

SULIT



**BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN MALAYSIA**

JABATAN KEJURUTERAAN MEKANIKAL

**PEPERIKSAAN AKHIR
SESI DISEMBER 2018**

DJJ3103: STRENGTH OF MATERIAL

**TARIKH : 24 APRIL 2019
MASA : 11.15 PAGI - 1.15 TENGAHARI (2 JAM)**

Kertas ini mengandungi **SEPULUH (10)** halaman bercetak.
Soalan Struktur (4 soalan)
Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN
(CLO yang tertera hanya sebagai rujukan)

SULIT

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
C1

- (a) List **THREE (3)** types of forces and illustrate them using suitable figures.
Senaraikan TIGA (3) jenis daya dan ilustrasikan menggunakan rajah yang sesuai.

[6 marks]

[6 markah]

CLO1
C2

- (b) A rod with 4.5 m length and cross sectional area of 1050 mm² elongates by 6.56 mm when 65 kN tensile force is applied on both sides. Calculate ,
Sebatang rod dengan panjang 4.5 m dan luas keratan rentas 1050 mm² memanjang sebanyak 6.56 mm apabila 65 kN daya tegangan dikenakan pada kedua sisi. Kira:

- i. the tensile stress in the rod
tegangan tegangan dalam rod

[2 marks]

[2 markah]

- ii. the strain in the rod
keterikan dalam rod

[2 marks]

[2 markah]

- iii. Young's Modulus of the rod
Modulus Young

[2 marks]

[2 markah]

- iv. The safety factor if the maximum stress (or ultimate stress) is 332 MN/m^2

faktor keselamatan jika tegasan maksimum (atau tegasan muktamad) adalah 332 MN/m^2

[2 marks]

[2 markah]

CLO1
C3

- (c) Consider both specimens set in figure A and Figure B are subjected to same temperature raise at 80°C .

*Pertimbangkan kedua-dua set spesimen dalam **Rajah A** dan **Rajah B** dikenakan peningkatan suhu sama sebanyak 80°C .*

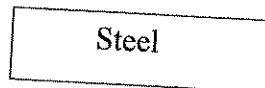


Figure A
Rajah B

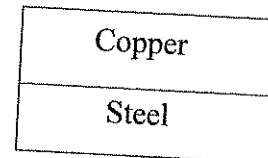


Figure B
Rajah B

Given t:-

Diberi:-

$$E_{\text{Steel/keulu}} = 200 \text{ GPa}$$

$$\alpha_{\text{steel/keulu}} = 11.7 \times 10^{-6}/^\circ\text{C}$$

$$A_{\text{Steel/keulu}} = 1000 \text{ mm}^2$$

$$L_{\text{Steel/keulu}} = 4200 \text{ mm}$$

$$E_{\text{copper/tembaga}} = 120 \text{ GPa}$$

$$\alpha_{\text{copper/tembaga}} = 17.0 \times 10^{-6}/^\circ\text{C}$$

$$A_{\text{copper/tembaga}} = 900 \text{ mm}^2$$

$$L_{\text{copper/tembaga}} = 4200 \text{ mm}$$

- i. Calculate the stress in the bar as in **Figure A**
*Kira tegasan dalam bar seperti dalam **Rajah A***

[3 marks]

[3 markah]

- ii. Calculate the stresses in both bars as in **Figure B**
*Kira tegasan dalam kedua-dua bar seperti dalam **Rajah B***

[8 marks]

[8 markah]

QUESTION 2

SOALAN 2

A simple supported beam carrying a few loads as shown in **Figure 2** below.

Satu rasuk disokong mudah dikenakan beberapa daya seperti ditunjukkan dalam Rajah 2 dibawah.

