UNIVERSITI SAINS MALAYSIA

Supplementary Semester Examination
Academic Session 2009/2010

June 2010

IWK 302 – WOOD ENGINEERING
[KEJURUTERAAN KAYU]

Duration: 3 hours
[Masa: 3 jam]

Please check that the examination paper consists of **FIFTEEN (15)** pages of printed material before you begin this examination.

Answer **FIVE** questions. All questions can be answered in Bahasa Malaysia OR English.

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

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **LIMABELAS (15)** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.*

*Jawab **LIMA** soalan. Semua soalan boleh dijawab dalam Bahasa Malaysia ATAU Bahasa Inggeris.*

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

1. Based on Irwin-kies Relationship and Figure 1, indicate that strain energy release rate (G) is

$G = P_c^2/2B(dC/da)$,

where
P_c = Crack load
B = Thickness
C = Compliance
a = Crack length

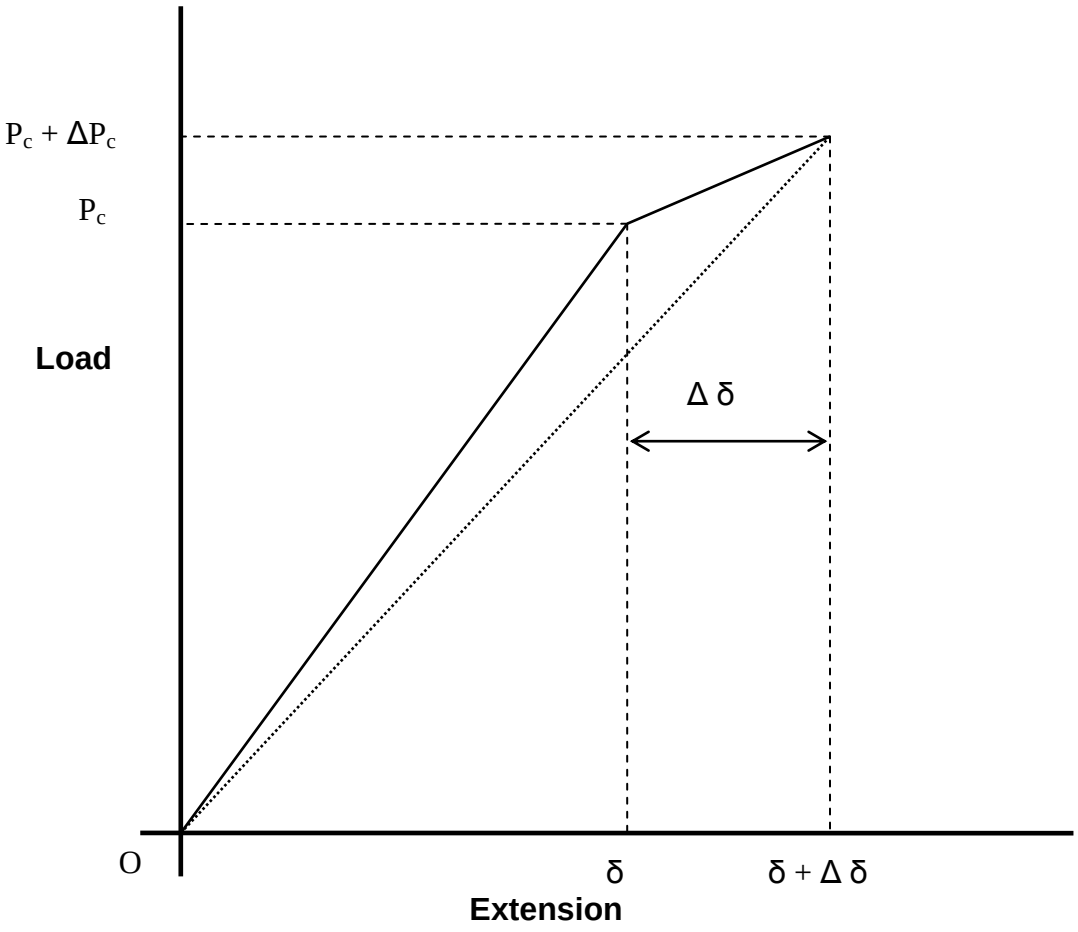


Figure 1

(20 marks)

…3/-

2. (a) For Figure 2, determine the following using integration method.

