UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER I
SESI 2013/2014

NAMA KURSUS	:	MEKANIK BAHAN
KOD KURSUS	:	DAB 10503
PROGRAM	:	2 DAB
TARIKH PEPERIKSAAN	:	DISEMBER 2013/JANUARI 2014
MASA	:	3 JAM
ARAHAN	:	JAWAB **EMPAT (4)** DARIPADA **ENAM (6)** SOALAN

KERTAS PEPERIKSAAN INI MENGANDUNGI **TIGA BELAS (13)** MUKA SURAT

S1 (a) **Rajah S1(a)** menunjukkan sebatang besi berukuran 40m panjang dikenakan daya tegangan yang menghasilkan perubahan sebanyak 27.5mm. Kirakan terikan yang terhasil pada besi tersebut.

(5 markah)

(b) **Rajah S1(b)** menunjukkan keadaan tegasan satah untuk satu elemen. Bina bulatan Mohr untuk elemen tersebut dan tentukan yang berikut:

(i) Kedudukan satah utama.
(ii) Nilai tegasan normal yang utama.
(iii) Nilai tegasan ricih dalam kedudukan satah utama.

(20 markah)

S2 (a) Tentukan tindakbalas pada penyokong A dan C untuk rasuk dan beban yang ditunjukkan dalam **Rajah S2(a).**

(5 markah)

(b) Lukiskan Gambarajah Daya Ricih dan Gambarajah Momen Lentur bagi rasuk yang ditunjukkan dalam **Rajah S2(b).**

(20 markah)

S3 **Rajah S3** menunjukkan sebuah rasuk berbentuk *Tee (T)*, tentukan:

(i) Kedudukan titik sentroid
(ii) Momen sifatekun kedua

(25 markah)

S4 Tentukan cerun pada keratan 1m dari A dan pesongan pada keratan 3m dari A bagi rasuk dalam **Rajah S4** dengan kaedah MacCaulay.

(25 markah)

S5 Sebatang aci besi berlubang mempunyai diameter luar iaitu 200 mm dan diameter dalam iaitu 100 mm. Aci tersebut dikenakan putiran sebanyak 40 kNm. Modulus ketegasan besi tersebut ialah 70 GPa. Tentukan:

(i) momen sifatekun kutub (J)
(ii) tegasan ricih pada bahagian luar aci besi
(iii) tegasan ricih pada bahagian dalam aci besi
(iv) magnitud sudut piuhan pada 3.5 m panjang

(25 markah)

S6 **Rajah S6** menunjukkan sebuah tiang aluminium diikat tegar pada bawahnya dan diletakkan kabel pada bahagian atasnya untuk mengelakkan pergerakan di sepanjang paksi x. Jika diandaikan ianya diikat tegar pada bahagian asasnya,

(i) Tentukan samada formula Euler's adalah memuaskan dengan menggunakan keadaan $\sigma_{cr} \leq \sigma_y$.

(ii) Kirakan beban terbesar yang dibenarkan, P.

(gunakan faktor keselamatan = 3.0, diberi E_{al} = 70GPa, σ_y = 215 Mpa, A = 7.5 (10^{-3}) m^2, I_x = 613 (10^{-6}) m^4, I_y = 23.2 (10^{-6}) m^4)

(25 markah)

-SOALAN TAMAT-

QUESTIONS IN ENGLISH

Q1 (a) **Figure Q1(a)** shows A 40m length of steel wire is subjected to a tensile load that produces a change in length of 27.5 mm. Determine the axial strain in the wire.

(5 marks)

(b) For the state of plane stress shown in **Figure Q1(b),** construct Mohr circle and determine the following:

i) The principle planes
ii) The principle stresses
iii) The maximum shearing stress and the corresponding normal stress

(20 marks)

Q2 (a) Determine the reactions at support A and C for the beams and loading as shown in **Figure Q2(a).**

(5 marks)

(b) Draw the Shear Force Diagram and Bending Moment Diagram for the beam shown in **Figure Q2(b).**

(20 marks)

Q3 **Figure Q3** shows a Tee (T) shape of beam. Determine:

i) The location of the centroid point
ii) The second moment of inertia

(25 marks)

Q4 Determine the slope and deflection at 1m and 3m from A for beam in the **Figure Q4** by using MacCaulay method.

