SULIT

POLITEKNIK MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI JUN 2016

DJJ3103: STRENGTH OF MATERIALS

TARIKH : 22 OKTOBER 2016 (SABTU)
MASA : 8.30 AM – 10.30 AM (2 JAM)

Kertas ini mengandungi **SEMBILAN (9)** halaman bercetak.

Empat (4) soalan berstruktur.

Dokumen sokongan yang disertakan: Rumus

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

INSTRUCTION:

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

ARAHAN :

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

QUESTION 1

SOALAN 1

CLO1
C1

a) Define the engineering terms below:

Berikan definisi bagi istilah kejuruteraan berikut:

i. Normal stress

Tegasan normal

ii. Normal strain

Terikan normal

[4 marks]

[4 markah]

CLO1
C2

b) A 4m length copper wire in Figure 1(b) is subjected to 100kN load. If the stress produce in the wire is 60 MN/m^2. Calculate:

Satu dawai tembaga yang panjangnya 4m seperti dalam Rajah 1(b) dikenakan beban 100kN. Jika ia menghasilkan tegasan dawai yang bernilai 60MN/m^2. Kirakan:

i. Strain

Terikan

ii. Elongation

Perubahan panjang

iii. Safety factor if ultimate tensile stress is 230MN/m^2

Faktor keselamatan jika nilai tegasan maksimum adalah 230MN/m^2

[6 marks]
[6 markah]

Given:
Diberi:

$E_{copper} = 112GN/m^2$

$E_{tembaga} = 112GN/m^2$

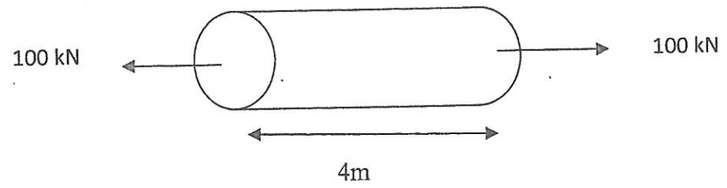


Figure 1(b)
Rajah 1(b)

CLO1
C4

c) Three bars are used to support a load of 100kN as in Figure 1(c). Each bar has the diameter of 20mm and 1m length. If the temperature is increased 100°C from the initial, calculate the stress occurred due to the force and temperature change in each individual bars. Assume the bar is remains in horizontal.

Tiga bar digunakan untuk menyokong beban 100kN seperti Rajah 1(c). Setiap bar mempunyai diameter 20mm dan panjang 1m. Jika suhu dinaikkan sebanyak 100°C daripada asal, kirakan nilai tegasan yang berlaku disebabkan dikenakan daya dan juga perubahan suhu yang berlaku pada setiap bar. Andaikan bar dalam keadaan mendatar.

Given:

$E_{aluminium}=70GN/m^2$ $\alpha_{aluminium}=23x10^{-6}/°C$

$E_{steel}=206GN/m^2$ $\alpha_{steel}=12x10^{-6}/°C$

Diberi:

$E_{aluminium}=70GN/m^2$ $\alpha_{aluminium}=23x10^{-6}/°C$

$E_{keluli}=206GN/m^2$ $\alpha_{keluli}=12x10^{-6}/°C$

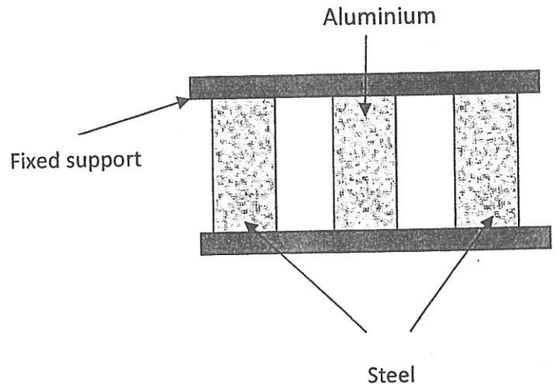


Figure 1(c)
Rajah 1(c)

[15 marks]
[15 markah]

QUESTION 2

SOALAN 2

An overhanging beam is loaded as show in Figure 2 below.

Satu rasuk yang tergantung dikenakan bebanan seperti Rajah 2 di bawah.

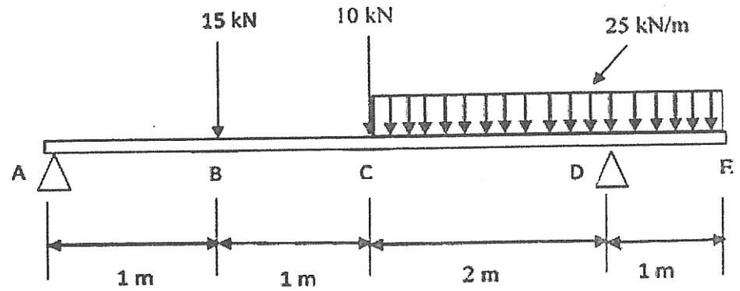


Figure 2 / *Rajah 2*

CLO1 C1

(a) Sketch the free body diagram of the beam and find reaction force at point A and D.
Lukiskan gambarajah badan bebas bagi rasuk dan dapatkan daya tindakbalas pada titik A dan D

[4 marks]
[*4 markah*]

CLO1 C3

(b) Determine shear force and bending moment at point ABCDE
Tentukan daya ricih dan momen lentur pada titik ABCDE

[10 marks]
[*10 markah*]

CLO1 C4

(c) i. Sketch the shear force diagram and bending moment diagram.
Lakarkan gambarajah daya ricih dan gambarajah momen lentur.

ii. Determine the value of maximum bending moment and its position
Tentukan nilai momen lentur maksimum dan kedudukannya.

