UNIVERSITI SAINS MALAYSIA

First Semester Examination
2013/2014 Academic Session

December 2013 / January 2014

REG 266 – Structural Design
[Rekabentuk Struktur]

Duration : 3 hours
(*Masa: 3 jam)*

Please check that this examination paper consists of SEVEN pages of printed material before you begin the examination.

Sila pastikan bahawa kertas peperiksaan ini mengandungi TUJUH muka surat yang tercetak sebelum anda memulakan peperiksaan ini.

Students are allowed to answer all questions in English OR in Bahasa Malaysia.

Jawab semua soalan sahaja dalam Bahasa Inggeris ATAU Bahasa Malaysia.

Answer **FIVE** questions only.

*Jawab **LIMA** soalan only.*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai].

1. (a) What is the difference between Statically Indeterminate beams and statically determinate beams. Please include sketch if any.

Apakah perbezaan di antara rasuk tak boleh tentu statik dan rasuk boleh tentu statik. Sila masukkan lakaran jika ada.

(6 marks/markah)

(b) With the aid of a diagram/s, describe the following terms:

(i) Methods of Consistent Deformations

(ii) Elastic material

Dengan bantuan gambarajah terangkan terma-terma berikut:

(i) Kaedah Kecacatan Kekal

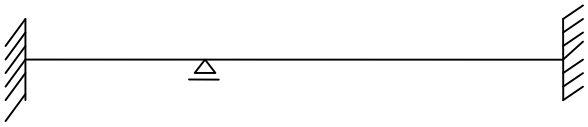
(ii) Bahan elastik

(8 marks/*markah*)

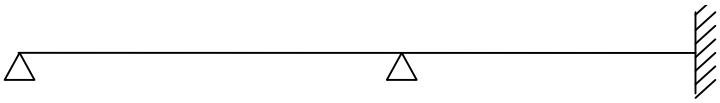
(c) Compute the determinacy of the following structures.

Kira darjah ketentuan untuk struktur-struktur berikut.

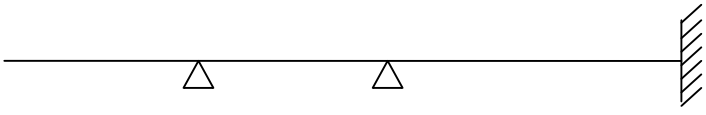
(i)



(ii)



(iii)



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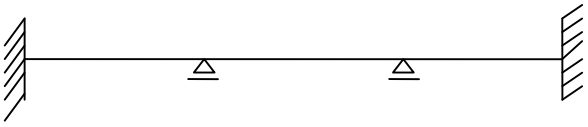
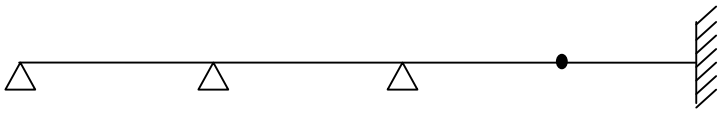
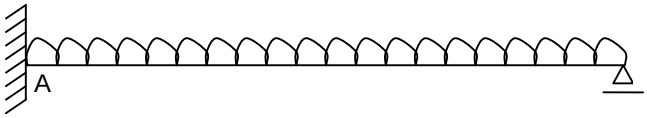


(v)



(vi)



(6 marks/*markah*)

2. (a) What are the boundary conditions at point A, B and C of the beam shown in **Figure 1**.

Apakah syarat-syarat sempadan di titik A, B dan C untuk rasuk seperti ditunjukkan dalam ***Rajah 1.***

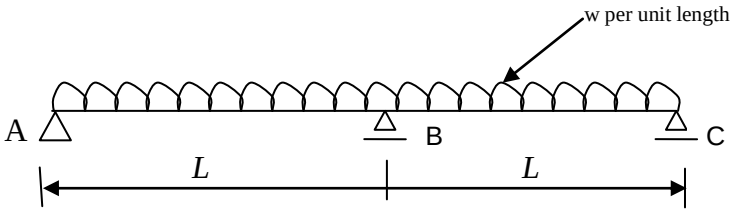


Figure 1/*Rajah 1*

(6 marks/*markah)*

(b) Determine the reactions of the beam shown in **Figure 1,** which is statically indeterminate to the first degree (n=1). Then draw the moment and shear diagram of the beam

*Tentukan tindakbalas untuk rasuk seperti ditunjukkan dalam **Rajah 1** yang mana adalah rasuk tak boleh tentu statik dengan satu darjah (n=1). Kemudian sertakan rajah momen lentur dan ricih rasuk.*

(14 marks/*markah*)

3. (a) In the elastic beam theory, what are the assumptions considered to calculate the deflection using the linear differential equation.

Dalam teori elastik rasuk, apakah andaian yang diambil untuk mengira pesongan menggunakan persamaan pembezaan linear.

