Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	STRUCTURAL ANALYSIS
COURSE CODE	:	BFC 21403/BFC 3023
PROGRAMME	:	2 BFF
EXAMINATION DATE	:	DECEMBER 2013/JANUARY 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 Figure **Q1** shows the plane truss structure, which the supports are pin and roller at point A and B, respectively. The Young's Modulus and cross section of the diagonal members are 210 GPA and 1.6×10^{-3} m^2 and for horizontal and vertical members are 200 GPA and 1.8×10^{-3} m^2, respectively. By using the Virtual Work Method,

(a) Determine determinacy and stability of structure.

(1 mark)

(b) Determine the internal forces of all members due to external load.

(8 marks)

(c) Determine the internal forces of all members due to internal load.

(8 marks)

(d) Calculate the horizontal displacement at joint D.

(8 marks)

Q2 Figure **Q2** shows the structure has a pin support at point A and a roller support at point B. The Young's Modulus of all members are 210 kN/mm^2 and the cross section of all members are 500 mm^2. By using the Virtual Work Method,

(a) Specify the determinacy and stability of the structure

(1 mark)

(b) Calculate the internal forces for all members due to external load, if the excess member of AB is ignored.

(8 marks)

(c) Calculate internal forces due to 1 unit load as substitution of member AB.

(8 marks)

(d) Determine the internal forces for all members.

(8 marks)

Q3 Figure **Q3** shows the structure ABCDE. The length of AB = AC = AD = AE= 6 m, where the end of B, C, D and E are fixed. If the 3 kN point load is applied at the centre of AB, using the Moment Distribution Method, determine

(a) stiffness of each member

(4 marks)

(b) distribution factor of each member

(4 marks)

(c) fixed end moment of each member

(4 marks)

(d) moment distribution of each member

(7 marks)

(e) support reaction of B, C, D and E

(6 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 reaction at B 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 bridge truss due to 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)

