 1 m/s. The natural frequency is 1.5 rad/s. Find the amplitude, A, and the period, T, of the motion.

(6 marks)

(c) The weight of a wooden block shown in Figure **Q3** is 25 kg and the spring stiffness is 4.8 N/mm. A bullet weighing 2.5 kg is fired at a speed of 10 m/s into the block and becomes embedded in the block. Determine the resulting motion, x(t) of the block.

(13 marks)

Q4. (a) Draw the stress distributions for elastic and plastic condition for a rectangular section with height, h, and width, b, as shown in Figure **Q4(a).**

(3 marks)

(b) From **Q4(a)** and $M=\int \sigma y dA$, prove that elastic moment, $Me = (bh^2/6)\sigma y$ and plastic moment, $Mp = (bh^2/4)\sigma y$.

(7 marks)

(c) Determine the critical load for the frame in Figure **Q4(c)**. Mp is constant for all members of the frame.

(15 marks)

Q5. (a) There are two (2) types of structural instability. Name and briefly explain each type.

(5 marks)

(b) Draw a free body diagram of a damped SDOF system and its response.

(6 marks)

(c) Find the reactions for the beam shown in Figure **Q5** and then draw the shear force and bending moment diagrams. Use Force Method, and take E = 200 GPa and I = 60 x 10^6 mm^4.

(14 marks)

Jawab mana-mana **EMPAT (4)** soalan.

S1 (a) Apakah sebab utama memilih struktur statik tidak boleh tentu di dalam industri pembinaan pada hari ini

(3 markah)

(b) Dapatkan nilai faktor kekukuhan *'global'*, K, bagi kekuda didalam Rajah **S1** dengan menggunakan kaedah kekukuhan. Nilai AE adalah tetap bagi setiap anggota kekuda.

(10 marks)

(c) Dapatkan daya tindakbalas pada setiap penyokong pada kekuda tersebut.

(12 marks)

S2 (a) Kegagalan dalam tiang kebiasaannya disebabkan oleh lengkokan dan kehancuran. Terangkan dengan ringkas kedua-dua kegagalan tersebut.

(5 markah)

(b) Formula bagi beban kritikal tiang dengan kedua-dua hujung pin adalah $P_{cr} = \pi^2 EI/L^2$. Tunjukkan bahawa formula bagi beban kritikal tiang dengan satu hujung terikat dan satu hujung bebas adalah $P_{cr} = 0.25\ \pi^2 EI/L^2$. Sertakan lukisan bagi menyokong kerja anda.

(5 markah)

(c) Satu kerangka keluli ABC dengan sambungan tegar membawa daya pugak W di B seperti dalam Rajah **S2**. Dapatkan persamaan ketidakseimbangan dan beban kritikal bagi kerangka tersebut

Diberi : $I_{AB} = I_{BC} = 1200\ cm^4$
$E = 200\ kN/mm^2$

(15 markah)

S3. (a) Berikan definasi bagi:
i. Dinamik
ii. Getaran
iii. Statik

(6 markah)

(b) Lakarkan rajah tindakbalas system 'spring' mudah dengan anjakan permulaan 0.5 mm dan halaju awal 1 m/s. Frekuensi adalah 1.5 rad/s. Dapatkan nilai amplitude, A, dan tempoh masa, T, bagi pergerakan tersebut.

(6 markah)

(c) Jisim satu blok kayu seperti dalam Rajah **S3** ialah 25 kg dan factor kekukuhan spring adalah 4.8 N/mm. Peluru dengan jisim 2.5 kg ditembak dengan kelajuan 10 m/s ke dalam blok dan bergerak bersama blok tersebut. Dapatkan pergerakan yang terhasil, x(t) bagi blok tersebut.

(13 markah)

S4. (a) Lakarkan taburan tegasan bagi keadaan elastik dan plastik bagi keratan segiempat tepat dengan tinggi, h, dan lebar, b, seperti dalam Rajah **S4(a)**.