   (i) the area, A

   (ii) the centroid

   (iii) the moment of inertia, I_x

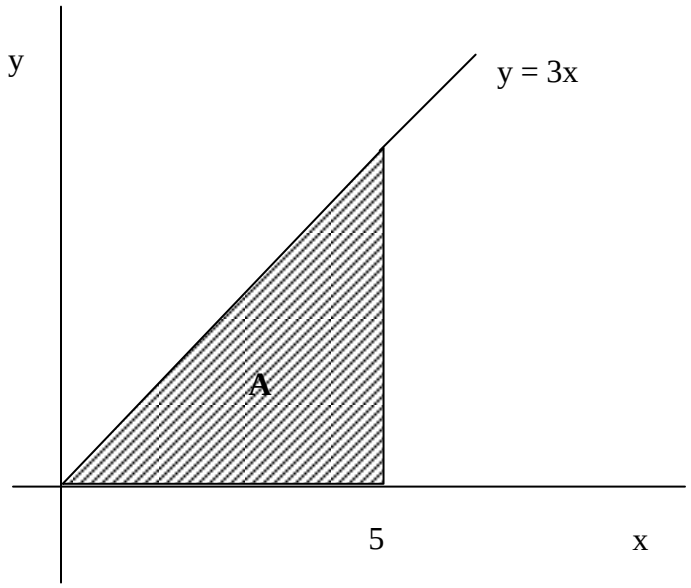


Figure 2

(10 marks)

(b) For the composite area shown in Figure 3, determine

(i) the coordinate of the centroid

(ii) the moment of inertia with respect to the x-axis, I_x.

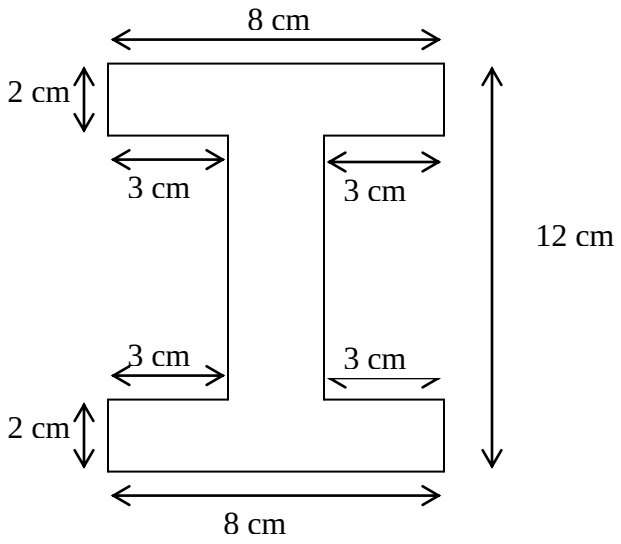


Figure 3

(10 marks)

3. A beam is loaded by a force as shown in Figure 4, the specifications of the beam are as follow;

F_{bo} = 8500 kN/m^2	(allowable bending stress)
F_{vo} = 750 kN/m^2	(allowable shear stress)
b = 20 m	(width of beam)
d = 1 m	(thickness of beam)

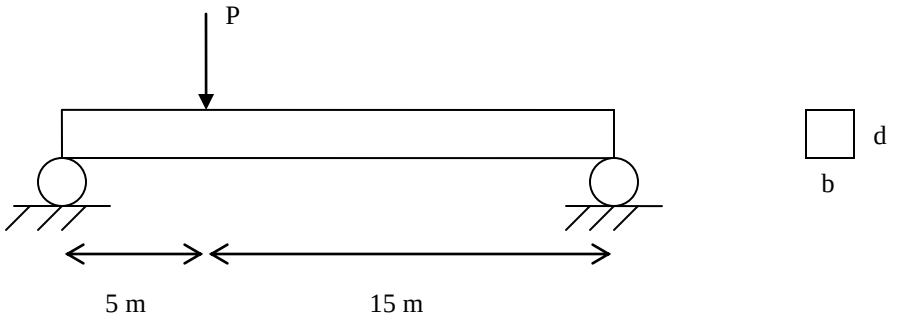


Figure 4

Determine the allowable force (P)

