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 : 2025/2026

DJJ30323: STRENGTH OF MATERIALS

TARIKH : 05 DISEMBER 2025
MASA : 08.30 PAGI - 10.30 PAGI (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)

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 (a) Elaborate the terms Normal Stress, Normal Strain, and Modulus of Elasticity, including their respective definitions and formulas.

Huraikan istilah Tekanan Normal, Terikan Normal dan Modulus Keanjalan, termasuk definisi dan formula masing-masing.

[6 marks]

[6 *markah*]

CLO1 (b) Compare the Simply Supported Beam and Cantilever Beam according to their definitions and diagrams.

Bandingkan Rasuk Sokong Mudah dan Rasuk Julur mengikut takrifan dan rajahnya

[6 marks]

[6 *markah*]

CLO2 (c) A simply supported beam is loaded as shown in Figure 1(c) below. Calculate:

Satu rasuk disokong mudah dikenakan beban seperti ditunjukkan pada Rajah 1(c). Kirakan:

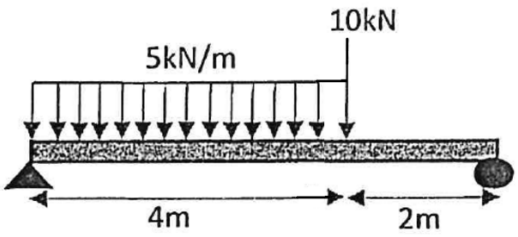


Figure 1 (c) / *Rajah 1(c)*

i. 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*]

ii. Calculate and sketch the shear force diagram.
Kirakan dan lakarkan gambarajah daya ricih.

[3 marks]
[3 *markah*]

iii. Calculate and sketch the bending moment diagram.
Kirakan dan lakarkan gambarajah momen lentur.

[5 marks]
[5 *markah*]

QUESTION 2

SOALAN 2

CLO1 (a) Explain the terms thermal stress, thermal strain, and coefficient of linear expansion, including their respective formulas and symbols.
Terangkan istilah tegasan suhu, keterikan suhu dan pekali pengembangan lelurus termasuk formula dan simbol masing-masing.

[6 marks]
[6 *markah*]

CLO1 (b) Explain with a diagram what a Series Composite Bar and a Parallel Composite Bar are in terms of external forces and extension.
Terangkan dengan gambarajah apakah Bar Komposit Siri dan Bar Komposit Selari dalam terma dari daya luaran dan pemanjangan.

[8 marks]
[*8 markah*]

CLO2 (c) A series of bars consisting of copper and aluminium bars are fixed in between two rigid walls as in Figure 2 (c). Determine the thermal stress induced in each bar if the temperature is increased by 80 °C. Calculate
Satu bar sesiri yang terdiri daripada kuprum dan aluminium dipasang tegar antara dua dinding seperti dalam Rajah 2 (c). Tentukan tegasan haba di dalam setiap bar tersebut jika suhu meningkat sebanyak 80 °C. Kirakan

Given / Diberi :

$E_{aluminium} = 69\ GN/m^2$; $\alpha_{aluminium} = 23 \times 10^{-6}$ /°C

$E_{copper} = 112 GN/m^2$; $\alpha_{copper} = 17 \times 10^{-6}$ /°C.

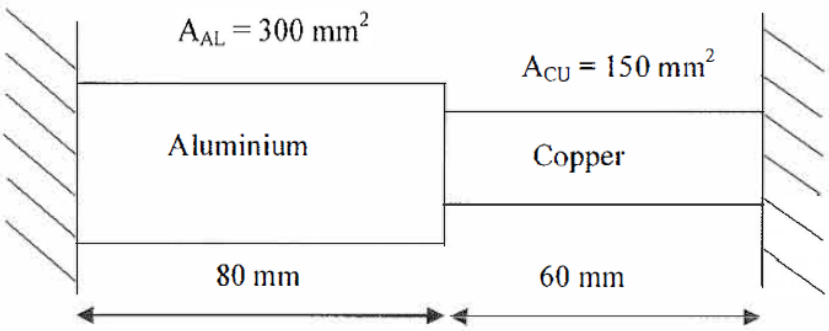


Figure 2 (c) / *Rajah 2 (c)*

i. The thermal stress developed in copper bar
Tegasan haba yang terbentuk dalam bar kuprum

[9 marks]
[*9 markah*]

ii. The thermal stress developed in aluminium bar
Tegasan haba yang terbentuk dalam bar aluminium

[2 marks]
[*2 markah*]

QUESTION 3

SOALAN 3

CLO1 (a) Based on the equation below, name **FIVE (5)** symbols below and their units:
*Berdasarkan persamaan dibawah, namakan **LIMA (5)** setiap simbol dan unitnya*

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

[5 marks]
[*5 markah*]

CLO1 (b) A cantilever T shape beam 10 m long supports a load of 300 N at the end of beam as illustrated in Figure 3 (b). Calculate:
Sebatang rasuk julur bentuk T, 10 m panjang menyokong beban 300 N di hujung rasuk seperti dalam Rajah 3 (b). Kirakan:

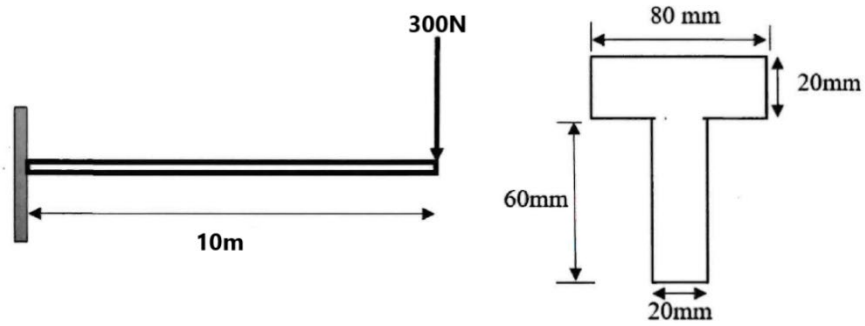


Figure 3 (b) / *Rajah 3 (b)*

i. Centroid of the beam on the neutral axis.
Sentroid bagi keratan rasuk pada paksi neutral.

