SULIT

POLITEKNIK MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI JUN 2015

DJJ3103 : STRENGTH OF MATERIALS

TARIKH : 29 OKTOBER 2015
MASA : 2.30 PM – 4.30 PM (2 JAM)

Kertas ini mengandungi **SEPULUH (10)** halaman bercetak.
Soalan Struktur (4 soalan). Jawab **SEMUA** soalan.
Dokumen sokongan yang disertakan : Lampiran

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

INSTRUCTION:

This section consists of **FOUR (4)** questions. Answer **ALL** questions.

ARAHAN :
*Bahagian ini mengandungi **EMPAT (4)** soalan . Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1
C1

(a) Define the following in engineering terms;
Definasikan mengikut istilah kejuruteraan;

i. Young's Modulus
Modulus Young

[2 marks]
[2 markah]

ii. Lateral Strain
Keterikan Sisi

[2 marks]
[2 markah]

iii. Longitudinal Strain
Keterikan Membujur

[2 marks]
[2 markah]

CLO1
C2

(b) An aluminum tube of length L = 500 mm is loaded in tension by forces, P as shown in Figure 1 (b). The outside and inside diameters are 90 mm and 40 mm, respectively. A strain gage is placed on the outside of the bar to measure the normal strains in the longitudinal direction.
Sebatang tiub aluminium mempunyai panjang L = 500 mm dan dikenakan daya tegangan, P seperti yang ditunjukkan dalam Rajah 1 (b) di bawah. Ia mempunyai diameter luar adalah 90 mm dan diameter dalam adalah 40 mm. Sebuah tolok keterikan diletakkan pada luar tiub itu bagi mengukur keterikan normal pada arah membujur.

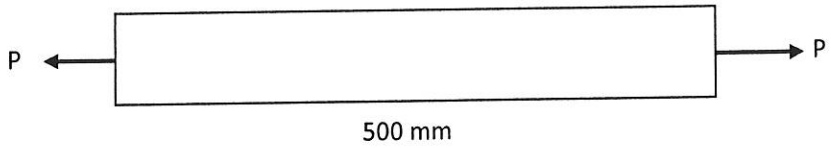


Figure 1 (b) / *Rajah 1 (b)*

i. If the measured strain, $\varepsilon = 650x10^{-6}$, calculate the elongation, ΔL of the tube.
Sekiranya pengukuran keterikan, $\varepsilon = 650x10^{-6}$, kirakan pemanjangan ΔL yang berlaku kepada tiub itu.

[2 marks]
[2 markah]

ii. If the stress in the bar is occurred to be 30MPa, calculate the load P is applied.
Sekiranya tegasan berlaku dalam bar ialah 30MPa, kirakan beban P yang dikenakan.

[4 marks]
[4 markah]

CLO1
C3

(c) A composite parallel bar is made from two bars, steel and copper with an initial temperature of 30 °C as shown in Figure 1 (c) . The steel cross-sectional area is 700 mm^2 and 1200 mm^2 for the copper. The bar is rigidly fixed at both ends. Calculate the stress in each bar when the temperature is risen to 80 °C

Given: $E_{Steel} = 206\ GN/m^2$; $\alpha_{Steel} = 12 \times 10^{-6}/^0C$
$E_{Copper} = 107\ GN/m^2$; $\sigma_{Copper} = 17.5 \times 10^{-6}/^0C$

Satu bar majmuk selari diperbuat daripada dua bar, keluli dan tembaga dengan suhu awal sebanyak 30 °C dan ditunjukkan seperti Rajah 1 (c). Luas keratan rentas keluli ialah 700 mm^2 and 1200 mm^2 bagi tembaga. Kedua-dua hujung bar ini dipasang tegar. Kirakan tegasan setiap bar ini jika suhu dinaikkan kepada 80 °C.

Given: $E_{Steel} = 206\ GN/m^2$; $\alpha_{Steel} = 12 \times 10^{-6}/^0C$
$E_{Copper} = 107\ GN/m^2$; $\sigma_{Copper} = 17.5 \times 10^{-6}/^0C$

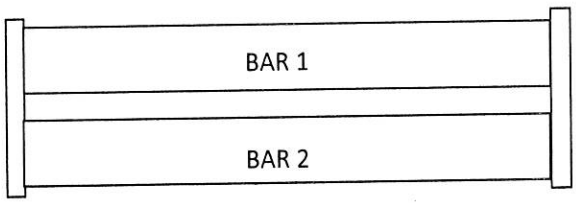


Figure 1 (c) / *Rajah (c)*

[13 marks]
[13 markah]

QUESTION 2

SOALAN 2

A 3 kN/m uniformly distributed load as in Figure 2 is placed on the simply supported beam from point A to point C and concentrated load 8 kN at point D.

Satu rasuk disokong mudah seperti dalam Rajah 2 dikenakan 3 kN/m beban teragih seragam dari titik A ke titik C dan beban tumpu 8 kN pada titik D.