(20 marks)

4. A cantilever beam is loaded as shown in Figure 5. Indicate that the maximum deflection is $WL^4/8EI$, where;

W = load/ per unit length
L = length of the beam
E = modulus of elasticity
I = moment of inertia computed about the neutral axis

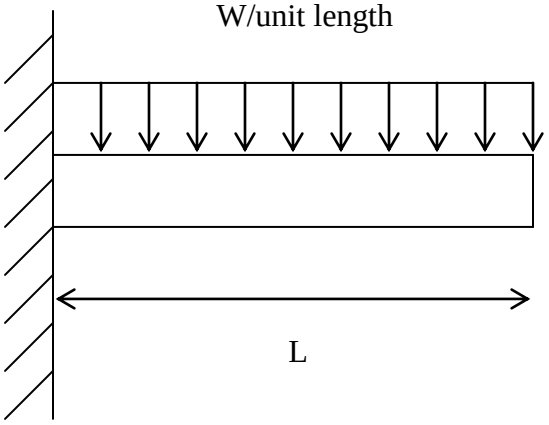


Figure 5

(20 marks

5. A roof made of solid wood has the following specifications;

C_d = 1.25 (load duration factor)
L = 18ft (length of the beam)
S = 2ft (space between beams)
dl = 20Ibf/ft^2 (dead load)
ll = 10 Ibf/ft^2 (live load)
F_{bo} = 1600 Ibf/in^2 (allowable bending stress)
F_{vo} = 750 Ibf/in^2 (allowable shear stress)
E = 1700000 Ibf/in^2 (modulus of elasticity)
P_o = L/180 (allowable deflection)

Test the suitability of a section with size 1.5 in x 9.25 in.

(20 marks)

6. A two dimensional structure in Figure 6 has dimensions in arbitrary units. Using Finite Element Method, determine

   (a) the displacement of each node
   (b) the reaction force at node 1 and 2
   (c) the axial force in each element

Element	E	A
13	1	1
23	1	1

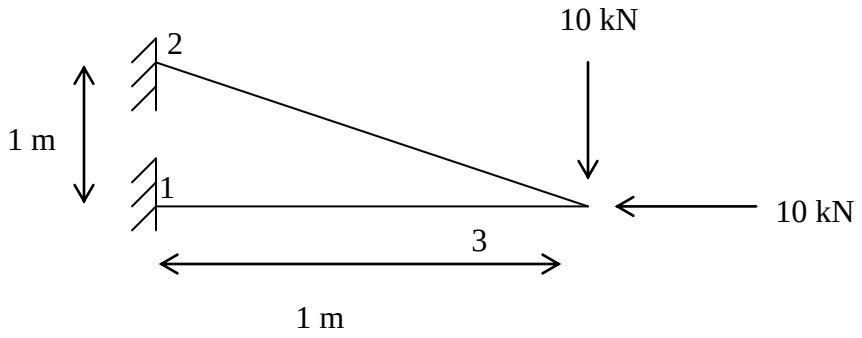


Figure 6

(20 marks)

1. *Berdasarkan hubungan Irwin-kies dan Rajah 1, tunjukkan bahawa kadar pembebasan tenaga terikan (G) adalah diberikan oleh*