[11 marks]
[*11 markah*]

QUESTION 3

SOALAN 3

CLO1 C1

a). A simply supported beam with cross-section as shown in Figure 3(a) below. Determine the value of Neutral Axis and Second Moment Area of the beam.
Satu rasuk disangga mudah dengan keratan rentas seperti yang ditunjukkan dalam Rajah 3(a) dibawah. Tentukan nilai Paksi Neutral dan Momen Luas Kedua rasuk tersebut.

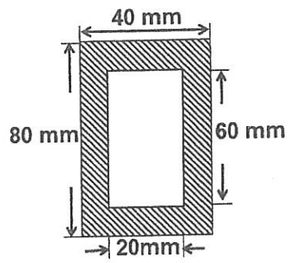


Figure 3(a)/ *Rajah 3(a)*

[7 marks]
[*7 markah*]

CLO1
C2

b) A simply supported beam with rectangular cross section carrying a uniformly distributed load of 20 kN/m which shown in figure 3(b). Determine the maximum bending stress in beam.

Satu rasuk disangga mudah dengan berkeratan rentas segiempat membawa beban teragih seragam 20 kN/m seperti dalam Rajah 3(b). Tentukan tegasan lentur maksimum dalam rasuk.

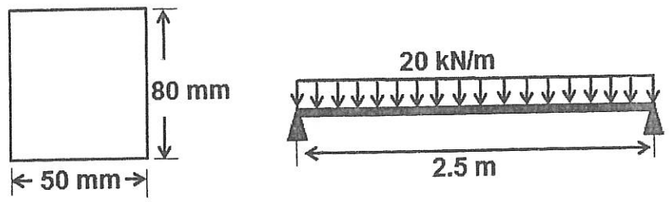


Figure 3(b)/*Rajah 3(b)*

[6 marks]

[*6 markah*]

CLO1
C3

c) A 2 m long simply supported beam with load 10 kN at the middle. Given the Modulus of Elasticity 200 GN/m^2 and moment of inertia 12 x 10^{-6} m^4.

Satu rasuk 2 m disokong mudah dikenakan beban 10 kN di tengah - tengah. Diberi modulus keanjalan 200 GN/m^2 dan momen inersia 12 x 10^{-6} m^4.

i) Determine the equation of Elastic Curve.

Tentukan persamaan Lengkungan Anjal.

ii) Calculate the Maximum Deflection of the beam.

Hitungkan Pesongan Maksimum rasuk.

[12 marks]

[*12 markah*]

QUESTION 4

SOALAN 4

A circular bar ABC, 3m long, is rigidly fixed at its ends A and C. The portion AB is 1.8m long and of 50mm diameter and BC is 1.2m long with 25mm diameter. If a twisting moment of 680Nm is applied at B, determine:

Bar bulat padu ABC mempunyai panjang keseluruhan 3m diikat pada kedua-dua hujung A dan C. Panjang AB adalah 1.8m dan berdiameter 50mm manakala panjang BC adalah 1.2m serta berdiameter25mm. Jika daya kilas adalah 680Nm di kenakan pada hujung B, kirakan:

Given G = 80GN/m^2

Diberi = 80GN/m^2

CLO1
C1

a) Second polar moment of area , J

Polar momen luas kedua, J

[4 marks]

[4 markah]

CLO1
C3

b) Torque at each bar, *T*

Daya kilasan pada setiap bar, T

[9 marks]

[9 markah]

CLO1
C2

c) Angle of twist, θ

Sudut kilasan, θ

[3 marks]

[3markah]

CLO1
C4

d) Shear stress at each bar and maximum power that can be distributed on the shaft.

Tegasan ricih pada setiap bar dan kuasa maksimum yang dihasilkan oleh putaran aci

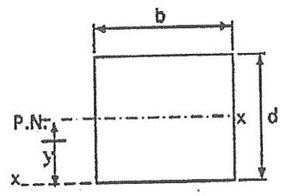
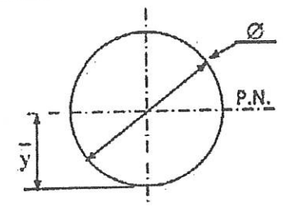
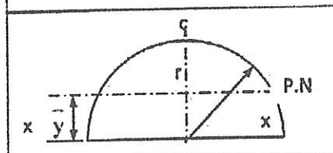
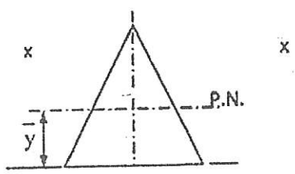
[9 marks]

[9 markah]

SOALAN TAMAT

BENDING STRESS

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

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

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

$$T = T_1 + T_2$$

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

LIST OF FORMULA DJJ3103-STRENGTH OF MATERIALS

FORCES ON MATERIALS

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

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

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

4. Percent reduction in area = $\frac{\text{original cross-sectional -area at fracture}}{\text{original cross sectional area}}$ 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.

$$\frac{P_1L_1}{A_1E_1}+\frac{P_2L_2}{A_2E_2}=\Delta t(\alpha_1L_1+\alpha_2L_2)$$

SHEAR FORCES AND BENDING MOMENT

$$\sum M_A \circlearrowright = \sum M_A \circlearrowleft$$

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