- END OF QUESTION –

FINAL EXAMINATION

SEMESTER/SESSION : SEM I/2013/2014 PROGRAMME : 2 BFF
COURSE NAME : STRUCTURAL ANALYSIS COURSE CODE: BFC21403/BFC3023

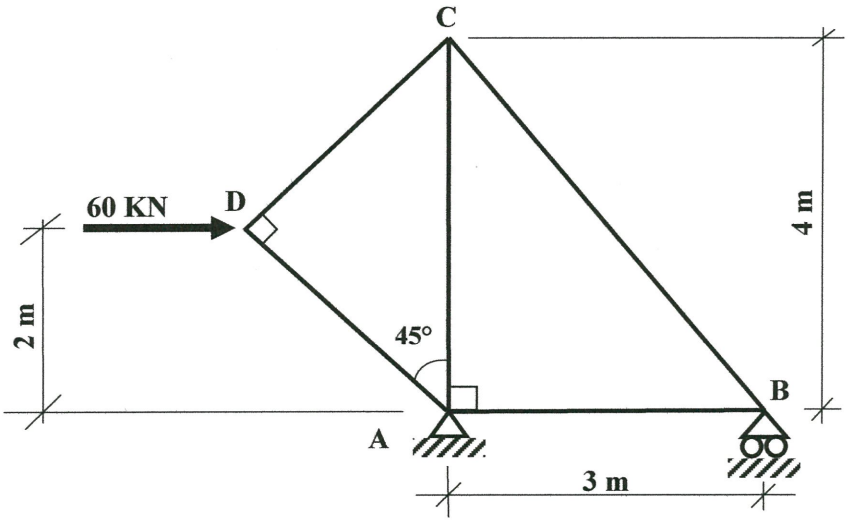


FIGURE Q1

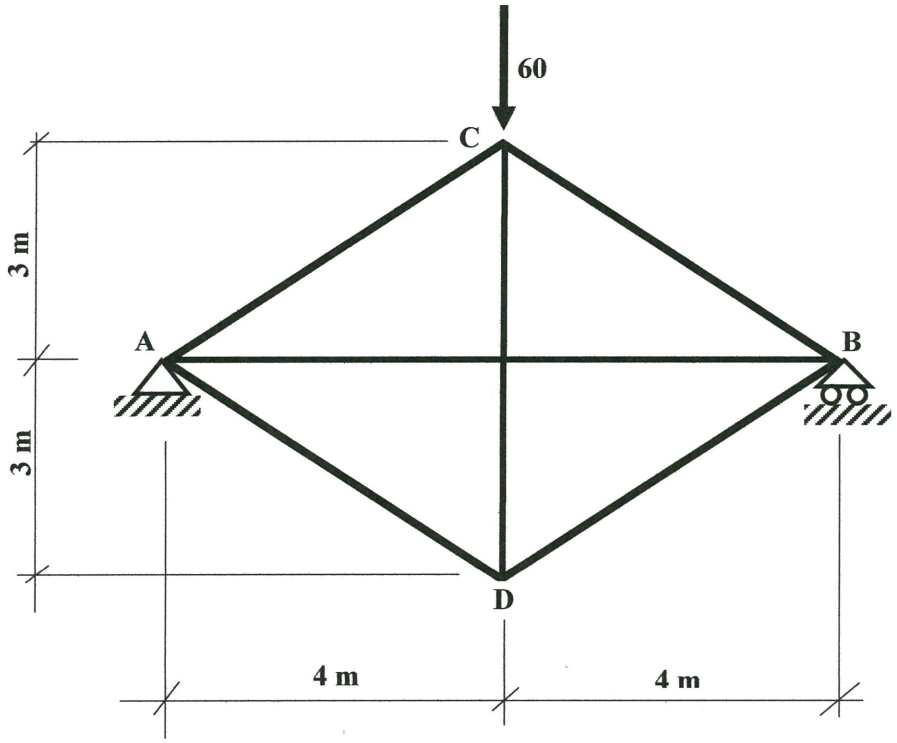


FIGURE Q2

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/2013/2014 PROGRAMME : 2 BFF
COURSE NAME : STRUCTURAL ANALYSIS COURSE CODE: BFC21403/BFC3023

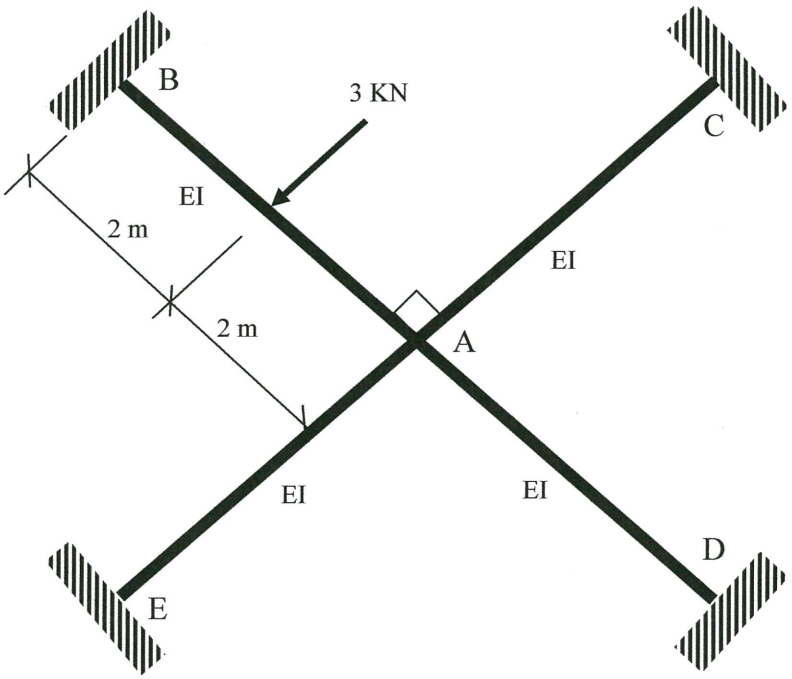
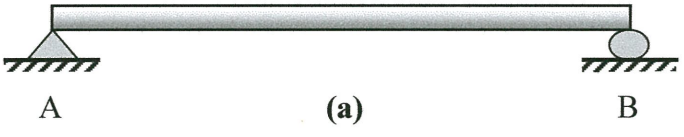


