



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2010/2011**

COURSE NAME : STRUCTURAL ANALYSIS  
COURSE CODE : BFC3023/ BFC21403  
PROGRAMME : 3 BFF  
EXAMINATION DATE : APRIL / MAY 2011  
DURATION : 3 HOURS  
INSTRUCTION : ANSWER FOUR (4) QUESTIONS ONLY.

THIS PAPER CONSISTS OF FOURTEEN (14) PAGES

**Q1** Figure Q1 shows a simply supported truss bridge loaded with a uniformly distributed load of 45 kN/m from B to G and a concentrated load of 250 kN at E.

Given:

All members gross area (exclude internal diagonal members) = 66.60 cm<sup>2</sup>

All internal diagonal members gross area = 35.90 cm<sup>2</sup>

Modulus of Elasticity = 205 kN/mm<sup>2</sup>

- (a) Determine the stability and determinacy of the structure. (4 marks)
- (b) Determine the reactions of the truss. (5 marks)
- (c) Complete the values of AE and F' in Table Q1. Show all calculations and attach the completed table together with your answer booklet. (8 marks)
- (d) What is the lateral displacement at joint H if a unit load applied horizontally? (5 marks)
- (e) Based on your opinion, what is the best method to reduce the lateral displacement at joint H? (3 marks)

**Q2** (a) What is the main difference between frame and truss. (2 marks)

(b) A truss is loaded with several loads as illustrated in Figure Q2. The Young Modulus of the truss members is constant. Properties of each member are shown in Table Q2. Based on Figure Q2:

- (i) Determine the stability and determinacy of the truss (2 marks)
- (ii) Calculate reaction at point E ( $R_E$ ). (17 marks)
- (iii) Point E is supported on a soil which will compress at the rate of 50 kN/mm after reaching compression force of 100 kN, calculate the displacement at point E due to support  $R_E$ .

(2 marks)

- (iv) If member ID is introduced into the truss, what are the effects to the internal member forces and support reactions?

(2 marks)

- Q3** (a) Write the procedures for the analysis of continuous beam using moment distribution method.

(5 marks)

- (b) One continuous beam is loaded with a uniformly and concentrated load as shown in Figure Q3. The cross section and Young Modulus of the beam is constant.

- (i) Calculate the end moment at the joints by using moment distribution method. Use **four (4)** cycles moment distribution.

(12 marks)

- (ii) Determine the support reactions.

(5 marks)

- (iii) Sketch the shear force diagram

(1.5 marks)

- (iv) Sketch the bending moment diagram.

(1.5 marks)

- Q4** (a) Explain the procedure for drawing the influence line.

(5 marks)

- (b) For the beam shown in Figure Q4, draw the influence lines for:

- (i) the vertical reaction at A

(6 marks)

- (ii) the shear at C

(7 marks)

- (iii) the moment at C

(7 marks)

- Q5** (a) Sketch the stress distribution diagram if the beam as shown in Figure Q5 with the cross section (b x h) is subjected to bending M due to point load P. (5 marks)
- (b) A portal frame ACDB is shown in Figure Q5 (b).
- (i) Determine the maximum plastic moment. (15 marks)
- (ii) If the cross section area of the beam is  $190 \text{ mm}^2$  and the lever arm is 300 mm, determine the yield stress,  $\sigma_y$ . (5 marks)
- Q6** (a) List **three (3)** classification of instability structure. (3 marks)
- (b) In your opinion, why elastic instability need to be considered in a structure? (2 marks)
- (c) A rigid steel frame ABC carry a vertical load F at C is shown in Figure Q6. Derive the instability equation and find the critical load ( $P_{cr}$ ) for the frame by referring to Table 1. Take  $I_{AC} = 1100 \text{ cm}^4$ ,  $I_{BC} = 1300 \text{ cm}^4$  and  $E = 207 \text{ kN/mm}^2$ . (20 marks)

**S1** Rajah **Q1** menunjukkan satu jambatan kekuda disokong mudah dibebani beban terdistribusi seragam  $45 \text{ kN/m}$  dari B ke G dan beban tumpu  $250 \text{ kN}$  pada E.

