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 II : 2025/2026

DJJ30323 : STRENGTH OF MATERIALS

TARIKH : 07 MEI 2026
MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)

Kertas ini mengandungi **SEPULUH (10)** halaman bercetak.

Struktur (4 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

TERBUKA

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) State **FOUR (4)** examples of effect to the material after force is given.

*Nyatakan **EMPAT (4)** contoh kesan yang berlaku pada bahan yang dikenakan daya.*

[4 marks]

[*4 markah*]

CLO1 (b) Based on general shape of stress versus strain in common tensile test as shown in Figure 1(b) below, explain the condition at the following in the stress – strain curve.

Berdasarkan bentuk asas tegasan lawan terikan dalam ujian tegasan seperti ditunjukkan pada Rajah 1(b), terangkan keadaan pada bahagian-bahagian berikut dalam lengkung tegasan -terikan.

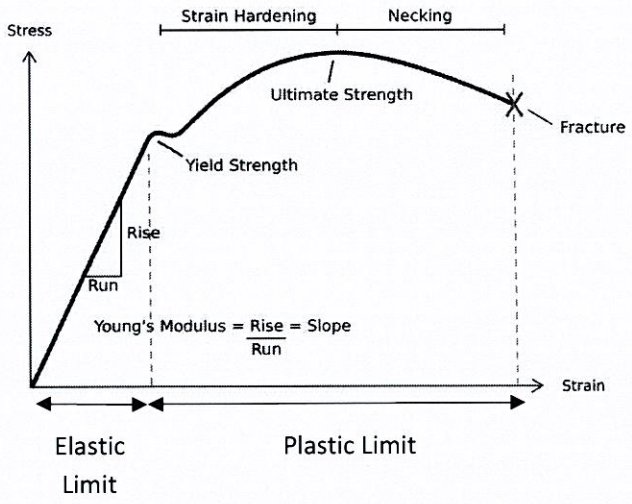


Figure 1(b)/ Rajah 1(b)

i. Elastic Limit
Had Anjal

ii. Plastic Limit
Had Plastik

iii. Yield Strength
Kekuatan Alah

iv. Ultimate Strength
Kekuatan Tegangan

[8 marks]
[*8 markah*]

CLO1

(c) A composite bar made up of aluminum bar and steel bar is firmly held between two unyielding supports as shown in Figure 1(c). Calculate the stress in each material when the temperature increases from 50°C to 100°C.
Satu sambungan bar komposit yang terdiri daripada aluminium dan keluli yang disokong tidak anjal di kedua-dua hujungnya seperti Rajah 1(c). Kirakan tegasan yang berlaku pada setiap bar apabila suhunya dinaikkan dari 50°C kepada 100°C.

Given/Diberi

$E_{aluminium} = 70\ GN/m^2$ $\alpha_{aluminium} = 24 \times 10^{-6}/C$

$E_{steel} = 210\ GN/m^2$ $\alpha_{steel} = 11.8 \times 10^{-6}/C$

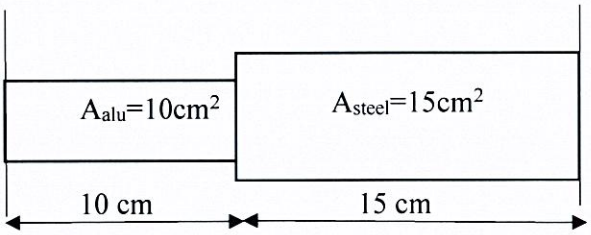


Figure 1(c)/ Rajah 1(c)

[13 marks]
[*13 markah*]

QUESTION 2

SOALAN 2

A simple supported beam is loaded as shown in Figure 2 below.

Satu rasuk disokong mudah dikenakan beban seperti ditunjukkan dalam Rajah 2.

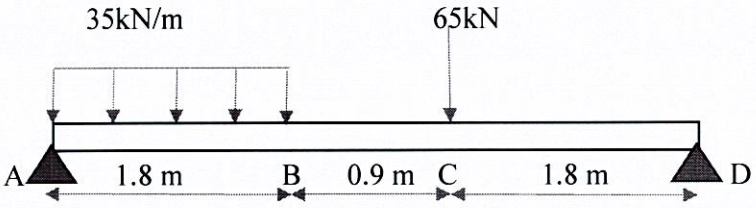


Figure 2/ *Rajah 2*

CLO1 (a) Express the value of reaction force with the aid of Free Body Diagram.

