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 II : 2022 / 2023

DJJ30103: STRENGTH OF MATERIALS

TARIKH : 20 JUN 2023
MASA : 8.30 PAGI – 10.30 PAGI (2 JAM)

Kertas ini mengandungi **TUJUH (7)** 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)** questions. Answer **ALL** questions.

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

QUESTION 1

SOALAN 1

CLO1 (a) Choose **FIVE (5)** types of forces and their effect.
Pilih ***LIMA (5)** jenis daya dan kesannya*

[10 marks]
[*10 markah*]

CLO1 (b) A composite bar is fixed in series with 108 cm of steel bar and 38 cm of brass bar. A cross sectional area of steel bar is 900 mm^2 and brass bar is 345 mm^2. The axial load of 100kN is applied to the bar. Express the value of the total elongation for the composite bar. Given E_{st} =200 GN/m^2 and E_{br} = 100GN/m^2.
Sebuah bar dipasang secara bersiri dengan bar keluli 108 cm dan bar loyang 38 cm. Luas keratan rentas bar keluli ialah 900 mm^2 dan bar loyang ialah 345 mm^2. Beban paksi 100kN dikenakan pada bar. Dapatkan nilai bagi jumlah pemanjangan bar komposit. Diberi E_{st} =200 GN/m^2 and E_{br} = 100GN/m^2.

[7 marks]
[*7 markah*]

CLO1 (c) The **Figure 1(c)** shows a composite bar rigidly fixed at both ends. Calculate the stress that occurs in every bar if the temperature is increased by 50 ^{0} C.

Rajah 1(c) *menunjukkan satu bar majmuk yang pasang tegar pada kedua-dua hujungnya. Kirakan tegasan yang terhasil pada setiap bar jika suhu naik sebanyak 50 ^{0}C.*

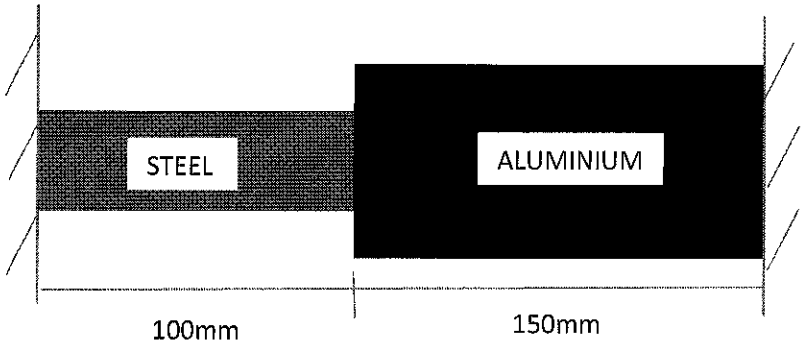


Figure 1(c)/ *Rajah 1(c)*

Given,

Diberi

Esteel = 200 GN/m^2 α = 12 X10^{-6}/^{0}C Area steel = 100 mm^2

Ealuminium = 69 GN/m^2 α = 23 X10^{-6}/^{0}C Area aluminium = 200 mm^2

[8 marks]
[8 markah]

QUESTION 2

SOALAN 2

A beam shown in **Figure 2** is subjected with uniform distributed load and concentrated load.

*Satu rasuk seperti dalam **Rajah 2** dikenakan beban teragih seragam dan beban tumpu.*

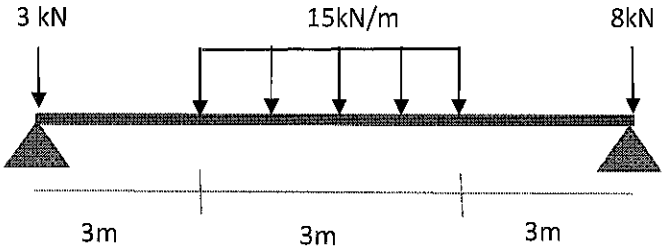


Figure 2/ *Rajah 2*

CLO1 a) Express the value of reaction force at support

Nyatakan nilai daya tindak balas di penyokong

[5 marks]
[*5 markah*]

CLO1 b) Calculate shear force value along the beam and sketch shear force diagram

Kirakan nilai daya ricih sepanjang rasuk dan lakar gambarajah daya ricih

[8 marks]
[*8 markah*]

CLO1 c) Calculate the bending moment value along the beam and sketch bending moment diagram

Kirakan nilai momen lentur sepanjang rasuk dan lakar gambarajah momen lentur.

[8 marks]
[*8 markah*]

CLO1 d) Write the maximum moment value and its position

Tuliskan nilai momen maksimum dan kedudukannya.

[4 marks]
[*4 markah*]

QUESTION 3

SOALAN 3

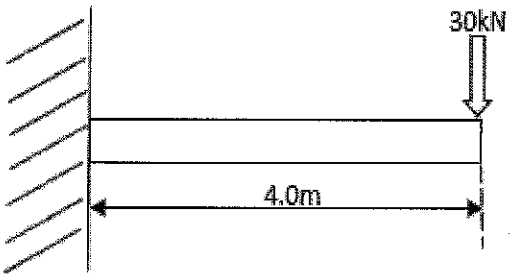
CLO2 (a) Name **FIVE (5)** symbol below with their unit.