Diberikan:

Luas kasar semua anggota (tidak termasuk anggota condong)	$= 66.60 \text{ cm}^2$
Luas kasar anggota condong	$= 35.90 \text{ cm}^2$
Modulus Keanjalan	$= 205 \text{ kN/mm}^2$

- (a) Tentukan kestabilan dan kebolehtentuan struktur tersebut. (4 markah)
- (b) Tentukan semua tindakbalas untuk kekuda tersebut. (5 markah)
- (c) Lengkapkan nilai-nilai AE dan F' di dalam Jadual **Q1**. Tunjukkan semua pengiraan dan lampirkan jadual yang telah lengkap bersama buku jawapan anda. (8 markah)
- (d) Apakah nilai pesongan ufuk sambungan H sekiranya beban satu unit dikenakan secara ufuk? (5 markah)
- (e) Berdasarkan pendapat anda, apakah kaedah yang terbaik untuk mengurangkan pesongan ufuk pada sambungan H? (3 markah)

- S2** (a) Apakah perbezaan utama antara kerangka dan kekuda. (2 markah)
- (b) Satu kekuda dikenakan dengan beberapa beban seperti yang ditunjukkan pada Rajah **Q2**. Modulus keanjalan pada setiap anggota kekuda adalah sama. Ciri setiap anggota adalah ditunjukkan seperti Jadual **Q2**. Berdasarkan Rajah **Q2**:
- (i) Tentukan kestabilan dan kebolehtentu statik bagi kekuda. (2 markah)
- (ii) Kirakan tindakbalas pada titik E ( $R_E$ ). (17 markah)

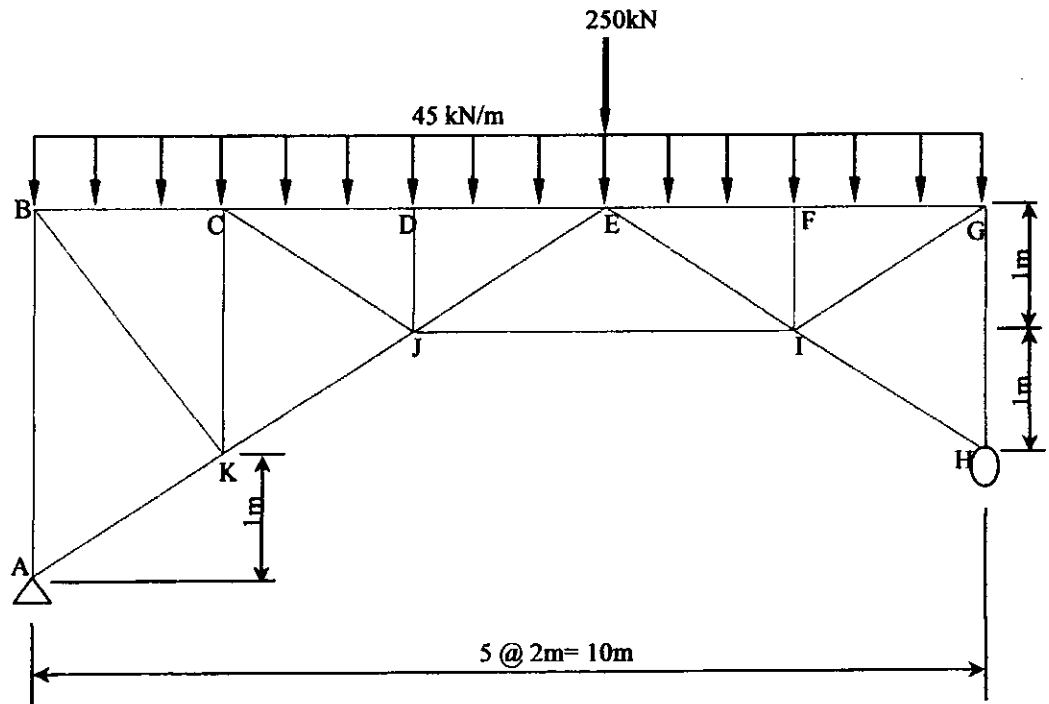
- (iii) Titik E disokong pada tanah di mana ia akan memampat pada kadar 50 kN/mm selepas mencapai daya mampatan 100 kN, kirakan pesongan pada sambungan E. (2 markah)
- (iv) Jika anggota ID diletakkan pada kekuda, apakah kesan pada daya dalaman anggota dan tindakbalas pada penyokong? (2 markah)
- S3 (a) Tuliskan prosedur untuk menjalankan analisis rasuk selanjur menggunakan kaedah agihan momen. (5 markah)
- (b) Satu rasuk selanjur menanggung beban teragih seragam dan beban tumpu seperti Rajah Q3. Keratan rentas dan Modulus Young untuk rasuk ini adalah malar.
- (i) Kirakan momen hujung pada semua sambungan dengan menggunakan kaedah agihan momen. Gunakan empat (4) kitaran untuk agihan momen. (12 markah)
- (ii) Tentukan tindakbalas pada penyokong. (5 markah)
- (iii) Lakarkan gambarajah daya ricih rasuk. (1.5 markah)
- (iv) Lakarkan gambarajah momen lentur rasuk. (1.5 markah)