$$G = P_c^2/2B(dC/da),$$

dengan
P_c = *Beban rekahan*
B = *Ketebalan*
C = *Komplians*
a = *Panjang retak*

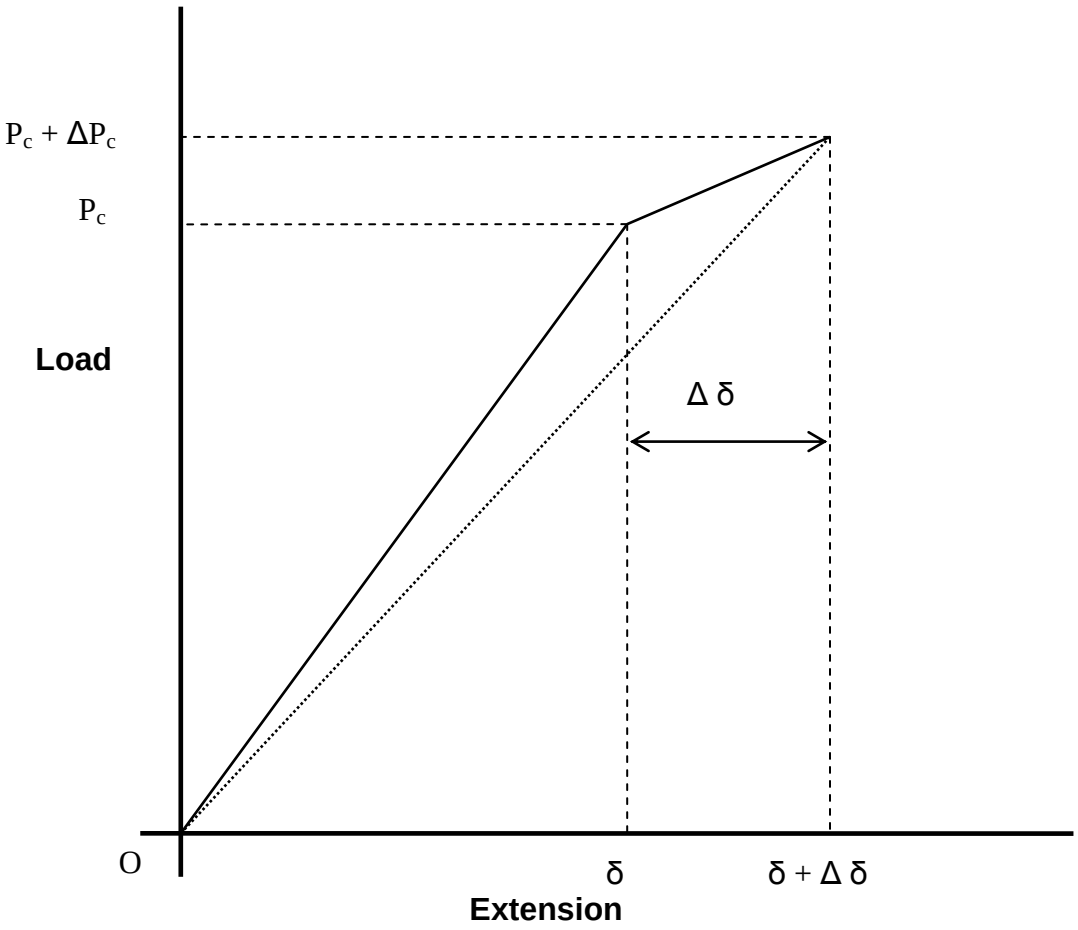


Figure 1

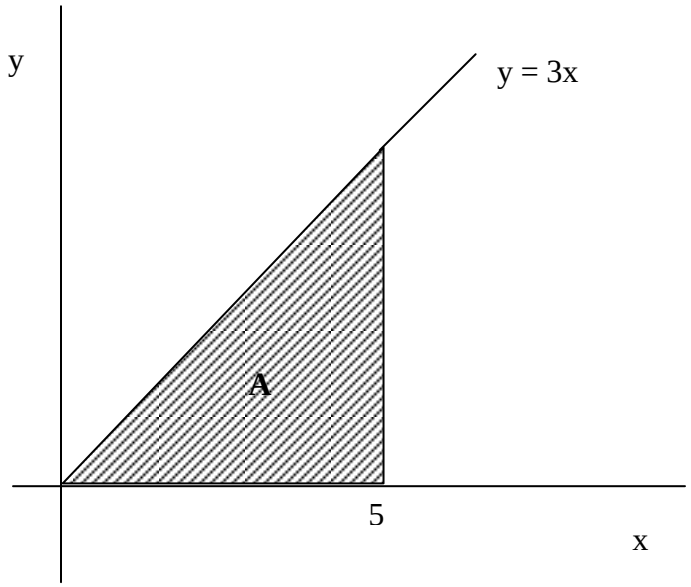
(20 markah)

2. (a) Untuk kawasan yang terlorek dalam Rajah 2, tentukan yang berikut dengan menggunakan kaedah pengamiran.