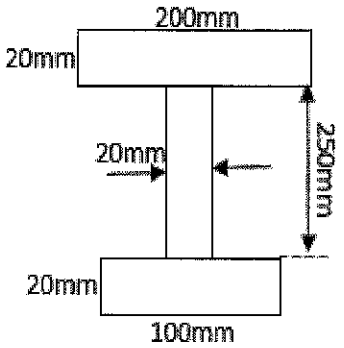
*Namakan **LIMA (5)** simbol dibawah beserta unitnya*

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

[5 marks]
[*5 markah*]

CLO2 (b) A cantilever beam of 4.0m long supports a load of 30kN. Calculate
Satu rasuk julur 4.0m panjang menyokong beban 30kN. Kirakan





i) Neutral axis
Paksi Neutral

[5 marks]
[*5 markah*]

i) Second area of moment
Momen Luas kedua

[6 marks]
[*6 markah*]

ii) Tensile bending stress
Tegasan lentur maksimum

[3 marks]
[*3 markah*]

CLO2 (c) **Figure 3(c)** shows 5m simply supported beam with distributed load of 6kN/m along the beam. Given EI = 72.917 kNm^2. By using the formula, determine the slope in degree unit at point B is the beam length were **decreased 20%**.

Rajah 3(c) *menunjukkan satu rasuk mudah sepanjang 5m dikenakan beban tergih seragam 6kN/m sepanjang rasuk. Diberi EI = 72.917 kNm^2. Dengan menggunakan formula, Tentukan kecerunan dalam unit darjah di titik B, sekirannya panjang rasuk* ***berkurang*** *sebanyak* ***20%****.*

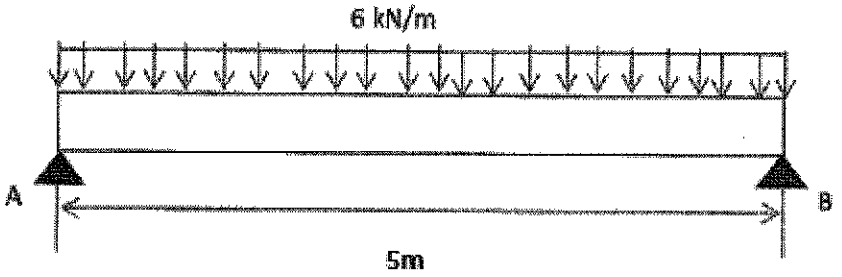


Figure 3(c) /Rajah 3(c)

[6 marks]
[*6 markah*]

QUESTION 4
SOALAN 4

CLO1 (a) State **FIVE (5)** symbols and their unit, for the equation below.
*Nyatakan **LIMA (5)** simbol beserta unitnya bagi persamaan dibawah.*

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

[5 marks]
[*5 markah*]

CLO1 (b) A 2m hollow shaft has 80 mm outer diameter with 10mm thickness is subjected to a torque of 200Nm. Given G= 70GPa, express the value of twisting angle for the shaft.

Sebatang 2m aci bergerongga berdiameter luar 80 mm dengan ketebalan 10 mm dikenakan daya kilas sebanyak 200Nm. Diberi G=70GPa. Dapatkan nilai sudut putaran bagi aci.

[8 marks]
[*8 markah*]

CLO1 (c) A solid steel shaft of 5m long is stressed at 80MPa when twisted through 0.0698 radian. Using G=83 GPa, Calculate shaft diameter

Sebatang aci padu sepajang 5m dikenakan tegasan sebanyak 80MPa apabila diputarkan 0.0698 radian. Diberi G=83GPa. Kirakan diameter aci

[5 marks]
[*5 markah*]

CLO1 (d) Referring to question 4(c), determine power transmitted by the shaft at 20 rev/min
Tentukan kuasa yang dihantar oleh aci pada 20 ppm

[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, $\nu = \frac{\text{laterial strain}}{\text{longitudinal strain}}$

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

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

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.

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

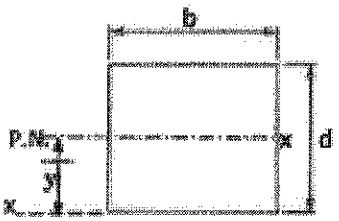
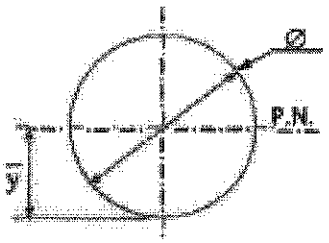
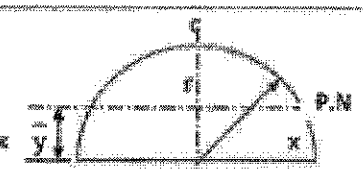
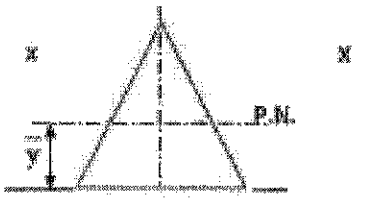
SHEAR FORCES AND BENDING MOMENT

$$\sum M_{\circlearrowleft} = \sum M_{\circlearrowright}$$

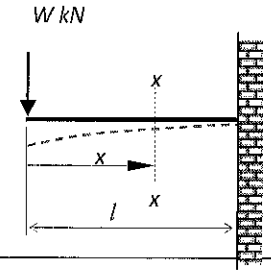
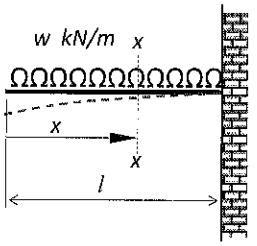
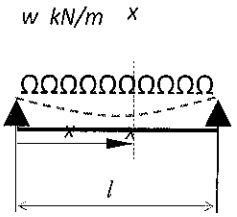
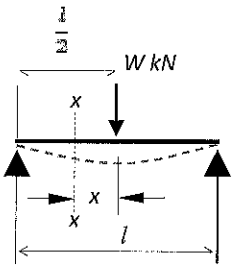
$$\sum F_{\uparrow} = \sum F_{\downarrow}$$

BENDING STRESS

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

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

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

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

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

4. PARALLEL COMPOSITE SHAFT

$$T = T_1 + T_2$$

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