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) State **THREE (3)** effects on the material under load.
*Nyatakan **TIGA (3)** kesan pada bahan yang dikenakan beban.*

[6 marks]
[*6 markah*]

CLO1
C2

(b) Referring to Figure 1(b), the stress versus strain graph for mild steel after tensile testing. Plot **FOUR (4)** important points at the graph and explain the condition of the specimen in between yield point.
*Merujuk kepada Rajah 1(b), graf tegasan melawan keterikan bagi keluli lembut selepas menjalani ujian tegangan. Plotkan **EMPAT (4)** titik penting pada graf tersebut dan terangkan apa yang berlaku pada spesimen ketika berada di antara titik alah.*

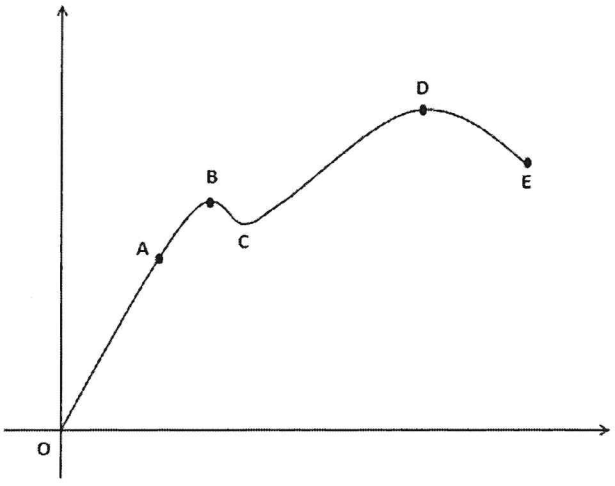


Figure 1(b) / Rajah 1 (b)

[8 marks]
[*8 markah*]

CLO1
C3

(c) A hollow mild steel has an outer diameter of 30mm, thickness of 5mm and 1.5m length. A solid rod of copper is fixed inside. The composite bar is rigidly fixed at both ends. Calculate the stress developed in each bar when the temperature is increased to 70°C.

Sebatang keluli lembut bergeronggang mempunyai diameter luar 30mm, ketebalan 5mm dan panjang 1.5m. Sebatang rod kuprum dipasang di dalam keluli tersebut. Bar komposit ini dipasang tegar di kedua-dua hujung. Kirakan tegasan yang berlaku pada setiap bar apabila suhu dinaikkan ke 70°C.

Given, $E_{Steel} = 206\ GN/m^2$ $\alpha_{Steel} = 12 \times 10^{-6}/^oC$

$E_{Copper} = 109\ GN/m^2$ $\alpha_{Copper} = 18.5 \times 10^{-6}/^oC$

Diberi: $E_{keluli} = 206\ GN/m^2$ $\alpha_{keluli} = 12 \times 10^{-6}/^oC$

$E_{kuprum} = 109\ GN/m^2$ $\alpha_{kuprum} = 18.5 \times 10^{-6}/^oC$

[11 marks]
[*11 markah*]

QUESTION 2
SOALAN 2

Figure 2 shows a 6m simply supported beam carries a uniform distributed load of 1.5 kN/m over the entire span and a point load of 2 kN at 2m from the right support.
Rajah 2 menunjukkan satu rasuk mudah sepanjang 6m menanggung beban teragih seragam 1.5kN/m pada keseluruhan rasuk dan beban tumpu, 2kN pada 2m dari penyokong kanan.

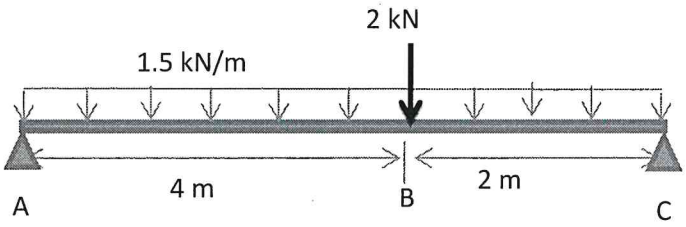


Figure 2 / Rajah 2

CLO1 C2 (a) Referring to Figure 2, with the aid of free body diagram for the beam, express the value of reaction force.
Merujuk kepada Rajah 2, dengan bantuan gambarajah badan bebas bagi rasuk, dapatkan nilai daya tindak balas.

[5 marks]
[*5 markah*]

CLO1 C3 (b) Calculate the shear force along the beam and sketch shear the force diagram.
Kirakan daya ricih sepanjang rasuk dan lakarkan gambarajah daya ricih.

[10 marks]
[*10 markah*]

CLO1 C3 (c) Calculate the bending moment value along the beam and sketch the bending moment diagram.
Kirakan nilai momen lentur sepanjang rasuk dan lakarkan gambarajah momen lentur.