(25 marks)

Q5 A hollow steel shaft has an outside diameter of 200 mm and an inside diameter 100 mm. The shaft is subjected to a torque of 40 kNm. The modulus of rigidity for the steel is 70 GPa. Determine:

i) polar moment of inertia of the cross sectional area (J) of the shaft.
ii) the shearing stress at the outside surface of the shaft.
iii) the shearing stress at the inside surface of the shaft.
iv) the magnitude of the angle of twist in a 3.5 m length.

(25 marks)

Q6 **Figure Q6** shows an aluminium column is fixed at its bottom and is braced at its top by cables in order to prevent movement at the top along x axis. If it is assumed to be fixed at its base;

i) Check whether the Euler's formula is appropriate or not by using the condition $\sigma_{cr} \leq \sigma_y$.

ii) Determine the largest allowable load, P that can be applied.

(use a factor of safety for buckling = 3.0, given E_{al} = 70GPa, σ_y = 215 Mpa, $A = 7.5\ (10^{-3})\ m^2$, $I_x = 613\ (10^{-6})\ m^4$, $I_y = 23.2\ (10^{-6})\ m^4$)

(25 marks)

- END OF QUESTION –

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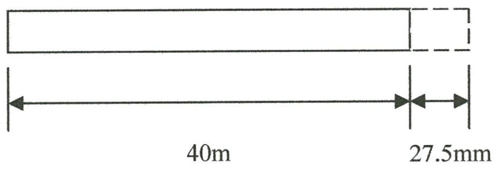
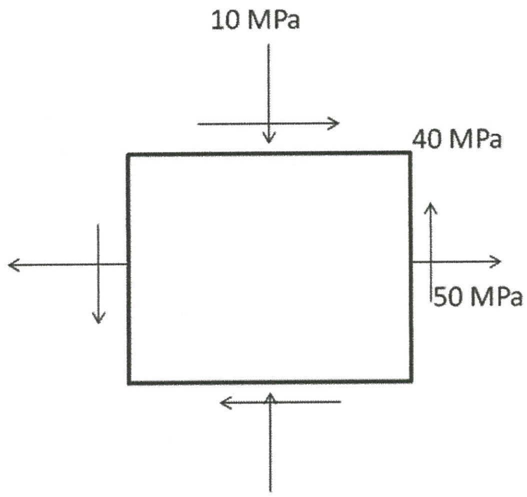


RAJAH S1(a) / FIGURE Q1(a)



RAJAH S1 (b) / FIGURE Q1 (b)

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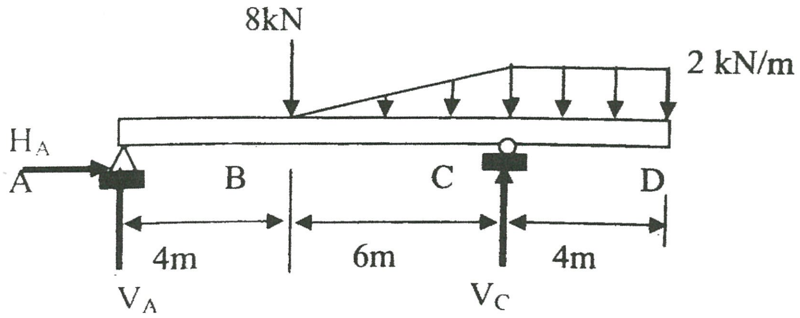
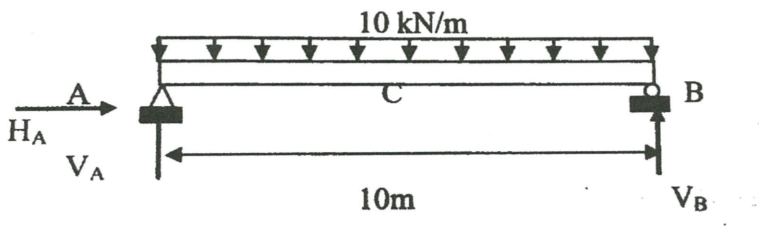


