SULIT

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

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI I : 2022 / 2023

DJJ30103: STRENGTH OF MATERIALS

TARIKH : 22 DISEMBER 2022
MASA : 8.30 PAGI – 10.30 PAGI (2 JAM)

Kertas ini mengandungi **SEBELAS (11)** halaman bercetak.

Struktur (4 soalan)

Dokumen sokongan yang disertakan : Kertas Graf, Formula dsb / Tiada

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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
C2

(a) Explain the terms below that is definition and units;

Terangkan istilah di bawah iaitu definisi, rumus dan unit;

i) Stress

Tegasan

[2 marks]

[*2 markah*]

ii) Strain

Keterikan

[2 marks]

[*2 markah*]

iii) Young's Modulus

Modulus Young

[2 marks]

[*2 markah*]

iv) Safety Factor

Faktor Keselamatan

[2 marks]

[*2 markah*]

v) Poisson Ratio

Nisbah Poisson

[2 marks]

[*2 markah*]

CLO1 C2 (b) Explain what is Series Composite Bar and Parallel Composite Bar in term of external forces.

Terangkan apakah Bar Komposit Siri dan Bar Komposit Selari dalam terma tegasan haba.

[7 marks]

[*7 markah*]

CLO1 C3 (c) As shown in **Figure 1(c)**, a compound bar rigidly mounted on each end. Calculate the stress in each bar when the temperature in assembly is increases to 100°C.

*Seperti dalam **Rajah 1(c)**, satu bar majmuk yang diikat tegar pada setiap hujung. Kirakan tegasan yang terhasil pada setiap bar apabila suhu dinaikkan kepada 100°C.*

Given;

Copper bar, E = 200 GPa, and α = 12 μ/°C.

Aluminium bar, E = 107 GPa, and α = 17.5 μ/°C.

Diberi;

Tembaga bar, E = 200 GPa, and α = 12 μ/°C.

Aluminium bar, E = 107 GPa, and α = 17.5 μ/°C.

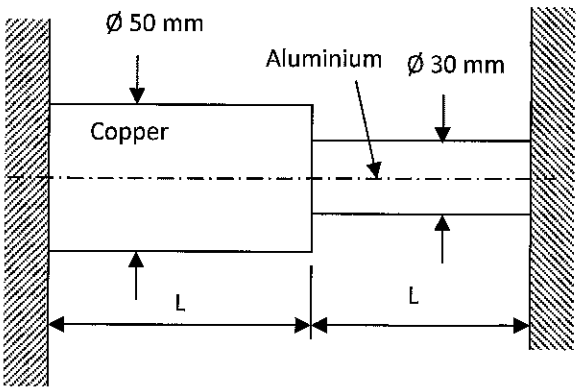


Figure 1(c)/ *Rajah 1(c)*

[8 marks]

[*8 markah*]

QUESTION 2

SOALAN 2

A simply supported beam is loaded with uniform distributed load and a pointed load as shown as **Figure 2.**

*Sebuah rasuk disangga mudah dikenakan beban teragih seragam dan satu daya tumpu seperti **Rajah 2.***

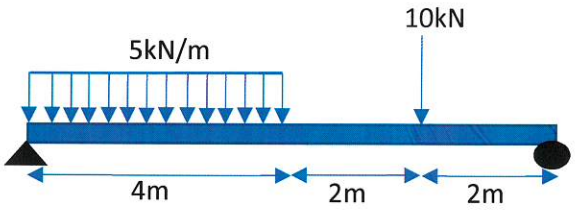


Figure 2/Rajah 2

CLO1 C2 *a)* With the aid of free body diagram, express the value of reaction force

Dengan batuan gambarajah badan bebas, dapatkan daya tindakbalas..

[5 marks]

[*5 markah*]

CLO1 C3 b) Calculate and sketch the shear force diagram.

Kirakan dan lakarkan gambarajah daya ricih.

[8 marks]

[*8 markah*]

CLO1 C3 c) Calculate and sketch the bending moment diagram.

Kirakan dan lakarkan gambarajah momen lentur.

[8 marks]

[8 markah]

CLO1 C3 d) Write the maximum moment value and its position

Tuliskan nilai momen maksimum dan kedudukannya.

[4 marks]

[*4 markah*]

QUESTION 3
SOALAN 3

CLO2 C1 (a) Based on the equation below, name **FIVE (5)** symbols and its unit.
*Berdasarkan persamaan dibawah, namakan **LIMA (5)** simbol dan unitnya.*

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

[5 marks]
[*5 markah*]

CLO2 C3 (b) Figure 3(b) shows the cross-sectional area of the simply supported beam.
Calculate:

Rajah 3(b) menunjukkan keratan rentas bagi satu rasuk disokong mudah.
Kirakan

i. Natural axis
Paksi neutral

[6 marks]
[*6 markah*]

ii. Second moment of area.
Momen luas kedua

[8 marks]
[*8 markah*]

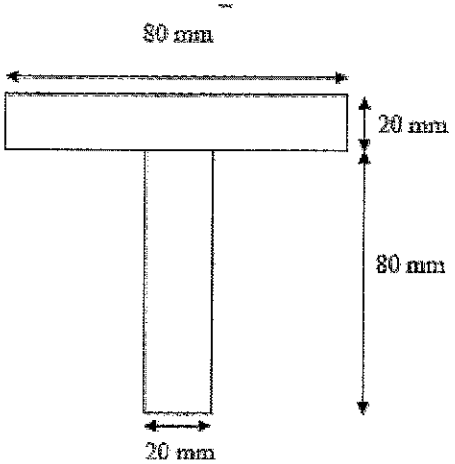


Figure 3(b) / *Rajah 3(b)*

CLO2 C4

(c) A 5 m long simply supported beam is given a point load of 25 kN at the middle of the beam. Determine the maximum deflection of the beam if the load were reduced 20%.