[3 marks]
[*3 markah*]

ii. Moment of inertia of the beam section on the neutral axis.
Momen inersia bagi keratan rasuk pada paksi neutral.

[3 marks]
[*3 markah*]

iii. Maximum bending stress of the beam.
Tegasan lentur maksimum bagi rasuk.

[4 marks]
[*4 markah*]

CLO2

(c) A hanging balcony is shown as Figure 3(c) which is 4 m long and has a flexural stiffness (EI) of 20 MNm^2. It also has a man point load of 1 kN at the free end, and the steel rail has a uniformly distributed load of 300 N/m along its entire length. Analyze the situation to determine:
Sebuah balcony yang tergantung seperti Rajah 3(c) berukuran 4 m panjang dengan nilai kekakuan lenturan (EI) 20 MNm^2. Ia dikenakan beban tumpu seorang lelaki bernilai 1 kN di hujung rasuk dan beban teragih seragam pagar keluli sebanyak 300 N/m disepanjang rasuk. Analisa situasi tersebut bagi menentukan:

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

i. Deflection of the beam.
Pesongan rasuk.

[5 marks]
[*5 markah*]

ii. Slope at the free end of the beam.
Kecerunan di hujung bebas rasuk.

[5 marks]
[*5 markah*]

QUESTION 4

SOALAN 4

CLO1 (a) State the meaning of the **FOUR (4)** symbols and their units for the equations below.

*Nyatakan maksud **EMPAT (4)** simbol berikut dan unitnya untuk persamaan dibawah.*

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

[4 marks]

[*4 markah*]

CLO1 (b) A shaft with a 50 mm diameter and 0.7 m length is subjected to a torque of 1200 Nm.

Satu aci berdiameter 50 mm dan panjangnya 0.7 m dikenakan dengan daya kilas sebanyak 1200 Nm.

i. Explain the term of torque and give **TWO (2)** torque applications in engineering.

*Takrifkan dayakilas dan berikan **DUA (2)** aplikasi daya kilas dalam kejuruteraan.*

[4 marks]

[4 *markah*]

ii. Calculate the shear stress and the angle of twist. Given G = 90 GN/m^2.

Kirakan tegasan ricih dan sudut kilas yang berlaku. Diberikan G = 90 GN/m^2.

[6 marks]

[6 *markah*]

CLO2

(c) A solid steel shaft 5 m long is stressed at 80 MN/m^2 when twisted through 4 °. Using G = 83 GN/m^2, calculate:

Sebuah aci keluli padu dengan 5m panjang dikenakan tegasan 80 MN/m^2 *apabila dipiuh pada 4°. Menggunakan G = 83 GN/m^2, kirakan:*

i. The shaft diameter.

Diameter aci

[5 marks]

[*5 markah*]

ii. Power transmitted by the shaft at 20 rev/min.

Kuasa yang dipindah oleh aci pada 20 pusingan/min

[6 marks]

[*6 markah*]

SOALAN TAMAT

DJJ30323: STRENGTH OF MATERIALS

FORCES ON MATERIALS

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

$$\upsilon = \frac{\varepsilon_y}{\varepsilon_x} \qquad S.F = \frac{\sigma_{ult}}{\sigma_w}$$

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

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

THERMAL STRESS AND COMPOSITE BAR

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

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

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

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

$$Force = wL\ (unit: N)$$

$$\Sigma \mathrm{M} \circlearrowright = \Sigma \mathrm{M} \circlearrowleft$$

$$Moment = Fd\ (unit: Nm)$$

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

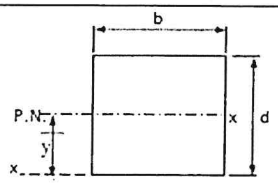
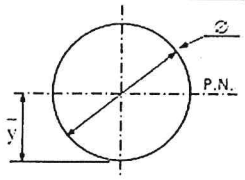
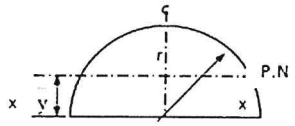
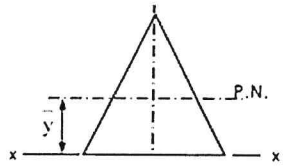
$$T = T_1 + T_2$$

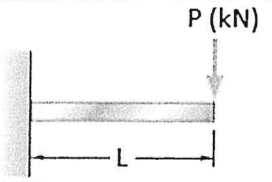
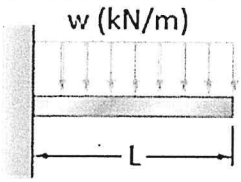
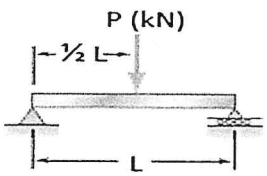
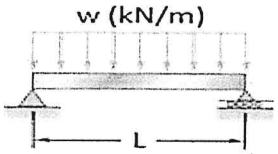
$$\theta_1 = \theta_2$$

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

BENDING STRESS AND BEAM DEFLECTION

$$\frac{M}{I}=\frac{\sigma}{y}=\frac{E}{R} \qquad \bar{y}=\frac{\Sigma Ay}{\Sigma A} \qquad I_{NA}=\Sigma(I+Ah^2)$$

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