SULIT

POLITEKNIK MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI DISEMBER 2017

DJJ3103 : STRENGTH OF MATERIAL

TARIKH : 02 APRIL 2018
MASA : 2.30 PETANG - 4.30 PETANG (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)** structured questions. Answer **ALL** questions.

ARAHAN:

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

QUESTION 1

SOALAN 1

(a) Identify each point shown in **Figure 1(a)** below.

*Kenalpasti dan namakan titik-titik dalam **Rajah 1(a)** dibawah*

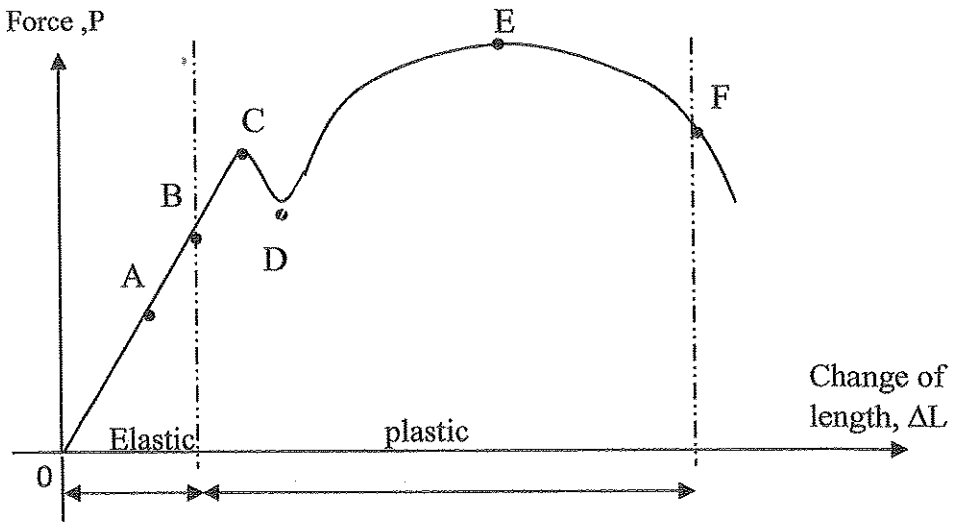


Figure 1(a) / Rajah 1(a)

[6 marks]

[*6 markah*]

CLO1
C2

(b) A rod with a diameter of 30 mm is subjected to compressive force of 170 kN. This force causes a reduction of 0.17×10^{-3} m of the rod's length. The initial length of the rod is 250 mm. Determine the modulus of elasticity of this material.

Satu rod berdiameter 30 mm dikenakan daya mampatan sebanyak 170 kN. Beban ini menyebabkan pengurangan panjang 0.17×10^{-3} m. Panjang asal rod adalah 250 mm. Tentukan modulus keanjalan bahan ini.

[8 marks]

[*8 markah*]

CLO1
C3

(c) A series composite bar consists of steel and brass bar is fixed in between two rigid walls at 20^0C shown in **Figure 1(c)** below. Calculate the stress induced in each of the bars if the temperature is increased to 80^0C. Given:

Bar majmuk siri diperbuat daripada logam keluli dan tembaga diikat tegar di setiap hujungnya pada suhu 20^0C seperti **Rajah 1(c)** dibawah . *Kirakan tegasan pada setiap bar apabila suhu meningkat sehingga mencapai* $80\,^0$C. *Diberi:*

$E_{brass} = 107GN/m^2$, $\alpha_{brass} = 17.5 \times 10^{-6}/^0C$

$E_{steel} = 200GN/m^2$, $\alpha_{steel} = 12.0 \times 10^{-6}/^0C$

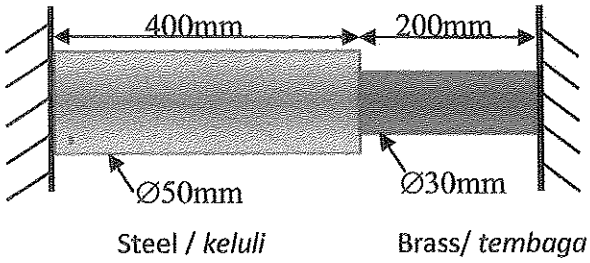


Figure 1(c) / Rajah 1(c)

[11 marks]

[*11 markah*]

QUESTION 2

SOALAN 2

A simple supported beam that carries uniformly distributed load and concentrated load at different distance as shown in **Figure 2**.