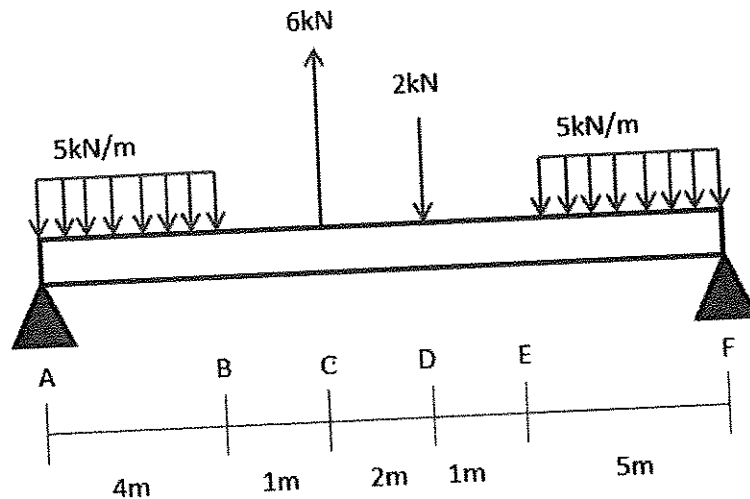


Figure 2

Rajah 2

CLO1
C2

- (a) Calculate the reaction force at point A and F
Kira daya tindak balas pada titik A dan F

[5 marks]

[5 markah]

CLO1
C3

- (b) Calculate the shear force along the beam and sketch shear force diagram
Kirakan daya ricih sepanjang rasuk tersebut dan lukiskan gambarajah daya ricih

[10 marks]

[10 markah]

CLO1
C3

- (c) Calculate the bending moment value along the beam and sketch bending moment diagram
Kirakan nilai momen lentur sepanjang rasuk tersebut dan lukiskan gambarajah momen lentur

[10 marks]

[10 markah]

QUESTION 3

SOALAN 3

CLO1
C1

- (a) Based on the equation below, Name each symbol and its unit.
Berdasarkan persamaan dibawah, Namakan setiap simbol dan unitnya.

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

[6 marks]

[6 markah]

CLO1
C2

- (b) The **Figure 3(b)** below shows the cross sectional of a simply supported beam. It carries a uniformly distributed load 50 kN/m along its 7 m length. Calculate the moment of inertia.

Rajah 3(b) dibawah menunjukkan keratan rentas bagi satu rasuk disangga mudah. Ia menanggung beban teragih seragam sebanyak 50 kN/m disepanjang 7 m panjang. Kirakan momen inersia.

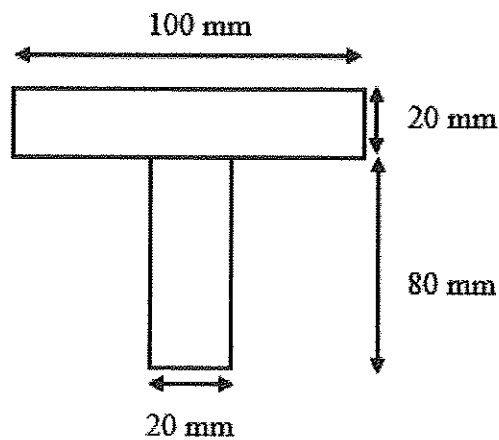


Figure 3(b)
Rajah 3(b)

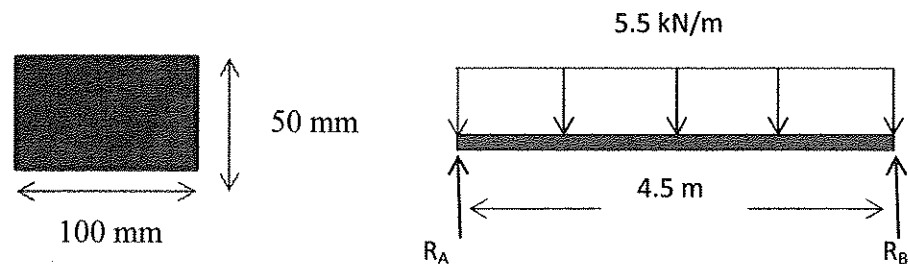
[8 marks]

[8 markah]

CLO1
C3

- (c) Beam AB with length of 4.5 m carry 5.5 kN/m uniformly distributed load along its, the cross section as shown in **Figure 3(c)**. Use Modulus of Elasticity, $E = 70 \text{ GPa}$ to calculate the slope at end A and the deflection at the midpoint of beam by using the double integration method.