(8 marks/*markah)*

(b) **Figure 2** shows a simply supported beam with a uniformly distributed load. Using method of integration, show that the deflection at the mid-span beam is given as

$$y = -\frac{5wL^4}{384EI}$$

***Rajah 2** menunjukkan satu rasuk disokong mudah dengan beban teragih seragam. Menggunakan kaedah integrasi, buktikan bahawa pesongan pada rasuk rentang diberikan sebagai*

$$y = -\frac{5wL^4}{384EI}$$

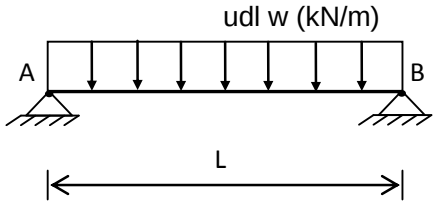


Figure 2/*Rajah 2*

(12 marks/*markah)*

4. (a) **Figure 3** shows a non-sway frame, loaded with a concentrated force of 25kN at beam span BC. The frame members have constant modulus of elasticity in all members. Using moment-distribution method;

Rajah 3 *menunjukkan satu kerangka tidak huyung dengan beban tumpu 25kN pada rasuk rentang BC. Kerangka mempunyai modulus keanjalan yang sama untuk semua rentang. Dengan menggunakan kaedah agihan momen;*

(i) Calculate the stiffness factor, distribution factors and fixed-end moments of the frame members.

Kirakan faktor kekukuhan, faktor agihan dan momen hujung terikat rasuk.

(6 marks/*markah)*

(ii) Calculate the bending moments at each joint and support.

Kira momen lentur pada setiap sendi dan penyokong.

(8 marks/*markah*)

(iii) Sketch the bending moment diagram, marking all important values.

Lakarkan gambar rajah momen lentur, dengan menandakan semua nilai penting.

(6 marks/*markah*)

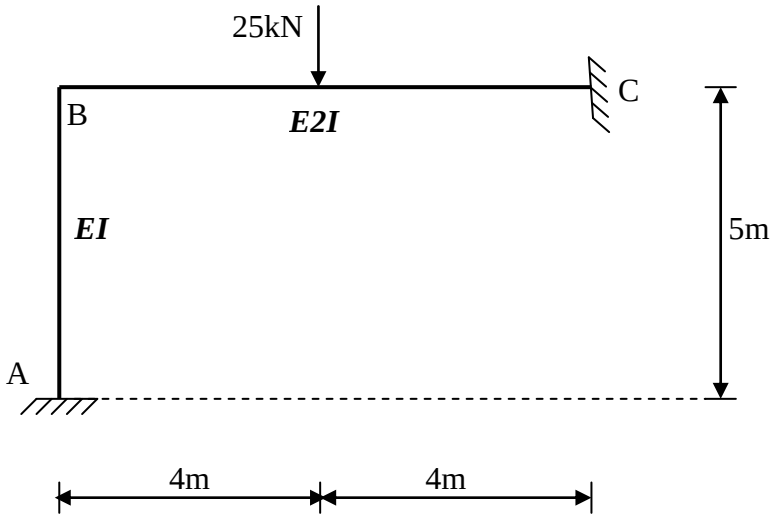


Figure 3/*Rajah 3*

5. (a) Give a brief description on degrees of freedom of a structure.

Terangkan tahap kebebasan struktur secara ringkas.

(5 marks/*markah*)

(b) Calculate the support reactions and the force in each member of the truss shown in **Figure 4** by the Matrix Stiffness Method of analysis. Given that:

Elastic modulus of all the structural members, E=200 GPa
Cross sectional area of all the structural members, A=0.005806 m^2

*Kirakan daya tindakbalas pada titik-titik sokongan dan daya dalaman setiap komponen kekuda yang tertunjuk dalam **Rajah 4** dengan kaedah analisis Matriks Kekukuhan. Diberi:*

Modulus elastik semua komponen struktur, E=200 GPa
Luas keratan rentas komponen struktur, A=0.005806 m^2