*Satu rasuk disokong mudah yang dikenakan daya teragih seragam dan daya paksi pada jarak yang berbeza seperti dalam **Rajah 2**.*

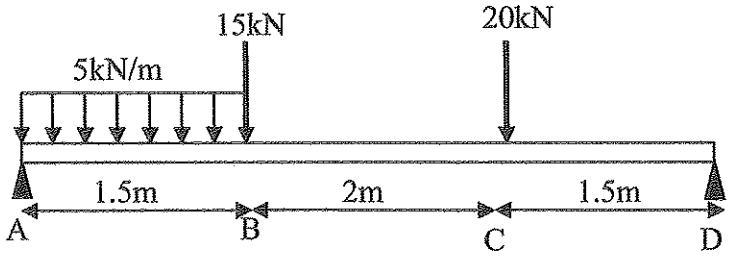


Figure 2 / *Rajah 2*

CLO1 C2 (a) Calculate the reaction force at point A and D

Kirakan daya tindak balas yang berlaku pada titik A dan D

[5 marks]

[*5 markah*]

CLO1 C3 (b) Calculate shear force and bending moment at all points along the beam.

Kirakan daya ricih dan momen lentur yang berlaku pada setiap titik disepanjang rasuk

[10 marks]

[*10 markah*]

CLO1 C3 (c) Draw the shear force and bending moment diagram for the beam. Determine the maximum bending moment value from the diagram.

Lukiskan gambarajah daya ricih dan gambarajah momen lentur rasuk tersebut. Tentukan nilai momen lentur maksimum daripada rajah tersebut.

[10 marks]

[*10 markah*]

QUESTION 3

SOALAN 3

CLO1
C1

(a) Name **SIX (6)** symbols and their units from the following equation.

Senaraikan ENAM (6) symbol dan unit berdasarkan rumus berikut.

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

[6 marks]

[*6 markah*]

CLO1
C2

(b) A simple supported beam with rectangular cross section carrying a uniformly distributed load of 10 kN\m is shown in **Figure 3(b).** Determine the maximum bending stress in the beam.

Satu rasuk disangga mudah dengan berkeratan rentas segiempat membawa beban teragih seragam 10 kN/m seperti dalam ***Rajah 3(b).*** *Dapatkan tegasan lentur maksimum dalam rasuk.*

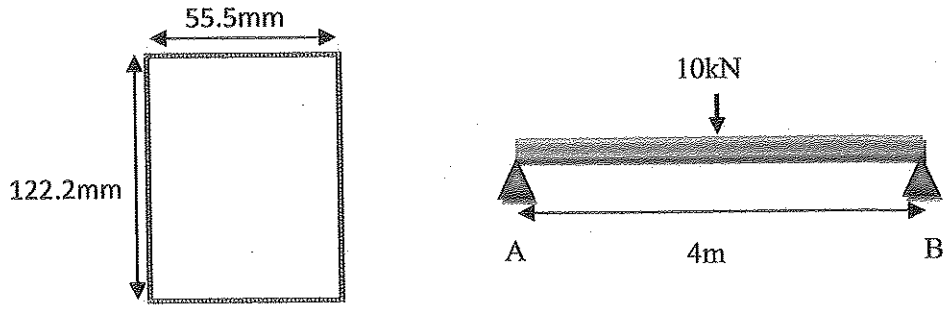


Figure 3(b) / *Rajah 3(b)*

[8 marks]

[*8 markah*]

CLO1
C3

c) Calculate the slope at A for the following beam shown in **Figure 3(c)** by using Double Integration Method.

*Hitungkan kecerunan pada A bagi rasuk yang ditunjukkan dalam **Rajah 3(c)** dengan menggunakan Kaedah Kamiran Berganda.*

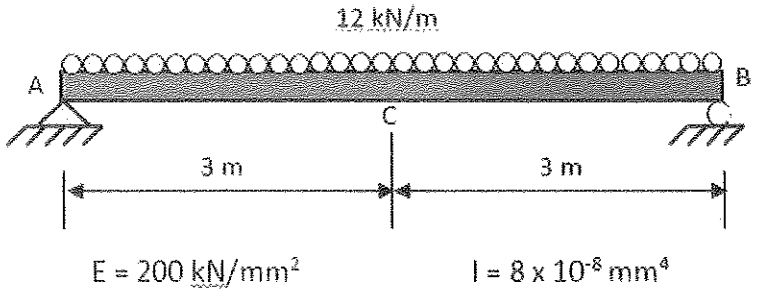


Figure 3(c) / Rajah 3(c)

[11 marks]

[*11 markah*]

QUESTION 4

SOALAN 4

CLO1
C1

(a) Define and state the units for any **FIVE (5)** of the symbols from the torsion equation below.