RAJAH S2 (a) / FIGURE Q2 (a)



RAJAH S2(b) / FIGURE Q2(b)

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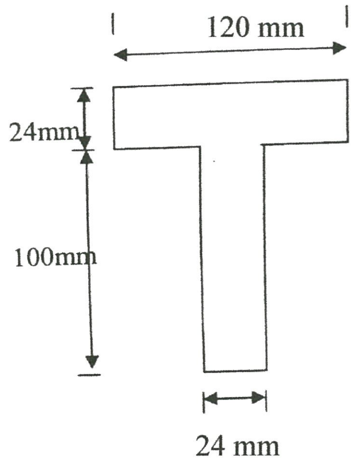
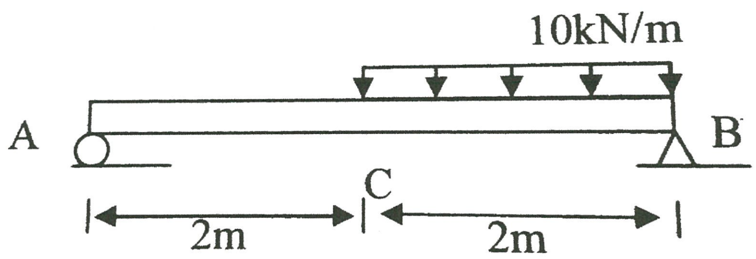


RAJAH S3 / FIGURE Q3



RAJAH S4 / FIGURE Q4

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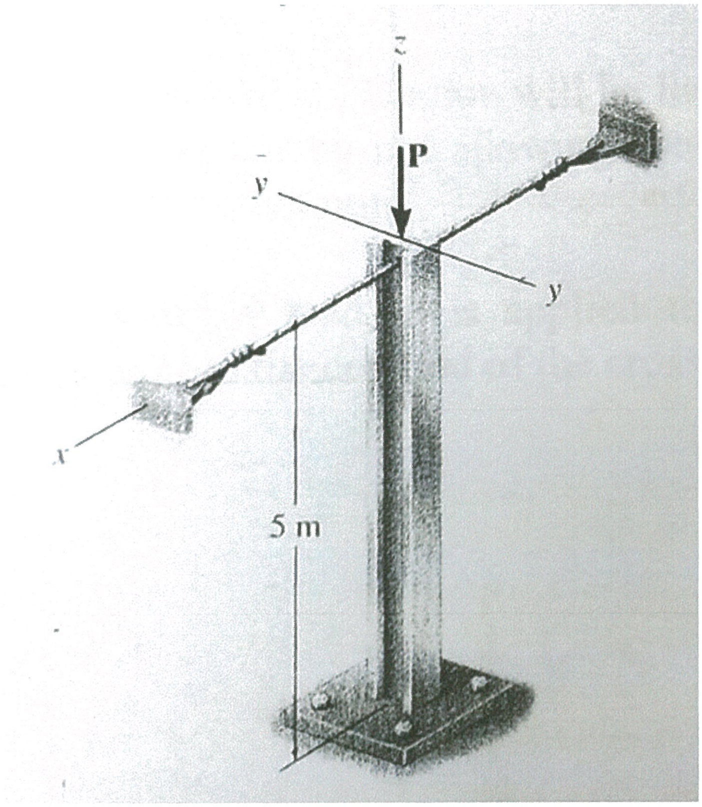

RAJAH S6 / FIGURE Q6

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FORMULA

$$\sigma_{max} = \sigma_1 = \left(\frac{\sigma_x + \sigma_y}{2}\right) + R \qquad \sigma_{min} = \sigma_2 = \left(\frac{\sigma_x + \sigma_y}{2}\right) - R$$

$$R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^{\ 2}} \qquad \theta_p = \frac{1}{2}\tan^{-1}\left(\frac{2\tau_{xy}}{\sigma_x - \sigma_y}\right)$$

$$\theta_s = \frac{1}{2}\tan^{-1}\left(-\frac{\sigma_x - \sigma_y}{2\tau_{xy}}\right) \qquad \sigma' = \frac{\sigma_x + \sigma_y}{2}$$

