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
tegasan 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/m²

faktor keselamatan jika tegasan maksimum (atau tegasan muktamad) adalah 332 MN/m²

[2 marks]

[*2 markah*]

CLO1 C3

(c) Consider boths 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.*

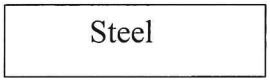


Figure A

Rajah B

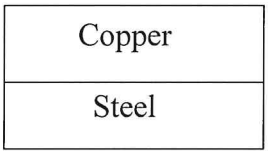


Figure B

Rajah B

Given t:-

Diberi:-

$E_{Steel/keluli}$ = 200 GPa

$\alpha_{steel/keluli}$ = 11.7x10^{-6}/°C

$A_{Steel/keluli}$ = 1000mm^2

$L_{Steel/keluli}$ = 4200 mm

$E_{copper/tembaga}$ = 120 GPa

$\alpha_{copper/tembaga}$ = 17.0x10^{-6}/°C

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

$L_{copper/tembaga}$ = 4200 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.*

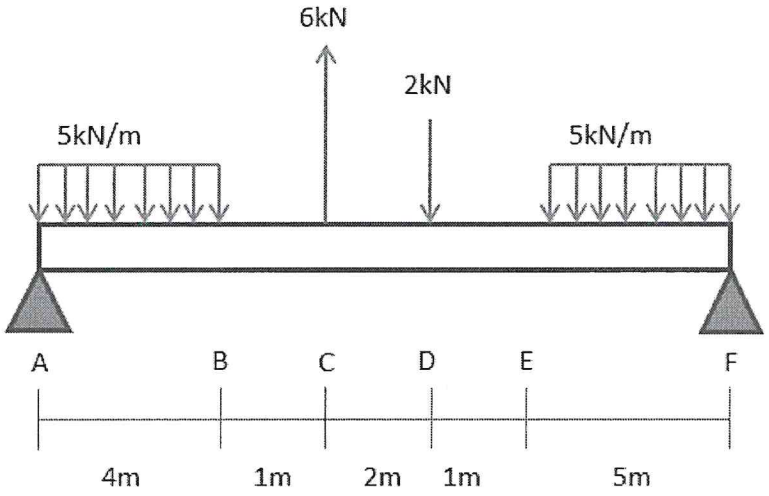


Figure 2

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.*

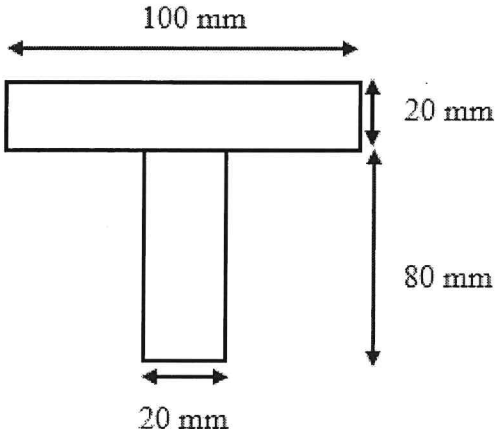


Figure 3(b)
Rajah 3(b)

[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 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 GPa untuk mengira kecerunan pada hujung A dan pesongan pada titik tengah rasuk menggunakan kaedah kamiran berganda.*

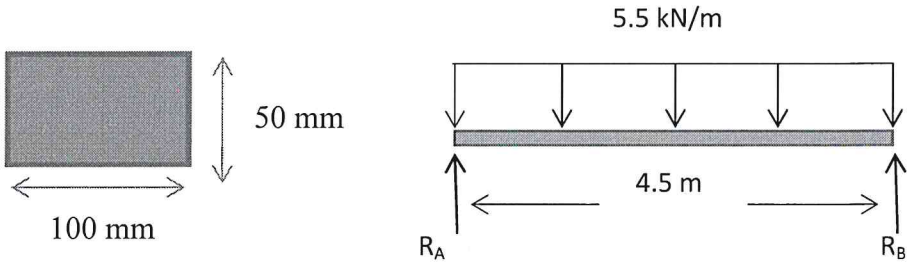


Figure 3(c)

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 at 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 piuh 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^{o}. Calculate the diameter of the shaft if G = 90 GPa.

Satu aci logam sepanjang 2.6 m memindahkan 5 MW kuasa pada 210 ppm tanpa mencapai tegasan ricih 55 MPa dan sudut piuh tidak melebihi 3^{o}. Kirakan diameter aci jika G = 90 GPa.

[13 marks]

[*13 markah*]

SOALAN TAMAT

POLITEKNIK MALAYSIA

LIST OF FORMULA JJ310- 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 = ——— 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.

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

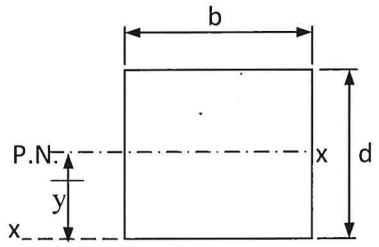
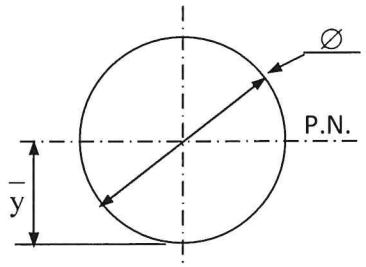
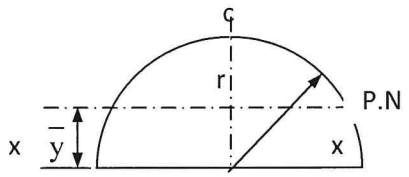
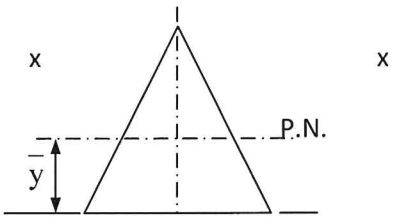
SHEAR FORCES AND BENDING MOMENT

$\sum M_A$ = $\sum M_A$

$$\Sigma F \quad = \quad \Sigma F$$

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

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

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

4. PARALLEL COMPOSITE SHAFT

$$T = T_1 + T_2$$

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