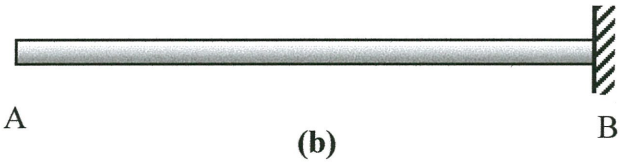
FIGURE Q3

FINAL EXAMINATION

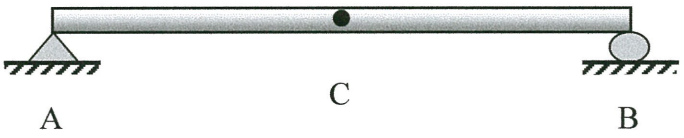
SEMESTER/SESSION: SEM I/2013/2014 PROGRAMME : 2 BFF
COURSE NAME : STRUCTURAL ANALYSIS COURSE CODE: BFC21403/BFC3023



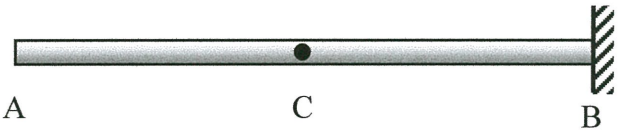
(a)



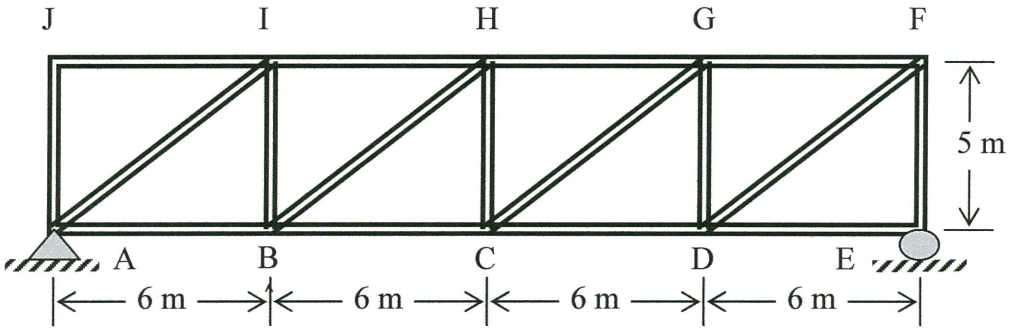
(b)



(c)



(d)

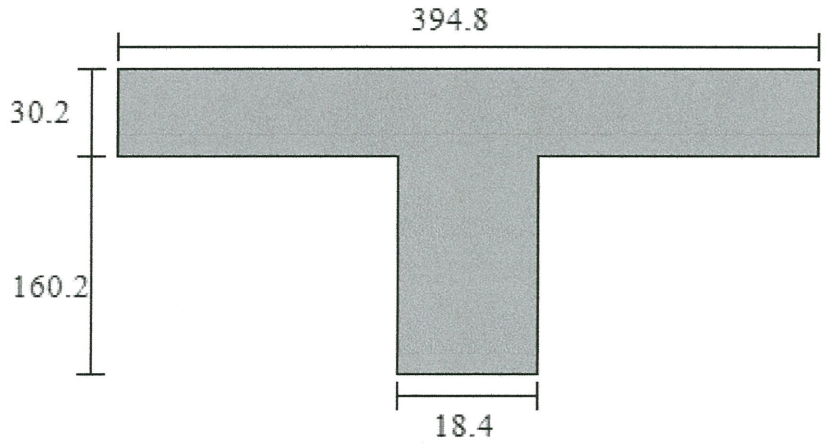


(e)

FIGURE Q4

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/2013/2014 PROGRAMME : 2 BFF
COURSE NAME : STRUCTURAL ANALYSIS COURSE CODE: BFC21403/BFC3023



All units in mm

FIGURE Q5(a)

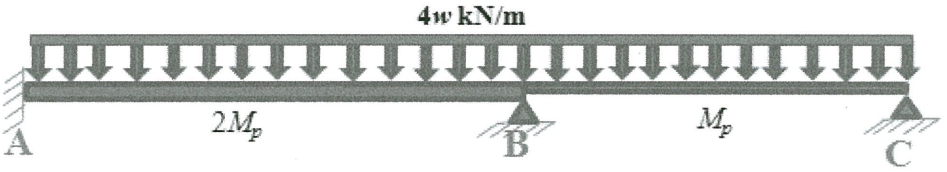


FIGURE Q5(b)