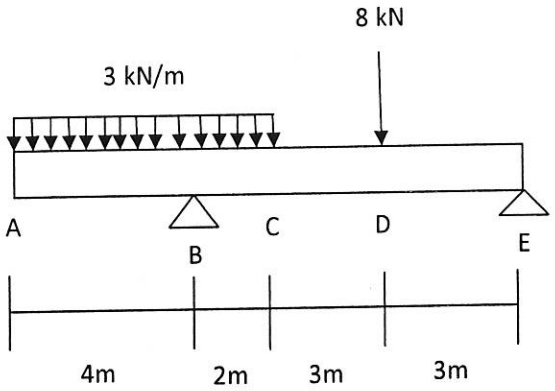


Figure 2/ *Rajah 2*

CLO 1
C1

i. Identify the reaction force at the support of B and E
Kenal pasti nilai daya tindakbalas pada penyokong B dan E

[2 marks]
[2 markah]

CLO 1
C3

ii. Determine shear force and bending moment at point ABCDE.
Tentukan daya ricih dan momen lentur pada titik ABCDE.

[10 marks]
[10 markah]

CLO1
C3

iii. Sketch the shear force and bending moment diagram.
Lakarkan gambarajah daya ricih dan momen lentur

[8 marks]
[8 markah]

CLO1
C4

iv. Determine the value of Contra flexure point from point A
Tentukan nilai *Titik kontralentur dari titik A*

[5 marks]
[5 markah]

QUESTION 3

SOALAN 3

CLO1
C1

(a) Determine the position of the neutral axis and the value of the second moment area of the beam with a cross-section as shown in **Figure 3 (a).**
Tentukan kedudukan paksi neutral dan nilai momen luas kedua pada paksi neutral bagi Rasuk yang mempunyai keratan rentas seperti ***Rajah 3 (a).***

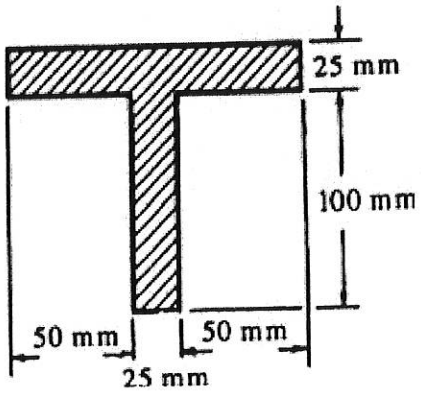


Figure 3 (a) / ***Rajah 3 (a)***

[8 marks]

[8 markah]

CLO1
C2

(b) A cantilever beam with a length of 2m and carries a uniformly distributed load of 8 kN/m as shown in **Figure 3 (b)**, which has a cross section as **Figure 3 (a)**,

calculate:

i. The maximum bending tensile stress
ii. The maximum bending compressive stress

Satu rasuk julur yang mempunyai panjang 2m dan membawa daya teragih seragam 8kN/m seperti yang ditunjukkan dalam ***Rajah 3 (b)****, dan mempunyai keratan rentas seperti* ***Rajah 3 (a)****. Kirakan:*

i. Tegasan lentur maksimum tegangan
ii. Tegasan lentur maksimum mampatan

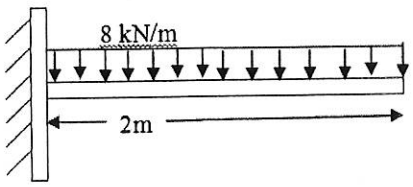


Figure 3 (b) / ***Rajah 3 (b)***

[7 marks]

[7 markah]

CLO1
C3

(c) A cantilever beam 6m in **Figure 3 (c)** has been imposed with concentrated force of 20 kN at the free end of the beam and a uniformly distributed load of 10 kN/m along the beam. Determine the maximum deflection and maximum gradient of the beam. Given EI = 60 MN m^2

*Sebatang rasuk julur 6m dalam **Rajah 3 (c)** telah dikenakan daya tumpu 20 kN di hujung bebas rasuk dan beban teragih seragam 10 kN/m di sepanjang rasuk. Tentukan pesongan maksimum dan kecerunan maksimum rasuk.*
Diberi EI = 60 MN m^2

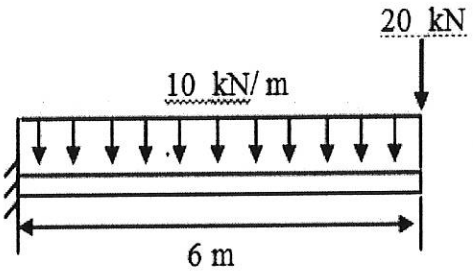


Figure 3 (c) / *Rajah 3 (c)*

[10 marks]
[10markah]

QUESTION 4
SOALAN 4

CLO1
C1

(a) Define the meaning of each symbol and its units.
Berikan maksud setiap simbol dan unitnya.

$$\frac{\tau}{R} = \frac{T}{J}$$

[4 marks]
[4 markah]

CLO1 C2 (b) A shaft with 60mm diameter and 0.8m long is subjected to a torque of 1300 Nm. Given G = 70 GPa. Calculate:

Sebuah aci berdiameter 60mm dan panjang 0.8 m dikenakan daya kilas sebanyak 1300N.m. Diberi G = 70 GPa. Kirakan:

i. Polar second moment of area of the shaft.
Momen luas kedua kutub aci.

