

SULIT



**KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI**

**BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN TINGGI**

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI I : 2024/2025

DJJ30103: STRENGTH OF MATERIALS

**TARIKH : 08 DISEMBER 2024
MASA : 11.30 PAGI – 1.30 PETANG (2 JAM)**

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

Struktur (4 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

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 | <p>(a) Express the following:</p> <p>i. FIVE (5) types of forces. [5 marks]
 <i>LIMA (5) jenis daya.</i> [5 markah]</p> <p>ii. ONE (1) effect for each forces. [5 marks]
 <i>SATU (1) kesan bagi setiap daya.</i> [5 markah]</p> |
| CLO1 | <p>(b) Aluminium bar with diameter and length of 15 mm and 875 mm is attached in series to a 30 mm x 30 mm square Steel bar, which has double of Aluminium's length. 25 kN of load is applied to the composite bar. Calculate:
 <i>Bar Aluminium dengan diameter dan panjang 15 mm dan 875 mm disambung secara siri pada bar Keluli persegi 30 mm x 30 mm yang mempunyai dua kali ganda panjang Aluminium. Beban 25 kN dikenakan pada bar komposit. Kirakan:</i></p> <p>Given / Diberi $E_{Al} = 70 \text{ GN/m}^2$ and $E_S = 210 \text{ GN/m}^2$.</p> <p>i. The area of both bar.
 <i>Luas kedua-dua bar.</i> [2 marks]
 [2 markah]</p> <p>ii. Total elongation of the composite bar.
 <i>Jumlah pemanjangan bar.</i> [5 marks]
 [5 markah]</p> |

- CLO1 (c) Figure 1(c) below shows a compound bar rigidly mounted at both end. Cross sectional area for steel and aluminium bar are 400 mm^2 and 335 mm^2 . If the temperature is dropped by 23°C . Calculate:

Rajah 1(c) dibawah menunjukkan bar majmuk yang diikat dengan tegar di kedua-dua hujungnya. Luas keratan rentas bagi keluli dan aluminium masing-masing ialah 400 mm^2 dan 335 mm^2 . Jika suhu menurun sebanyak 23°C . Kirakan:

Given / Diberi:

$$E_S = 203 \text{ GN/m}^2 ; \alpha_S = 11.7 \times 10^{-6}/^\circ\text{C}$$

$$E_A = 75 \text{ GN/m}^2 ; \alpha_A = 23.6 \times 10^{-6}/^\circ\text{C}$$

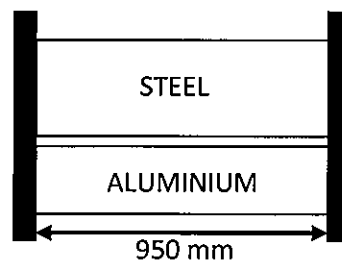


Figure 1 (c)/ Rajah 1 (c)

- i. The total elongation of the bar.

Jumlah pemanjangan bar.

[3 marks]

[3 markah]

- ii. The thermal stress developed in each bars.

Tegasan haba yang terbentuk dalam setiap bar.

[5 marks]

[5 markah]

QUESTION 2**SOALAN 2**

A simple support beam is applied load as shown in Figure 2 below.

Sebatang rasuk disokong mudah dikenakan beban ditunjukkan pada Rajah 2 di bawah.

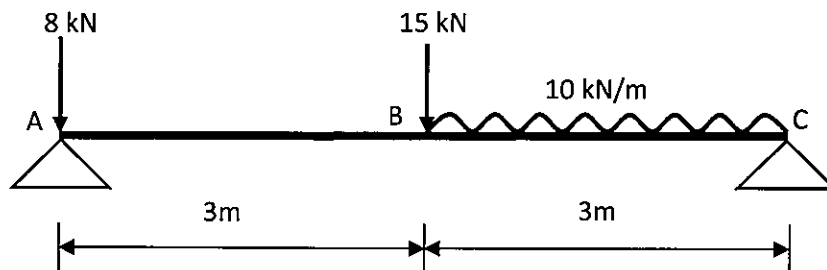


Figure 2 / Rajah 2

- CLO1 (a) Express the value of reaction force with the aid of Free Body Diagram.
Nyatakan nilai daya tindakbalas dengan bantuan Gambarajah Badan Bebas.
 [5 marks]
 [5 markah]
- CLO1 (b) Based on reaction force value:
Berdasarkan nilai daya tindak balas:
- i. Calculate the shear force along the beam.
Kirakan daya ricih sepanjang rasuk.
 [4 marks]
 [4 markah]
 - ii. Sketch the shear force diagram.
Lakarkan gambarajah daya ricih.
 [4 marks]
 [4 markah]

CLO1

(c) Referring the shear force diagram:

Merujuk kepada gambarajah daya ricih:

- i. Calculate the bending moment value.

Kirakan nilai momen lentur.

[4 marks]

[4 markah]

- ii. Sketch the bending moment diagram.

Lakarkan gambarajah memon lentur.

[4 marks]

[4 markah]

- iii. Show the value of maximum bending moment and its position in the diagram.