- S4** (a) Terangkan prosedur untuk melukis garis imbas. (5 markah)
- (b) Untuk rasuk yang ditunjukkan dalam Rajah Q4, lukiskan garis imbas untuk:
- (i) tindakbalas pugak pada A (6 markah)
- (ii) ricih pada C (7 markah)
- (iii) momen pada C (7 markah)
- S5** (a) Lakarkan diagram agihan tegasan jika rasuk seperti Rajah Q5 (a) dengan keratan rentas ( $b \times h$ ) mempunyai lenturan  $M$  dari beban tumpu  $P$ . (5 markah)
- (b) Satu kerangka portal ACDB ditunjukkan dalam Rajah Q5 (b).
- (i) Tentukan momen plastik maksimum. (15 markah)
- (ii) Sekiranya luas keratan rentas rasuk adalah  $190 \text{ mm}^2$  dan lengan momen ialah  $300 \text{ mm}$ , tentukan tegasan alah,  $\sigma_y$ . (15 markah)
- S6** (a) Senaraikan **tiga (3)** klasifikasi dalam stuktur yang tidak stabil. (3 markah)
- (b) Pada pendapat anda, mengapa ketidakstabilan elastik perlu dipertimbangkan dalam sesuatu struktur. (2 markah)
- (c) Sebuah kerangka keluli ABC terikat tegar dikenakan beban pugak  $F$  seperti yang ditunjukkan dalam Rajah Q6. Dengan merujuk kepada Jadual Q6, terbitkan persamaan ketidakstabilan dan tentukan beban kritikal ( $P_{cr}$ ) untuk kerangka tersebut. Guna  $I_{AC} = 1100 \text{ cm}^4$ ,  $I_{BC} = 1300 \text{ cm}^4$  dan  $E = 207 \text{ kN/mm}^2$ . (20 markah)

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**FIGURE Q1**



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TABLE Q1

Truss Members	L (x 10 <sup>3</sup> mm)	AE (x 10 <sup>3</sup> kN)	F' (kN)	$\mu$	$\frac{F'\mu L}{AE}$
<b>Bridge Deck</b>					
BC	2		-280	-0.40	
CD	2		-940	-1.60	
DE	2		-940	-1.60	
EF	2		-660	-1.20	<i>Pr. Singh</i>
FG	2		-660	-1.20	
<b>Bottom Chord Members</b>					
HI	2.24		0	1.12	
IJ	4		1140	2.40	
JK	2.24				
AK	2.24		0	1.12	
<b>Vertical Members</b>					
AB	3		-325	-0.40	
CK	2				
DJ	1		-90	0	
FI	1		-90	0	
GH	2		-375	-0.60	
<b>Diagonal Members</b>					
BK	2.83		396	0.57	
CJ	2.24		738	1.34	
EJ	2.24		-224	0.22	
EI	2.24				
IG	2.24		738	1.32	

Name : \_\_\_\_\_  
 Student Id No. : \_\_\_\_\_  
 Lecturer Name : \_\_\_\_\_

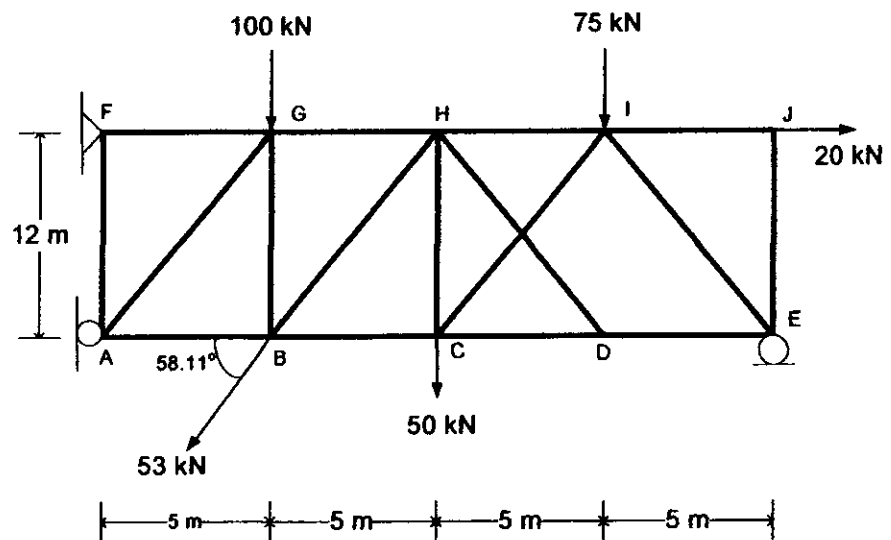
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**TABLE Q2**