*Rasuk AB dengan panjang 4.5m menanggung 5.5 kN/m beban teragih seragam disepanjangnya, keratan rentas rasuk adalah seperti ditunjukkan dalam **Rajah 3(c)**. Gunakan Modulus Keanjalan, $E = 70 \text{ GPa}$ untuk mengira kecerunan pada hujung A dan pesongan pada titik tengah rasuk menggunakan kaedah kamiran berganda.*

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

[11 marks]

[11 markah]

QUESTION 4**SOALAN 4**CLO1
C1

- (a) State the meaning of each symbol and its unit for the equation below.
Nyatakan maksud setiap symbol dan unitnya bagi persamaan dibawah.

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

[5 marks]

[5 markah]

- CLO1
C2
- (b) A shaft with 45 mm diameter and 0.45 m long is subjected to a torque of 1500 Nm. Determine the shear stress and the angle of twist of the shaft.
Satu aci berdiameter 45 mm dan 0.45 m panjang dikenakan daya kilas 1500 Nm. Kira tegasan ricih dan sudut puih aci tersebut.
- [7 marks]
[7 markah]
- CLO1
C3
- (c) A steel shaft in a length of 2.6 m transmits 5 MW of power at 210 rpm without exceeding a shearing stress of 55 MPa and twisting angle not more than 3° . Calculate the diameter of the shaft if $G = 90 \text{ GPa}$.
Satu aci logam sepanjang 2.6 m memindahkan 5 MW kuasa pada 210 ppm tanpa mencapai tegasan ricih 55 MPa dan sudut puih tidak melebihi 3° . Kirakan diameter aci jika $G = 90 \text{ GPa}$.
- [13 marks]
[13 markah]

SOALAN TAMAT

LIST OF FORMULA JJ310- 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 = $\frac{A_f - A_o}{A_o} \times 100 \%$

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

$$\sum M_A \curvearrowright = \left(\sum M_A \curvearrowleft \right)$$

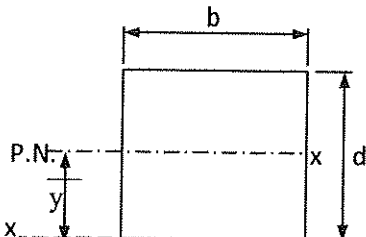
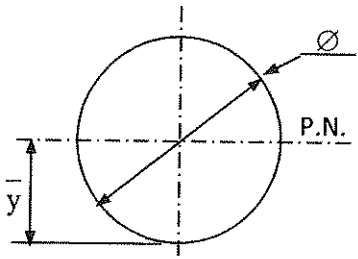
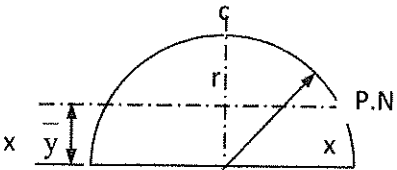
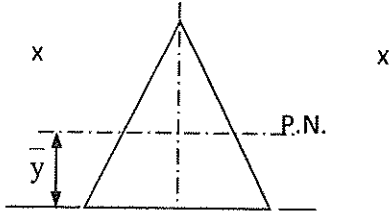




$$\Sigma F = \Sigma F$$

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

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

$$\begin{aligned}\theta_{AC} &= \theta_{AB} + \theta_{BC} \\ &= \frac{T_1 L_1}{G_1 J_1} + \frac{T_2 L_2}{G_2 J_2} \\ &= T \left(\frac{L_1}{G_1 J_1} + \frac{L_2}{G_2 J_2} \right)\end{aligned}$$

4. PARALLEL COMPOSITE SHAFT

$$T = T_1 + T_2$$

$$\theta = \left(\frac{T_1 L_1}{G_1 J_1} \right) = \left(\frac{T_2 L_2}{G_2 J_2} \right)$$