[10 marks]
[*10 markah*]

QUESTION 3
SOALAN 3

CLO1
C1

(a) Name each symbol below with their unit.
Namakan setiap simbol dibawah beserta unitnya.

$$\frac{M}{I_{NA}} = \frac{\sigma}{\bar{y}} = \frac{E}{R}$$

[6 marks]
[*6 markah*]

CLO1
C2

(b) Figure 3 shows the bending moment, M = 600Nm acting on a cross section of the beam. Express the value of maximum bending stress in the beam.
Rajah 3 menunjukkan Momen lentur, M = 600Nm bertindak ke atas keratan rentas suatu rasuk. Dapatkan nilai tegasan lentur maksimum di dalam rasuk.

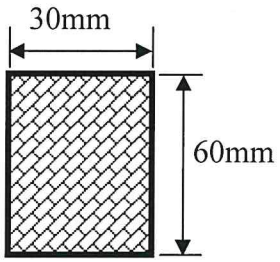


Figure 3/ *Rajah 3*

[8 marks]
[*8 markah*]

CLO1
C3

(c) A 5m long simply supported beam is given a point load of 20kN at the middle of the beam. Calculate the maximum deflection of the beam. Given E= 190GN/m^2 and I = 13.5 x 10^{-6} m^4.
Sebatang rasuk disokong mudah sepanjang 5m dikenakan beban tumpu sebanyak 20kN di pertengahan rasuk. Kirakan pesongan maksimum rasuk. Diberi E= 190GN/m^2 dan I = 13.5 x 10^{-6} m^4.

[11 marks]
[*11 markah*]

QUESTION 4
SOALAN 4

CLO1
C1

(a) State the equation and units for Second Polar Moment of Area for solid cylinder and hollow cylinder.
Nyatakan formula dan unit bagi Polar Momen Luas Kedua bagi aci silinder padu dan aci silinder berlubang.

[5 marks]
[*5 markah*]

CLO1
C2

(b) A shaft with 60mm diameter and 0.9m long is subjected to a torque of 1300Nm. Given G = 70GPa. Express the value angle of twist for the shaft.
Sebatang aci berdiameter 60mm dan panjang 0.9m dikenakan daya kilas sebanyak 1300Nm. Diberi G = 70GPa. Dapatkan nilai putaran bagi aci.

[7 marks]
[*7 markah*]

CLO1
C3

(c) A shaft with diameter of 100mm and 3m long is transmitting 70kW power at 500rpm. Calculate;
Sebatang aci berdiamater 100mm dan panjang 3m memindahkan kuasa sebanyak 70kW pada 500ppm. Kirakan;

i) Shear stress induced in the shaft.
Tegasan ricih yang terhasil di dalam aci.

[9 marks]
[*9 markah*]

ii) Modulus of Rigidity if the twisting angle is 0.0025 rad.
Modulus Ketegaran jika sudut putaran adalah 0.0025 rad.

[4 marks]
[*4 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 $= \dfrac{\text{Elongation}}{\text{Length}} \times 100\ \%$

4. Percent reduction in area $= \dfrac{A_{f-A_o}}{A_o} \times 100\ \%$

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.

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

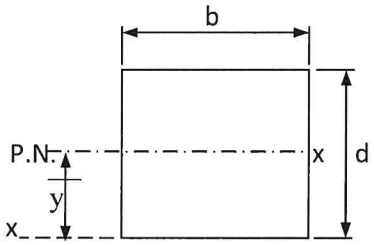
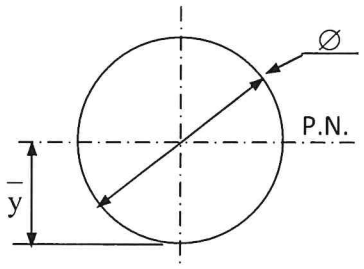
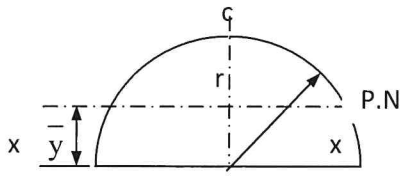
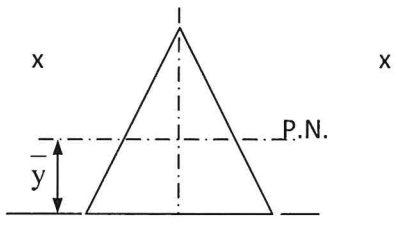
SHEAR FORCES AND BENDING MOMENT

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

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

BENDING STRESS

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

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

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

$$T = T_1 + T_2$$

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