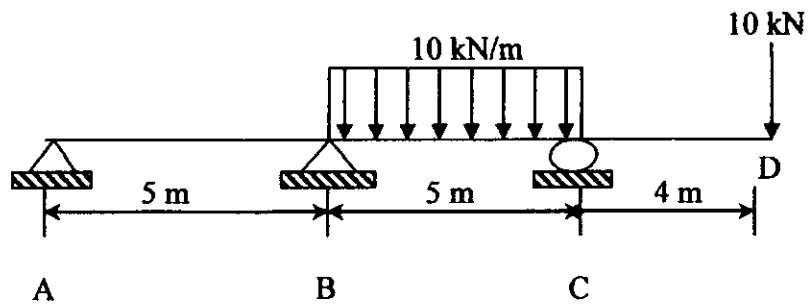
Member	Area (cm <sup>2</sup> )
AB	3
BC	3
CD	3
DE	3
FG	3
GH	3
HI	3
IJ	3
AF	3
AG	2
BG	2
BH	2
CH	2
CI	2
HD	2
IE	2
JE	3



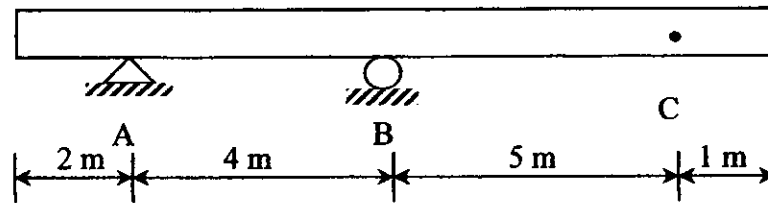
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**FIGURE Q3**

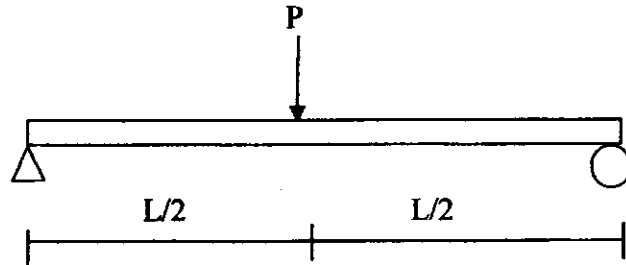


**FIGURE Q4**

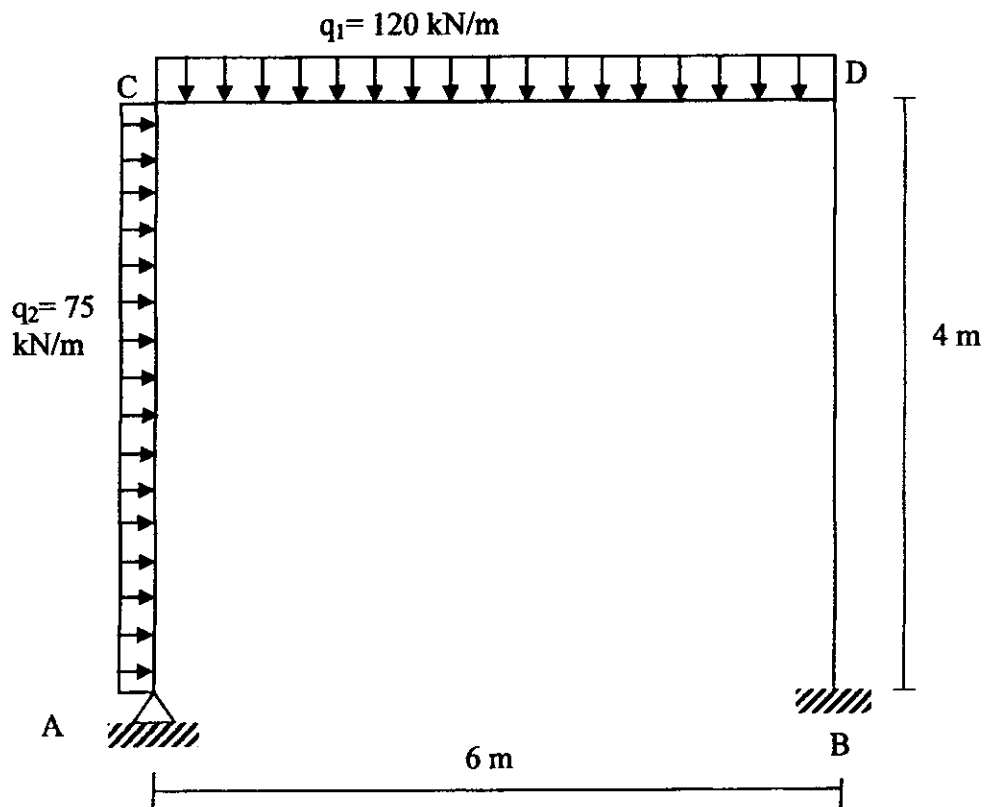
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**FIGURE O5 (a)**