Tunjukkan nilai dan kedudukan momen lentur maksimum dalam Gambarajah.

[4 marks]

[4 markah]

QUESTION 3**SOALAN 3**

CLO2

(a) Define the terms below:

Definisikan istilah-istilah dibawah:

i. Centroid.

Centroid.

[2 marks]

[2 markah]

ii. Second moment of area.

Momen luas kedua.

[2 marks]

[2 markah]

iii. Bending moment.

Momen lentur.

[2 marks]

[2 markah]

CLO2

(b) A cantilever T shape beam 400 mm long supports a load of 25 kN at the end of beam as illustrated in Figure 3(b). Calculate:

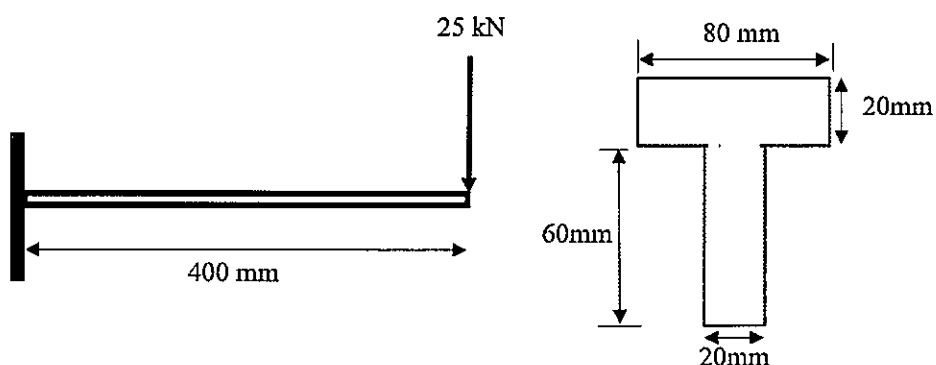
Sebatang rasuk julur bentuk T, 400 mm panjang menyokong beban 25 kN di hujung rasuk seperti dalam Rajah 3(b). Kirakan:

Figure 3(b) / Rajah 3(b)

- i. Centroid of the T shape beam.

Centroid bagi rasuk bentuk T.

[3 marks]

[3 markah]

- ii. Moment of inertia of the beam section.

Momen inersia bagi keratan rasuk.

[3 marks]

[3 markah]

- iii. Maximum bending stress of the beam.

Tegasan lentur maksimum bagi rasuk.

[3 marks]

[3 markah]

CLO2

- c) A 0.8 m long T shape beam supports a uniformly distributed load of 8 kN/m as illustrated in figure 3(c). Given the Young's Modulus, $E = 80$ GPa and the second moment of area, $I = 1.51 \times 10^{-6} \text{ m}^4$. Determine:

Sebatang rasuk berbentuk T panjangnya 0.8 m menyokong beban tak seragam sebanyak 8 kN/m seperti ditunjukkan dalam rajah 3(c). Diberi Modulus Young, $E = 80$ GPa dan Momen Luas Kedua, $I = 1.51 \times 10^{-6} \text{ m}^4$. Tentukan:

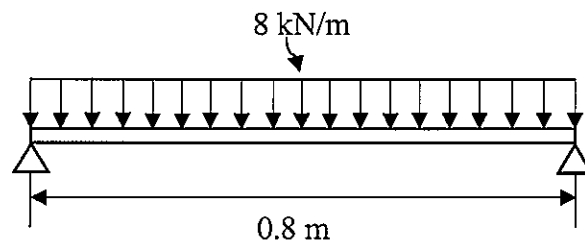


Figure 3(c) / Rajah 3(c)

- i. The slope of the beam.

Kecerunan rasuk.

[5 marks]

[5 markah]

- ii. New Young Modulus if the maximum deflection is $1.41 \times 10^{-4} \text{ m}$.

Modulus Young jika pesongan maksimum adalah $1.41 \times 10^{-4} \text{ m}$.

[5 marks]

[5 markah]

QUESTION 4**SOALAN 4**

- CLO2 (a) State the terms and unit for each symbols below.

Nyatakan terma dan unit bagi setiap simbol dibawah.

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

[5 marks]

[5 markah]

- CLO2 (b) A shaft with 60 mm diameter and 0.9 m long is subjected to a torque of 1300 Nm. Given $G = 70\text{GPa}$. Calculate:

Sebatang aci berdiameter 60 mm dan panjang 0.9 m dikenakan daya kilas sebanyak 1300 Nm. Diberi $G = 70\text{GPa}$. Kirakan:

- i. The twist angle of shaft.

Sudut putaran bagi aci.

[5 marks]

[5 markah]

- ii. The shear stress induced in the shaft.

Tegasan ricih yang terhasil dalam aci.

[3 marks]

[3 markah]

CLO2

(c) A 0.8 m long solid shaft is transmitting 70 kW power at 500 rpm. Determine:
Sebatang aci padu sepanjang 0.8 m memindahkan kuasa sebanyak 70 kW pada 500 rpm. Tentukan:

i. Total torque.