(i) Keluasan kawasan terlorek, A

(ii) Pusat bentuk

(iii) Momen inersia terhadap paksi x, I_x



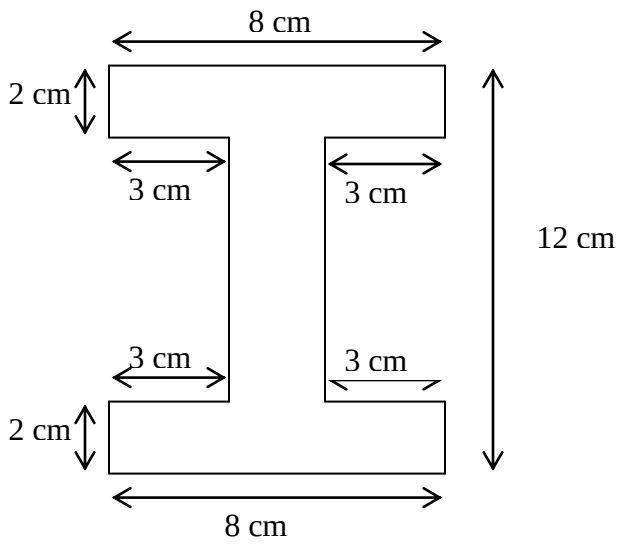
Rajah 2

(10 markah)

(b) Untuk rajah komposit yang ditunjukkan dalam Rajah 3, tentukan

(i) Kordinat pusat bentuk

(ii) Momen inersia terhadap paksi x, I_x.

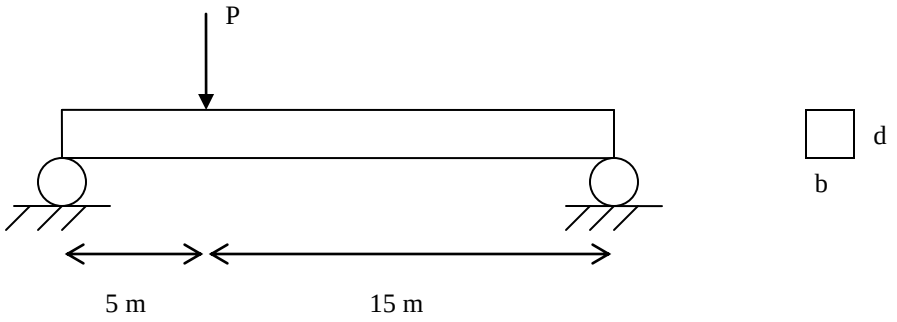


Rajah 3

(10 markah)

3. *Suatu bim dibebankan dengan suatu daya seperti yang ditunjukkan dalam Rajah 4 dan spesifikasi bim dalam seperti berikut*

$F_{bo} = 8500\ kN/m^2$	*(tegasan lenturan izin)*
$F_{vo} = 750\ kN/m^2$	*(tegasan ricih izin)*
$b = 20\ m$	*(lebar bim)*
$d = 1\ m$	*(ketebalan bim)*



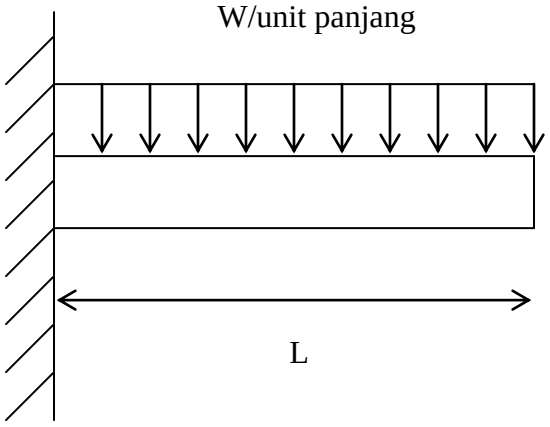
Rajah 4

Tentukan daya (P) yang dibenarkan

(20 markah)