*Takrifkan dan nyatakan unit-unit untuk mana-mana **LIMA (5)** simbol daripada persamaan kilasan di bawah.*

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

[5marks]

[*5 markah*]

CLO2
C2

(b) A hollow aluminium tube of 2.75m length used in a roof structure has an outside diameter of 104mm and inside diameter of 82mm. If the tube is twisted in pure torsion by torques acting at one end, calculate the angle of twist (in degree) when the maximum shear stress is 48Mpa. Given, G = 28GPa

Sebatang tiub aluminium berongga sepanjang 2.75m digunakan dalam struktur bumbung berdiameter luar 104mm dan diameter dalam 82mm. Sekiranya tiub itu di kilas disatu hujung dengan daya kilasan padu, kirakan sudut kilasan (dalam darjah) apabila daya ricih maksimum adalah 48Mpa? Diberi, G = 28GPa.

[7 marks]

[*7 markah*]

CLO2
C3

(c) A circular compound shaft AB and BC are bonded together at point B where it is rigidly fixed at both ends, A and C. The portion AB is made of brass and 450mm long and 50mm in diameter while BC is made of aluminium and 300mm long with 38mm in diameter. If a twisting moment of 1.2kNm is applied at B, calculate the maximum shearing stress for:

Sebatang shaf majmuk berputar AB dan BC digabungkan bersama di titik B yang mana kedua-dua hujung A dan C adalah tetap. Bahagian AB adalah tembaga dengan panjangnya 450mm dan berdiameter 50mm sementara bahagian BC adalah aluminium dengan panjangnya 300mm dan berdiameter 38mm. Sekiranya momen kilasan sebanyak 1.2kNm dikenakan di B, tentukan daya ricih maksumum untuk:

i. Brass cylinder bar / *Bar silinder tembaga*

ii. Aluminium cylinder bar / *Bar silinder aluminium*

Given / *Diberi*, $G_{Brass} = 39GN/m^2$ and $G_{Aluminium} = 26GN/m^2$

[13 marks]

[*13 markah*]

SOALAN TAMAT

LIST OF FORMULA DJJ3103 - STRENGTH OF MATERIALS

FORCES ON MATERIALS

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

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

3. Percent Elongation = $\dfrac{\text{Elongation}}{\text{Length}}$ x 100 %

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

5. Strain Energy, $U = \dfrac{1}{2} P\Delta L$

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.

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

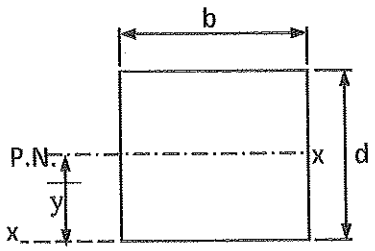
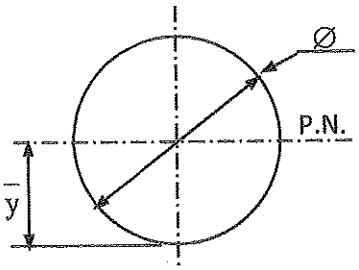
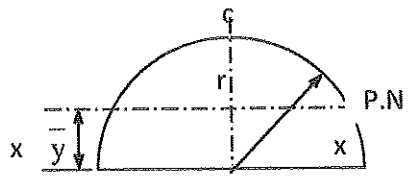
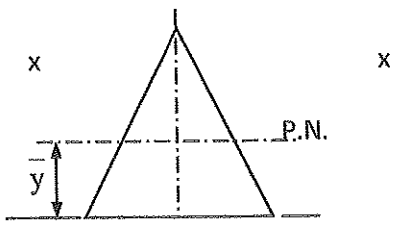
SHEAR FORCES AND BENDING MOMENT

$$\sum M_A \circlearrowright = \sum M_A \circlearrowleft$$

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

BENDING STRESS

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

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

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

$$T = T_1 + T_2$$

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