Given E = 190GN/m^2 and I = 13.5x10^{-6}m^4

Sebatang rasuk disokong mudah sepanjang 5 m dikenakan beban tumpu sebanyak 25 kN di pertengahan rasuk. Tentukan pesongan maksimum rasuk sekiranya beban tumpu berkurang 20%.

Diberi: E = 190GN/m^2 dan I = 13.5x10^{-6}m^4

[6 marks]

[*6 markah*]

QUESTION 4

SOALAN 4

CLO1 C1

(a) State the terms and unit for each symbol below.

Nyatakan terma dan unit bagi setiap simbol dibawah.

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

[5 marks]

[*5 markah*]

CLO1 C2

(b) A copper shaft has a diameter of 55 mm and 65 cm long is having applied torque of 2.85 kNm. Express the value of shear stress and twisting angle of the shaft due to applied torque if G_{copper} = 40G N/m^2.

Aci kuprum dengan diameter 55 mm dan 65 cm panjang dikenakan daya kilas 2.85 kNm. Bincang dan kira tegasan ricih dan sudut piuhan aci kesan dari kilasan yang dikenakan jika G_{copper} = 40G N/m^2

[8 marks]

[*8 markah*]

CLO1 C3

(c) A solid shaft with a length of 3.4 m at speed of 205 rpm transmits 7 MW of power. The shaft has a maximum allowable twisting angle is 4°. Calculate the torque of the shaft.

Aci padu yang panjangnya 3.4 m berkelajuan 205 rpm menghantar kuasa 7 MW Sudut piuhan maksima aci adalah is 4°. *Kirakan daya kilas aci*

[5 marks]

[*5 markah*]

CLO1 C4

(d) By referring to question 4(c), determine the diameter of shaft if value of G=80 GPa

Dengan merujuk soalan 4(c), Tentukan diameter aci jika nilai G=80 GPa

[7 marks]

[*7 markah*]

SOALAN TAMAT

LIST OF FORMULA DJJ30103 – STRENGTH OF MATERIALS

FORCES ON MATERIALS

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

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

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

4. Percent reduction in area = $\frac{A_f - A_0}{A_0} \times 100\ \%$

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.

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

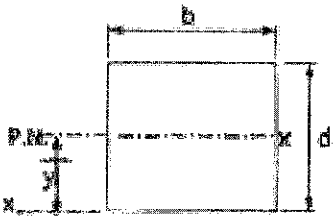
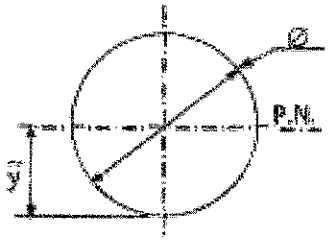
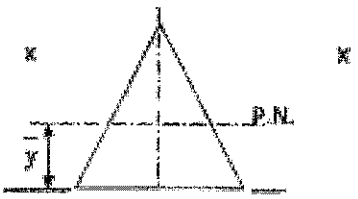
SHEAR FORCES AND BENDING MOMENT

$$\sum M_{\circlearrowleft} = \left(\sum M_{\circlearrowright}\right)$$

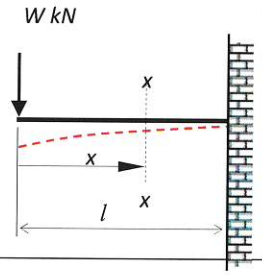
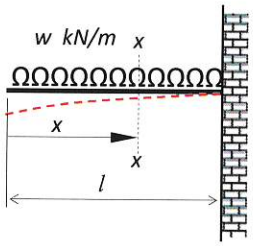
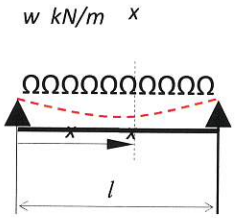
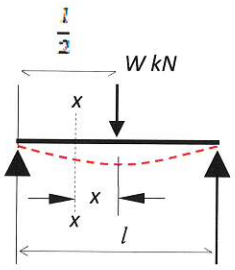
$$\sum F\uparrow = \sum F\downarrow$$

BENDING STRESS

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

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

BEAM DEFLECTION

Case	(Θ_{max}= dy/dx)	(y_{max})
	$\frac{Wl^2}{2EI}$	$-\frac{Wl^3}{3EI}$
	$\frac{wl^3}{6EI}$	$-\frac{wl^4}{8EI}$
	$\pm\frac{wl^3}{24EI}$	$-\frac{5wl^4}{384EI}$
	$\pm\frac{Wl^2}{16EI}$	$-\frac{Wl^3}{48EI}$

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

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

$$\begin{aligned}\theta_{AC}&=\theta_{AB}+\theta_{BC}\\&=\frac{T_1L_1}{G_1J_1}+\frac{T_2L_2}{G_2J_2}\\&=T\left(\frac{L_1}{G_1J_1}+\frac{L_2}{G_2J_2}\right)\end{aligned}$$

4. PARALLEL COMPOSITE SHAFT

$$T = T_1 + T_2$$

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