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/2013/2014 PROGRAMME : 2 BFF
COURSE NAME : STRUCTURAL ANALYSIS COURSE CODE: BFC21403/BFC3023

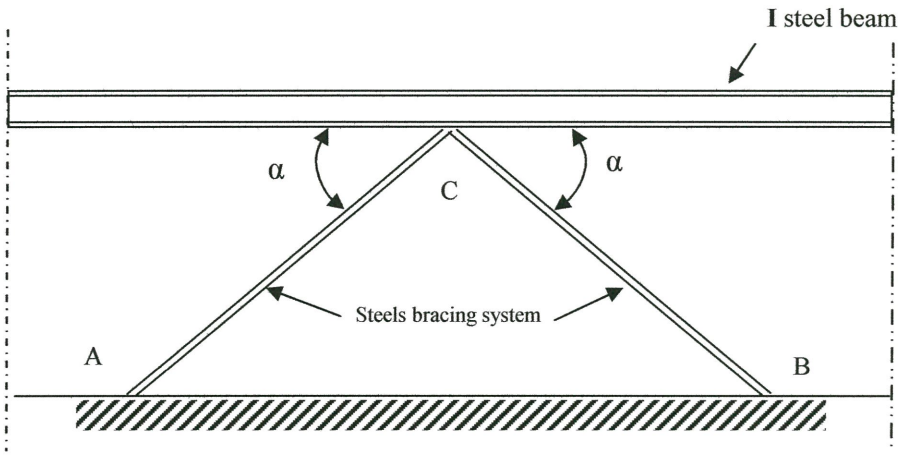


FIGURE Q6

FINAL EXAMINATION

SEMESTER/SESSION: SEM I/2013/2014 PROGRAMME : 2 BFF
COURSE NAME : STRUCTURAL ANALYSIS COURSE CODE: BFC21403/BFC3023

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

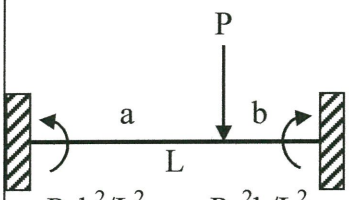
ρ	s
1.00	2.467
1.04	2.394
1.08	2.320
1.12	2.245
1.16	2.168
1.20	2.090
1.24	2.011
1.28	1.930
1.32	1.848
1.36	1.764
1.40	1.678
1.44	1.591
1.48	1.502
1.52	1.411
1.56	1.319
1.60	1.224
1.64	1.127
1.68	1.028
1.72	0.927
1.76	0.823
1.80	0.717
1.84	0.608
1.88	0.496
1.92	0.382
1.96	0.264

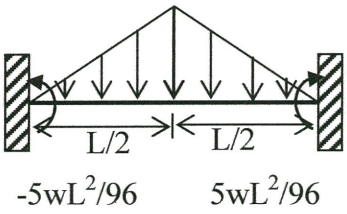
ρ	s
2.00	0.143
2.04	0.018
2.08	-0.110
2.12	-0.242
2.16	-0.379
2.20	-0.519
2.24	-0.665
2.28	-0.815
2.32	-0.971
2.36	-1.133
2.40	-1.301
2.44	-1.475
2.48	-1.656
2.52	-1.845
2.56	-2.043
2.60	-2.249
2.64	-2.465
2.68	-2.692
2.72	-2.930
2.76	-3.180
2.80	-3.445
2.84	-3.725
2.88	-4.021
2.92	-4.337
2.96	-4.673
3.00	-5.032

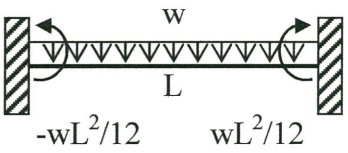
FINAL EXAMINATION

SEMESTER/SESSION: SEM I/2013/2014 PROGRAMME : 2 BFF
COURSE NAME : STRUCTURAL ANALYSIS COURSE CODE: BFC21403/BFC3023

Fixed End Moment (FEM):







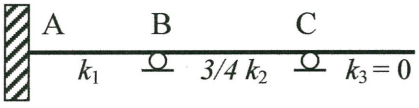
Unit Load Method:

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

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

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

Distribution Factor, DF:



$k_1 = k_2 = 4EI/L$

B

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