(3 markah)

(b) Dari soalan **S4(a)** dan $M=\int \sigma y dA$, buktikan momen elastik, $Me =(bh^2/6)\sigma y$ dan momen plastik, $Mp =(bh^2/4)\sigma y$.

(7 markah)

(c) Dapatkan nilai beban genting bagi kerangka dalam Rajah **S4(b)**. Mp adalah malar untuk semua anggota kerangka.

(15 markah)

S5. (a) Terdapat dua (2) jenis ketidakstabilan struktur. Namakan dan terangkan secara ringkas setiap satu.

(5 markah)

(b) Lakarkan rajah *'free body'* bagi system *'damped'* SDOF dan geraf tindakbalasnya.

(6 markah)

(b) Dengan menggunakan kaedah daya, dapatkan tindakbalas pada rasuk dalam Rajah **S5** dan lakarkan gambarajah daya ricih dan momen lentur bagi rasuk tersebut.

Diberi $E = 200$ GPa dan $I = 60(10^6)$ mm^4.

(14 markah)

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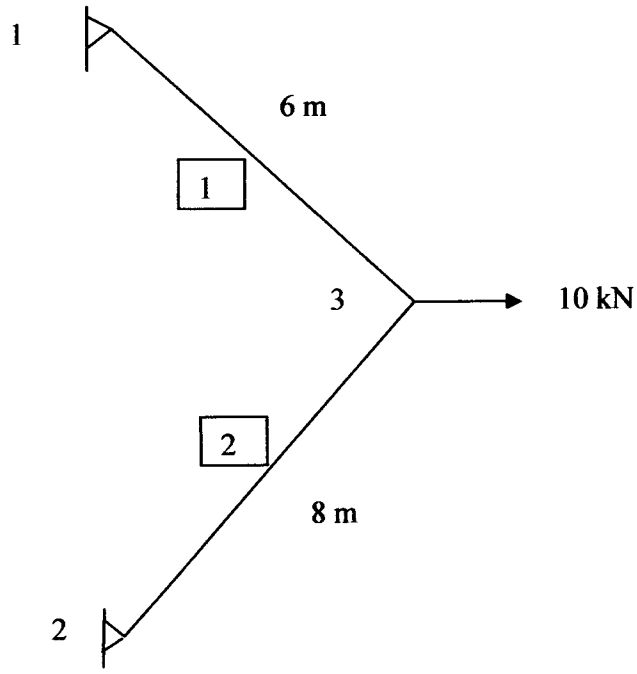

Figure Q1

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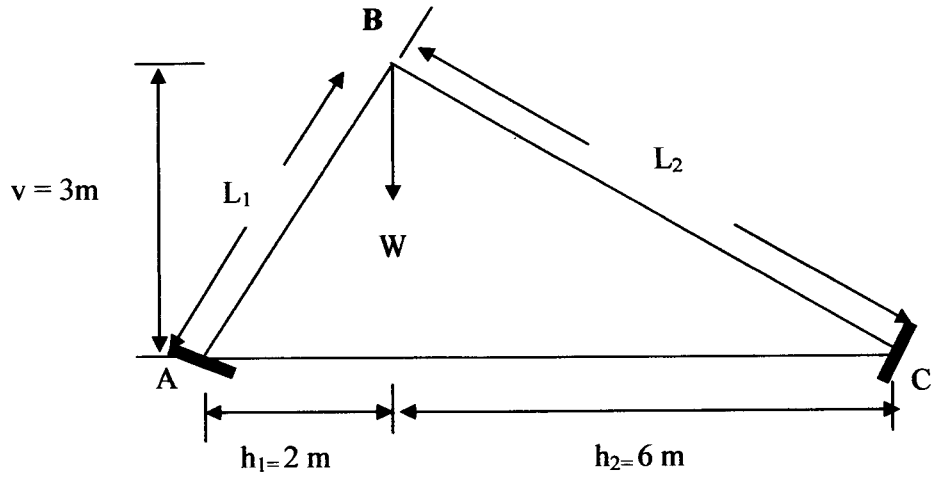