4. *Suatu bim kantilever dibebankan seperti yang ditunjukkan dalam Rajah 5. Tunjukkan pesongan maksimum bim tersebut adalah bersamaan dengan $WL^4/8EI$, dengan;*

W = Beban/ unit panjang
L = Panjang bim
E = Modulus kekenyalan
I = Moment inersia terhadap paksi neutral



Rajah 5

(20 markah)

5. *Suatu bim bumbung lurus yang diperbuat daripada kayu pejal mempunyai spesifikasi berikut;*

C_d = *1.25 (factor tempoh masa pengenaan beban)*
L = *18ft (panjang bim)*
S = *2ft (jarak antara bim)*
dl = *20Ibf/ft^2 (beban mati)*
ll = *10 Ibf/ft^2 (beban hidup)*
F_{bo} = *1600 Ibf/in^2 (tegasan lenturan izin)*
F_{vo} = *750 Ibf/in^2 (tegasan ricih izin)*
E = *1700000 Ibf/in^2 (modulus kekenyalan)*
P_o = *L/180 (pesongan izin)*

Uji kesesuaian keratan yang bersaiz 1.5 in x 9.25 in

(20 markah)

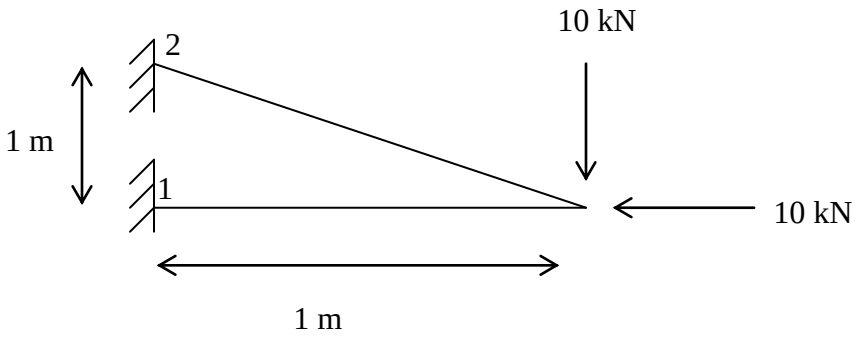
6. *Suatu struktur dua dimensi dalam Rajah 6 dengan ukurannya diberikan dalam unit sebarangan. Dengan menggunakan Kaedah Elemen Terhingga, tentukan*

   (i) Sesaran setiap nod

   (ii) Daya tindak balas pada nod 1 dan 2

   (iii) Daya paksian setiap elemen

Elemen	*E*	*A*
13	*1*	*1*
23	*1*	*1*



Rajah 6

(20 markah)

List of formulations

Z = $bd^2/6$ (section modulus)
I = $bd^3/12$ (moment of inertia)
L_e = $L - 2d$ (effective length)
V = $wL_e/2$ (maximum shear force)
M = $wL^2/8$ (maximum bending moment)
F_b = M/Z (actual bending stress)
F_v = $3V/2A$ (actual shear stress)
P = $5wL^4/384EI$ (actual deflection)
C_f = $(12/d)^{1/9}$ (size factor)
C_c = $1 - 2000\ (t/R)^2$ (curve factor)
F_r = $3M/2R_mA$ (actual radius stress)

Senarai formula

Z = $bd^2/6$ (modulus keratan)
I = $bd^3/12$ (momen inertia)
L_e = $L - 2d$ (panjang berkesan)
V = $wL_e/2$ (tegasan ricih maksimum)
M = $wL^2/8$ (momen lenturan maksimum)
F_b = M/Z (tegasan lenturan sebenar)
F_v = $3V/2A$ (tegasan ricih sebenar)
P = $5wL^4/384EI$ (pesongan sebenar)
C_f = $(12/d)^{1/9}$ (faktor saiz)
C_c = $1 - 2000\ (t/R)^2$ (faktor lengkukan)
F_r = $3M/2R_mA$ (tegasan jejarian sebenar)

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