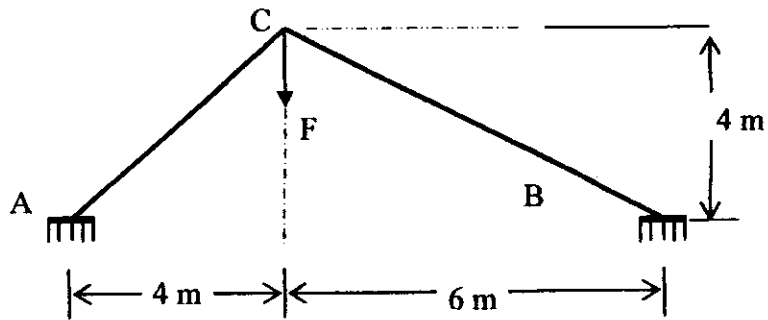


**FIGURE O5 (b)**

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**FIGURE 06**

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TABLE O6

$p$	$s$	$c$
-1	5.175	0.338
-0.8	4.959	0.361
-0.6	4.735	0.387
-0.4	4.501	0.418
-0.2	4.257	0.455
0	4	0.5
0.04	3.947	0.51
0.08	3.894	0.521
0.12	3.84	0.532
0.16	3.785	0.543
0.2	3.73	0.555
0.24	3.674	0.568
0.28	3.617	0.581
0.32	3.65	0.595
0.36	3.502	0.609
0.4	3.444	0.624
0.44	3.385	0.64
0.48	3.325	0.657
0.52	3.264	0.675
0.56	3.203	0.694
0.6	3.14	0.714
0.64	3.077	0.735
0.68	3.013	0.757
0.72	2.948	0.781
0.76	2.883	0.806
0.8	2.816	0.833
0.84	2.748	0.862

$p$	$s$	$c$
0.88	2.68	0.893
0.92	2.61	0.926
0.96	2.539	0.962
1	2.467	1
1.04	2.394	1.042
1.08	2.32	1.087
1.12	2.245	1.136
1.16	2.168	1.19
1.2	2.09	1.249
1.24	2.011	1.314
1.28	1.93	1.386
1.32	1.848	1.465
1.36	1.764	1.555
1.4	1.678	1.656
1.44	1.591	1.77
1.48	1.502	1.9
1.52	1.411	2.051
1.56	1.319	2.227
1.6	1.224	2.435
1.64	1.127	2.684
1.68	1.028	2.988
1.72	0.927	3.367
1.76	0.823	3.852
1.8	0.717	4.497
1.84	0.608	5.393
1.88	0.496	6.722
1.92	0.382	8.899

$p$	$s$	$c$
1.96	0.264	13.109
2	0.143	24.684
2.04	0.018	197.386
2.08	-0.11	-33.292
2.12	-0.242	-15.436
2.16	-0.379	-10.085
2.2	-0.519	-7.511
2.24	-0.665	-5.998
2.28	-0.815	-5.003
2.32	-0.971	-4.299
2.36	-1.133	-3.775
2.4	-1.301	-3.37
2.44	-1.475	-3.048
2.48	-1.656	-2.787
2.52	-1.845	-2.57
2.56	-2.043	-2.387
2.6	-2.249	-2.231
2.64	-2.465	-2.097
2.68	-2.692	-1.981
2.72	-2.93	-1.878
2.76	-3.18	-1.788
2.8	-3.445	-1.708
2.84	-3.725	-1.637
2.88	-4.021	-1.573
2.92	-4.337	-1.515
2.96	-4.673	-1.463
3	-5.032	-1.416