Figure Q2

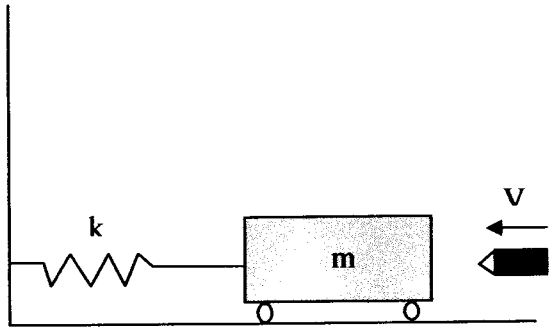

Figure Q3

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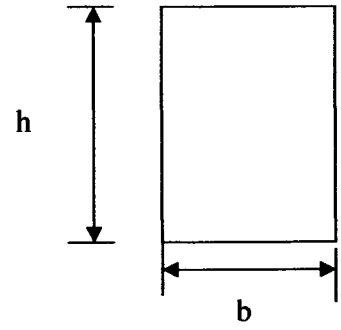

Figure Q4(a)

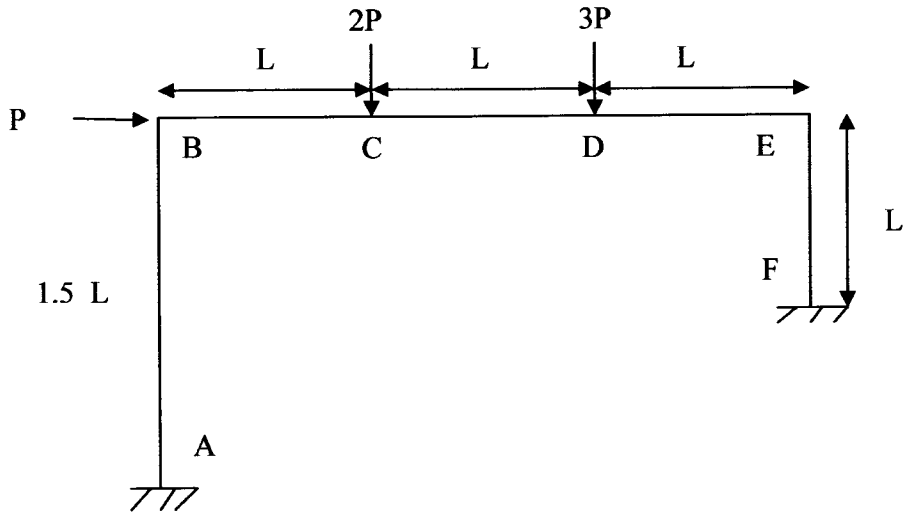

Figure Q4(c)

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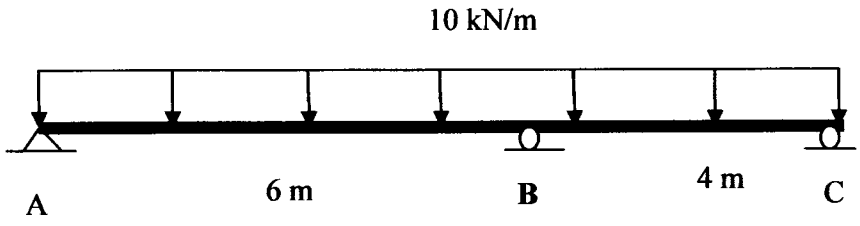

Figure Q5

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APPENDIX A

Tabulated Selected Values of Stability Functions (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

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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
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

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3·00	−5·032	−1·416	5·053	50·746
3·04	−5·417	−1·373	4·793	55·312
3·08	−5·832	−1·334	4·544	60·519
3·12	−6·281	−1·298	4·306	66·491
3·16	−6·767	−1·266	4·077	73·381
3·20	−7·297	−1·236	3·856	81·383
3·24	−7·878	−1·209	3·641	90·744
3·28	−8·518	−1·184	3·432	101·783
3·32	−9·227	−1·162	3·228	114·917
3·36	−10·018	−1·141	3·028	130·700

Tabulated Selected Values of Stability Functions (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