Nyatakan nilai daya tindakbalas dengan bantuan Gambarajah Beban Bebas.

[6 marks]

[*6 markah*]

CLO1 (b) Based on reaction force value

Berdasarkan nilai daya tindakbalas

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 to the shear force diagram

Merujuk kepada gambarajah daya ricih

i. Calculate the bending moment value.

Kirakan nilai momen lentur.

[4 marks]

[*4 markah*]

ii. Using the bending moment diagram, show the value of maximum bending moment and its position in the diagram.

Dengan menggunakan gambarajah momen lentur, tunjukkan nilai dan kedudukan momen lentur maksimum dalam gambarajah.

[7 marks]

[*7 markah*]

QUESTION 3

SOALAN 3

CLO2 (a) Based on the equation below, name **FIVE (5)** the terms represented by letter in the following bending stress formula with their unit.

*Berdasarkan persamaan di bawah, namakan **LIMA (5)** istilah yang diwakili dalam formula tegasan lenturan berikut dengan unitnya.*

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

[5 marks]

[*5 markah*]

CLO2 (b) A cantilever beam 10 m long carries a uniformly distributed load along the span of the beam. The cross-section is as shown in Figure 3(b). Calculate:

Satu rasuk julur sepanjang 10 m menanggung beban teragih seragam disepanjang rentang rasuk itu. Keratan rentas adalah seperti yang ditunjukkam dalam Rajah 3(b). Kirakan :

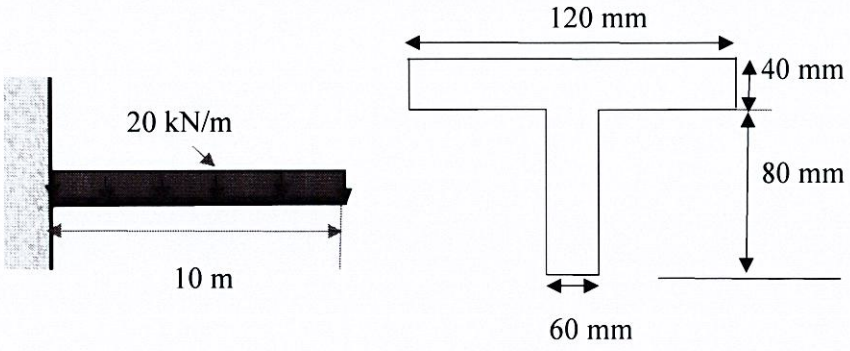


Figure 3(b)/ *Rajah 3(b)*

i. Centroid of the beam on the neutral axis.

Sentroid bagi keratan rasuk pada paksi neutral.

[4 marks]

[4 *markah*]

ii. Moment of inertia of the beam section on the neutral axis.

Momen inersia bagi keratan rasuk pada paksi neutral.

[4 marks]

[*4 markah*]

iii. Maximum bending moment of the beam.

Tegasan maksimum bagi rasuk

[2 marks]

[2 *markah*]

CLO2

(c) A beam with L m length is simply supported a uniformly distributed load of 7 kN/m. The diagram has cross sectional area as Figure 3(c). If the maximum deflection is 0.847 m. Determine:

Sebuah rasuk dengan panjang L m disokong secara ringkas dengan beban teragih seragam 7 kN/m. Gambarajah tersebut mempunyai luas keratan rentas seperti Rajah 3(c). Jika pesongan maksimum ialah 0.847 m. Tentukan:

Given: E = 165 GN/m^2

Diberi: E = 165 GN/m^2

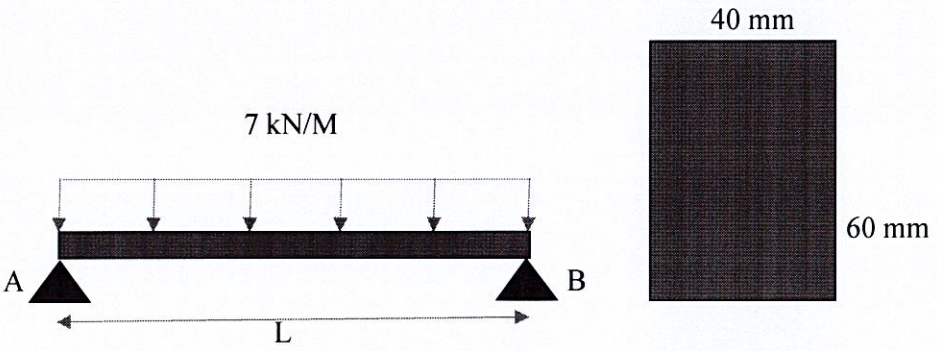


Figure 3(c)/ Rajah 3(c)

i. Second moment of section area about the neutral axis.

Momen luas kedua keratan rentas terhadap paksi neutral.

[4 marks]

[*4 markah*]

ii. The length L of the beam.

Panjang L bagi rasuk.

[6 marks]

[*6 markah*]

QUESTION 4

SOALAN 4

CLO2 (a) Compare the equation and units for Second Polar Moment of Area between solid cylinder and hollow cylinder by using Schematic Diagram.
Bezakan formula dan unit Momen Luas Kedua Polar bagi aci silinder padu dan aci silinder berlubang menggunakan Gambarajah Skema.

[6 marks]
[*6 markah*]

CLO2 (b) A 1000 Nm torque is acting on a solid cylinder shaft with 50 mm in diameter and 1 m length. The shaft is made from steel with modulus of rigidity 79 GPa. Calculate:
Daya kilasan sebanyak 1000 Nm bertindak ke atas sebuah aci padu silinder dengan diameter 50 mm dan panjang 1 m. Aci tersebut diperbuat daripada keluli dengan modulus ketegaran 79 GPa. Kirakan:

i. The Maximum Shear Stress in the shaft
Tegasan Ricih Maksimum di dalam aci

[6 marks]
[*6 markah*]

ii. The Angle of Twist for the shaft in degree.
Sudut Putaran bagi aci dalam darjah.

[5 marks]
[*5 markah*]

CLO2

(c) A shaft with a diameter of 100 mm and 3 m long is transmitting 70kW power at 500 rpm. Calculate:

Sebatang aci berdiameter 100 mm dan panjang 3 m memindahkan kuasa sebanyak 70kW pada 500 rpm. Kirakan:

i. Shear stress induced in the shaft.

Tegasan ricih yang terhasil di dalam aci.

[6 marks]

[*6 markah*]

ii. Modulus of Rigidity if the twisting angle is 0.0025 rad.

Modulus Ketegaran jika sudut putaran adalah 0.0025 rad.

[2 marks]

[*2 markah*]

SOALAN TAMAT

POLITEKNIK MALAYSIA

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

$P_1 = P_2$

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

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

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

$Force = wL\ (unit: N)$

$\Sigma M \circlearrowright = \Sigma M \circlearrowleft$

$Moment = Fd\ (unit: Nm)$

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

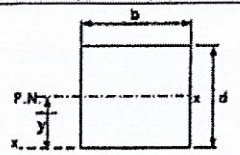
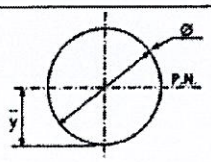
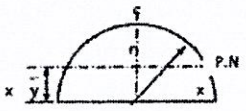
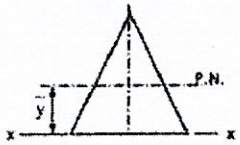
$T = T_1 + T_2$

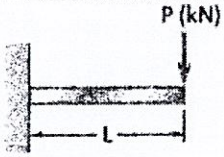
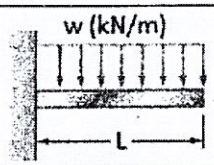
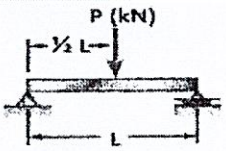
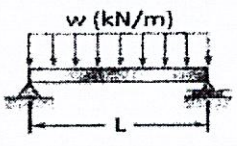
$\theta_1 = \theta_2$

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

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