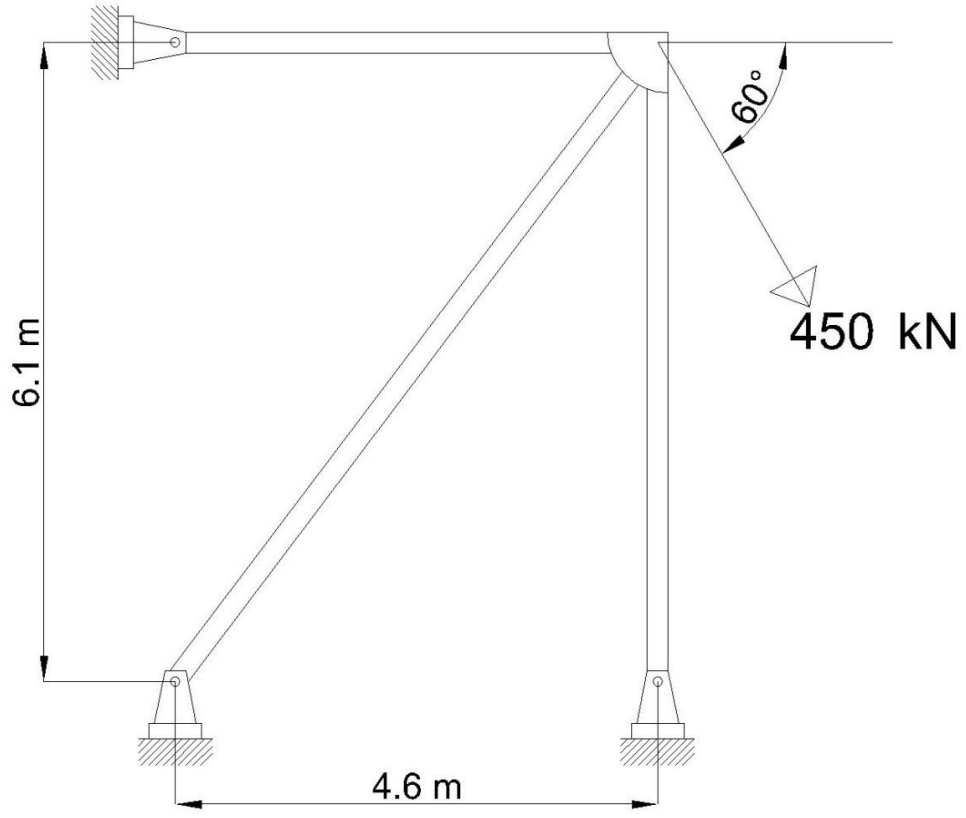


Figure 4/*Rajah 4*

(15 marks/*markah*)

6. Calculate the support reactions for the continuous beam shown in **Figure 5** using the Matrix Stiffness Method of analysis. Given that EI=constant throughout the beam.

*Kirakan daya tindakbalas bagi rasuk yang ditunjukkan dalam **Rajah 5** dengan kaedah analisis Matriks Kekukuhan. Diberi bahawa EI=pemalar bagi seluruh rasuk tersebut.*

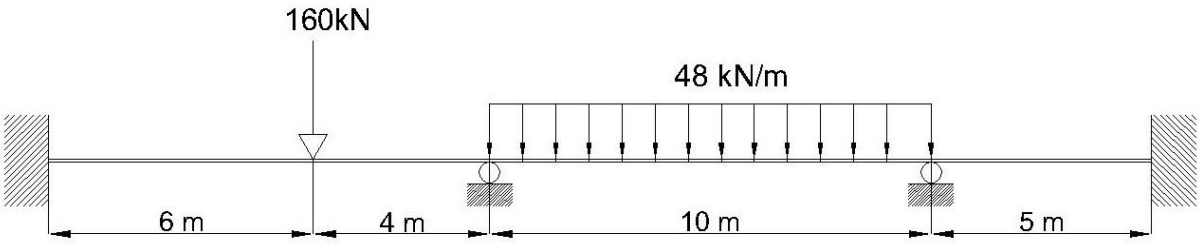
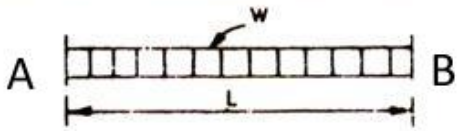
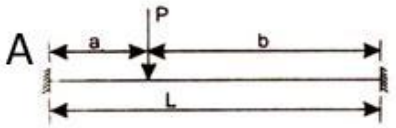
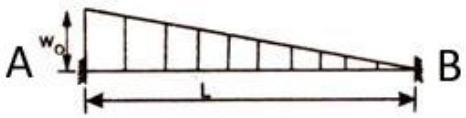
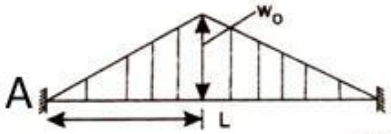
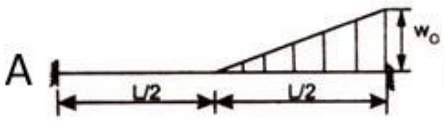
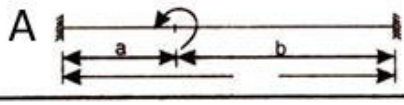


Figure 5 /*Rajah 5*

Table 1 : Fixed End Moment Equations

Jadual 1 : Persamaan Momen Hujung Terikat

Type of loading	Fixed End Moments	
	FEM_{AB}	FEM_{BA}
	$+\frac{WL^2}{12}$	$-\frac{WL^2}{12}$
	$+\frac{Pab^2}{L^2}$	$-\frac{Pa^2b}{L^2}$
	$+\frac{W_oL^2}{20}$	$-\frac{W_oL^2}{30}$
	$+\frac{9}{56}W_oL^2$	$-\frac{9}{56}W_oL^2$
	$+\frac{7}{960}W_oL^2$	$-\frac{23}{960}W_oL^2$
	$+\frac{M}{L^2}b(b-2a)$	$+\frac{M}{L^2}a(2b-a)$

(20 marks/*markah)*