Second moment of inertia:

$$\Sigma I_{xx} = [I_x + Ad^2]_1 + [I_x + Ad^2]_2 + [I_x + Ad2]_3 + \ldots\ldots$$

$$\Sigma I_{yy} = [I_y + As^2]_1 + [I_y + As^2]_2 + [I_y + As^2]_3 + \ldots\ldots$$

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SEMESTER / SESI : SEM I / 2013/2014 PROGRAM : 2 DAB
KURSUS :MEKANIK BAHAN KOD KURSUS : DAB 10503

(1) $EI\dfrac{d^4y}{dx^4} = q(x)$ Force-deflection equation

(2) $EI\dfrac{d^3y}{dx^3} = V(x) = \int q(x)dx + C_1$ Shear-deflection equation

(3) $EI\dfrac{d^2y}{dx^2} = M(x) = \iint q(x)dx^2 + C_1x + C_2$ Bending moment-deflection equation

(4) Slope-deflection equation

$$EI\frac{dy}{dx} = EI\theta(x) = \int M(x)dx + C_3$$
$$= \iiint q(x)dx^3 + C_1x^2 + C_2x + C_3$$

(5) Deflection equation

$$EIy(x) = \int M(x)dx^2 + C_3x + C_4$$
$$= \iiint\int q(x)dx^4 + C_1x^3 + C_2x^2 + C_3x + C_4$$

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SEMESTER / SESI : SEM I / 2013/2014 PROGRAM : 2 DAB
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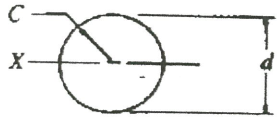
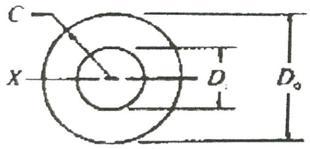
Area Shape	I	J
Solid circle 	$\frac{\pi d^4}{64}$	$\frac{\pi d^4}{32}$
Hollow circle 	$\frac{\pi(D_o^4 - D_i^4)}{64}$	$\frac{\pi(D_o^4 - D_i^4)}{32}$

$\tau = \frac{Tr}{J}$ $\phi = \frac{TL}{JG}$ $P = T\omega$ $P = 2\pi f T$

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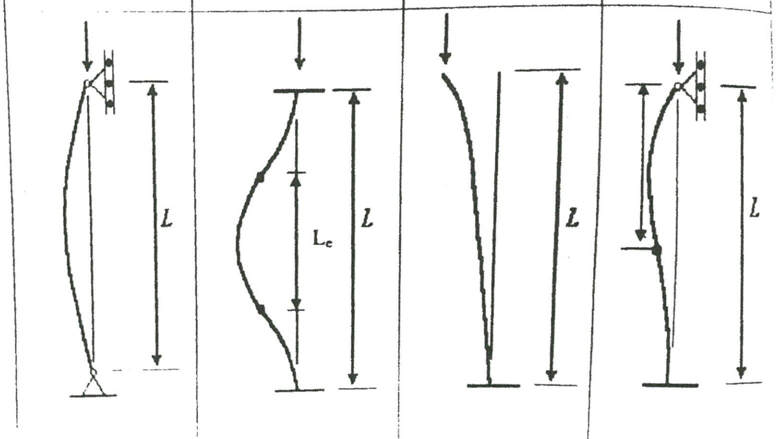

	Pinned-pinned	Fixed-fixed	Cantilever	Fixed-pinned
Basic Formula	$P_{cr} = \frac{\pi^2 EI}{L_e^2}$			
L_e	L	0.5L	2L	0.7L
P_{cr}	$P_{cr} = \frac{\pi^2 EI}{(L)^2}$	$P_{cr} = \frac{\pi^2 EI}{(0.5L)^2}$	$P_{cr} = \frac{\pi^2 EI}{(2L)^2}$	$P_{cr} = \frac{\pi^2 EI}{(0.7L)^2}$

$\sigma_{cr} = P_{cr}/A$

$P_{allow} = P_{cr} / F.O.S$