Jumlah daya kilas.

[3 marks]

[3 markah]

ii. The diameter of shaft if maximum shear stress is 150 MPa.

Diameter aci jika tegasan ricih maksimum adalah 150 MPa.

[5 marks]

[5 markah]

iii. Modulus of rigidity if the maximum twist angle allowed is 0.085 rad.

Modulus ketegaran jika sudut putaran adalah 0.085 rad.

[4 marks]

[4 markah]

END OF QUESTIONS

SOALAN TAMAT

FORCES ON MATERIALS

$$P = \sigma A \quad \sigma = \varepsilon E$$

$$v = \frac{\varepsilon_y}{\varepsilon_x} \quad S.F = \frac{\sigma_{ult}}{\sigma_w}$$

$$\% \Delta L = \frac{L_f - L_o}{L_o} \times 100\%$$

$$\% A = \frac{A_o - A_f}{A_o} \times 100\%$$

THERMAL STRESS AND COMPOSITE BAR

$$\Delta L = \frac{PL}{AE} = \frac{\sigma L}{E}$$

$$\Delta L = \alpha L \Delta t \quad \sigma = E \alpha \Delta t$$

Subjected to force:

Series

$$P_1 = P_2$$

$$\Sigma \Delta L = L_1 + L_2$$

Parallel

$$P = P_1 + P_2$$

$$\Delta L_1 = \Delta L_2$$

Subjected to temperature:

Series

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

Parallel

$$\frac{\sigma_1}{E_1} + \frac{\sigma_2}{E_2} = \Delta t (\alpha_b - \alpha_k)$$

SHEAR FORCE AND BENDING MOMENT

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

$$Force = wL \text{ (unit: N)}$$

$$\Sigma M \curvearrowright = \Sigma M \curvearrowleft$$

$$Moment = Fd \text{ (unit: Nm)}$$

TORSION

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

$$P = T\omega$$

$$\omega = \frac{2\pi N}{60}$$

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

Series compound

$$T_1 = T_2$$

$$\frac{G_1 \theta_1 J_1}{L_1} = \frac{G_2 \theta_2 J_2}{L_2}$$

$$\Sigma \theta = \theta_1 + \theta_2$$

Parallel compound

$$T = T_1 + T_2$$

$$\theta_1 = \theta_2$$

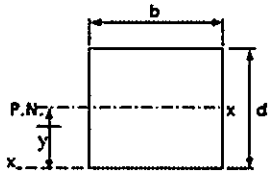
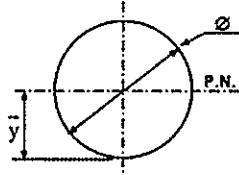
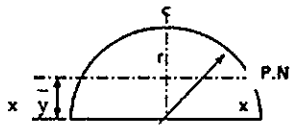
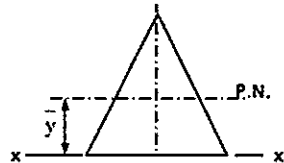
$$\frac{T_1 L_1}{G_1 J_1} = \frac{T_2 L_2}{G_2 J_2}$$

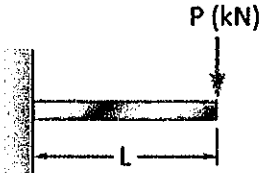
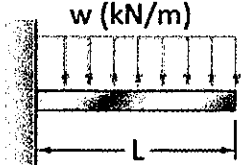
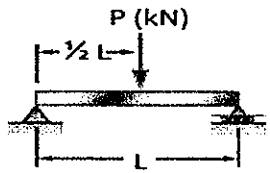
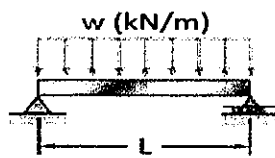
BENDING STRESS AND BEAM DEFLECTION

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

$$\bar{y} = \frac{\Sigma Ay}{\Sigma A}$$

$$I_{NA} = \Sigma(I + Ah^2)$$

Shape	Centroid, y	Second Moment of Area, I
	$y = \frac{d}{2}$	$I_{NA} = \frac{bd^3}{12}$
	$y = \frac{d}{2}$	$I_{NA} = \frac{\pi d^4}{64}$
	$y = \frac{4r}{3\pi}$	$I_{NA} = 0.11r^4$
	$y = \frac{h}{3}$	$I_{NA} = \frac{bh^3}{36}$

Beam	Moment, $M_{\max}$	Slope, $\theta_{\max}$	Deflection, $y_{\max}$
	PL	$-\frac{PL^2}{2EI}$	$-\frac{PL^3}{3EI}$
	$\frac{wL^2}{2}$	$-\frac{wL^3}{6EI}$	$-\frac{wL^4}{8EI}$
	$\frac{PL}{4}$	$\pm \frac{PL^2}{16EI}$	$-\frac{PL^3}{48EI}$
	$\frac{wL^2}{8}$	$\pm \frac{wL^3}{24EI}$	$-\frac{5wL^4}{384EI}$