[3 marks]
[3 markah]

ii. Angle of twist for the shaft.
Sudut putaran bagi aci.

[5 marks]
[5 markah]

CLO1 C3 (c) A shaft with diameter of 120 mm and 2.5 m length is transmitting 50kW power at 600rpm. Calculate:

Sebuah aci berdiameter 120mm dan panjang 2.5m memindahkan kuasa sebanyak 50kW pada 600 ppm. Kirakan:

i. Shear stress induced in the shaft.
Tegasan ricih yang terhasil di dalam aci.

[9 marks]
[9 markah]

ii. Modulus of rigidity of the material if the twisting angle is 0.0015 rad.
Modulus ketegaran bahan jika sudut putaran adalah 0.0015 rad.

[4 marks]
[4 markah]

SOALAN TAMAT

LIST OF FORMULA DJJ3103-STRENGTH OF MATERIALS

FORCES ON MATERIALS

1. Safety factor = $\dfrac{\text{Maximum Stress}}{\text{Work Stress}}$

2. Poisson's Ratio, ν = $\dfrac{\text{laterial strain}}{\text{longitudinal strain}}$

3. Percent Elongation = $\dfrac{\text{Elongation}}{\text{Length}}$ x 100 %

4. Percent reduction in area = $\dfrac{\text{original cross - sectional - area at fracture}}{\text{original cross sectional area}}$ x 100 %

5. Strain Energy, $U = \frac{1}{2} P\Delta L$

THERMAL STRESSES AND COMPOSITE BARS

1. Equation of a parallel composite bar subjected to a temperature change.

$$\frac{\sigma_1}{E_1} + \frac{\sigma_2}{E_2} = (\alpha_2 - \alpha_1)\,\Delta t$$

2. Equation of a series composite bar subjected to a temperature change.

$$\frac{P_1 L_1}{A_1 E_1} + \frac{P_2 L_2}{A_2 E_2} = \Delta t(\alpha_1 L_1 + \alpha_2 L_2)$$

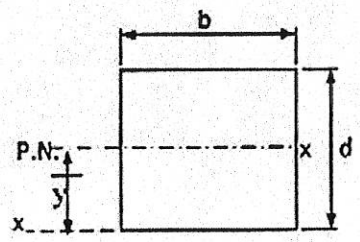
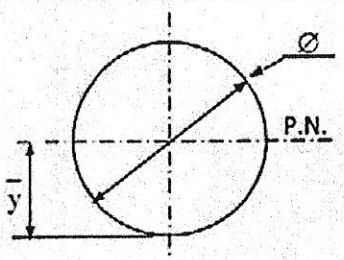
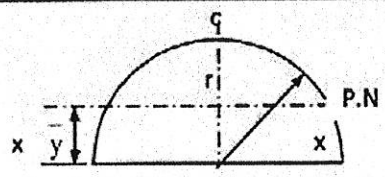
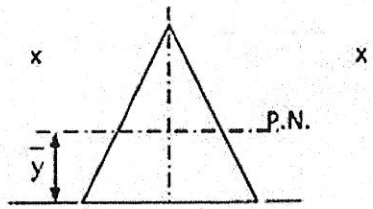
SHEAR FORCES AND BENDING MOMENT

$$\sum M_A \circlearrowright = \left(\sum M_A \circlearrowleft\right)$$

$$\Sigma F \uparrow = \Sigma F \downarrow$$

BENDING STRESS

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

SHAPE	CENTROID	MOMENT OF INERTIA
	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_{P.N.} = \frac{bd^3}{12}$ $I_{xx} = \frac{bd^3}{3}$
	$\bar{x} = d/2$ $\bar{y} = d/2$	$I_{P.N.} = \frac{\pi d^4}{64} = \frac{\pi r^4}{4}$
	$\bar{y} = \frac{4r}{3\pi}$	$I_{PN} = 0.11\, r^4$ $I_{xx} = \frac{\pi r^4}{8}$
	$\bar{y} = h/3$	$I_{P.N.} = \frac{bh^3}{36}$ $I_{xx} = \frac{bh^3}{12}$ $I_{yy} = \frac{hb^3}{48}$

TORSION OF SHAFT

1. TORSION FORMULA

$$\frac{T}{J}=\frac{\tau}{R}=\frac{G\theta}{L}$$

2. POLAR MOMENT OF INERTIA

$$J=\frac{\pi d^4}{32}$$

3. SERIES COMPOSITE SHAFT

$$T=\frac{G_1\theta J_1}{L_1}=\frac{G_2\theta_2 J_2}{L_2}$$

$$\theta_{AC}=\theta_{AB}+\theta_{BC}$$

$$=\frac{T_1L_1}{G_1J_1}+\frac{T_2L_2}{G_2J_2}$$

$$=T\left(\frac{L_1}{G_1J_1}+\frac{L_2}{G_2J_2}\right)$$

4. PARALLEL COMPOSITE SHAFT

$$T = T_1 + T_2$$

$$0=\left(\frac{T_1L_1}{G_1J_1}\right)=\left(\frac{T_2L_2}{G_2J_2}\right)$$