POLITEKNIK
MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI DISEMBER 2015

DJJ3103 : STRENGTH OF MATERIAL

TARIKH : 13 APRIL 2016
MASA : 2.30 PM – 4.30 PM (2 JAM)

Kertas ini mengandungi **SEMBILAN (9)** 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

CLO 1
C1

(a)   List **FOUR (4)** types of loads with examples

*Senaraikan **EMPAT (4)** jenis beban berserta contoh*

[6 marks]

[*6 markah*]

CLO 1
C2

(b)   Identify the formulas and units of the following terms;

Kenal pasti rumus dan unit bagi terma-terma berikut;

    i.   Poisson ratio

        Nisbah Poisson

    ii.   Safety factor

        Faktor keselamatan

    iii.   Young Modulus

        Modulus Young

[6 marks]

[*6 markah*]

CLO 1
C3

(c)   The Figure 1(c) shows a compound bar rigidly mounted on each end. Calculate the stress that occurs in every bar if the temperature is lowered to 50° C.

Rajah 1(c) menunjukkan satu bar majmuk yang di ikat tegar pada kedua-dua hujungnya. Kirakan tegasan yang terhasil pada setiap bar jika suhu diturunkan kepada 50° C.

Given;

Diberi;

$$E_{steel} = 200 \text{ GN/m}^2 \text{ ; } \alpha_{steel} = 12 \times 10^{-6} /{}_\circ \text{ C} \text{ ; } Area_{steel} = 100 \text{ mm}^2$$

$$E_{al} = 69 \text{ GN/m}^2 \text{ ; } \alpha_{al} = 23 \times 10^{-6} /{}_\circ \text{ C} \text{ ; } Area_{al} = 200 \text{ mm}^2$$
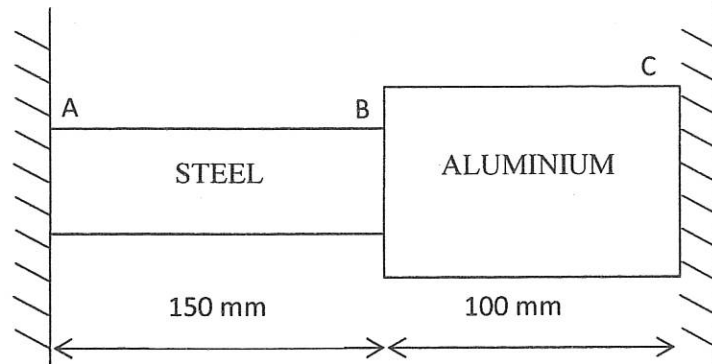

Figure 1(c) / *Rajah 1(c)*

[13 marks]

[*13 markah*]

QUESTION 2
SOALAN 2

A beam shown in Figure 2 is subjected with uniform distributed load of 3 kN/m from point A to point C and concentrated load of 8 kN at point D.

Satu rasuk seperti dalam Rajah 2 dikenakan daya 3 kN/m beban teragih seragam dari titik A ke titik C dan beban tumpu sebanyak 8 kN pada titik D.
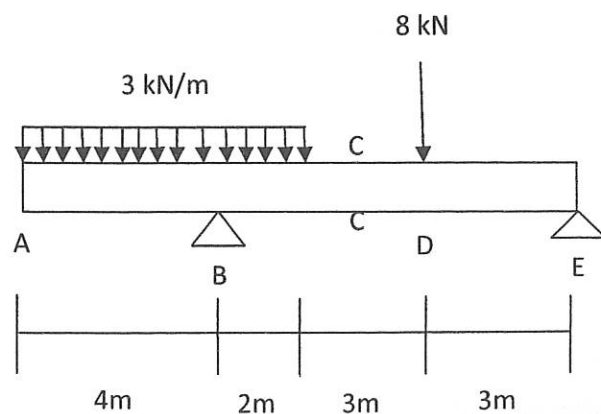

Figure 2 / *Rajah 2*

CLO 1
C1

i.   Sketch the free body diagram of the beam

     Lukiskan gambarajah jasad bebas rasuk

           [2 marks]

           [*2 markah*]

CLO 1
C3

ii.   Determine shear force and bending moment at point ABCDE.

     Tentukan daya ricih dan momen lentur pada titik ABCDE.

           [10 marks]

           [*10 markah*]

CLO2
C3

iii.   Sketch the shear force and bending moment diagram.

     Lakarkan gambarajah daya ricih dan momen lentur.

           [8 marks]

           [*8 markah*]

CLO1
C4

iv.   Analyze the value of Contraflexure point from point A.

     Analisa nilai Titik kontralentur dari titik A.

           [5 marks]

           [*5 markah*]

QUESTION 3
SOALAN 3

CLO1
C1

(a)   State the meanings and its units of each symbols for equation below

     Nyatakan maksud dan unit bagi setiap simbol – simbol persamaan dibawah

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

           [7 marks]

           [*7 markah*]

CLO1
C2

(b)   Beam AB supports a uniformly distributed load of 6 kN/m with dimensions shown in Figure 3(b). Solve the problems by using the double integration method. Used the given EI = 72.917 kNm².

Rasuk AB dikenakan beban teragih seragam 6 kN/m seperti ditunjukkan di Rajah 3(b). Selesaikan masalah dengan menggunakan kaedah kamiran berganda. Gunakan EI = 72.917 kNm².

i.   Determine the equation of elastic curve

Tentukan persamaan lengkungan anjal

[12 marks]
[*12 markah*]

CLO1
C3

ii.   Calculate the slope at end A

Kirakan kecerunan pada penghujung titik A
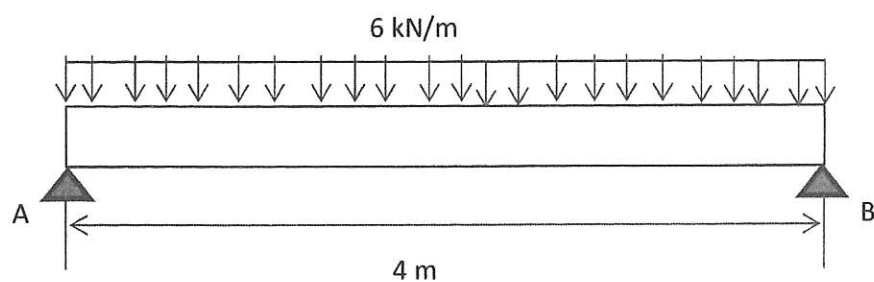
[6 marks]
[*6 markah*]

6 kN/m

A   B

4 m

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

QUESTION 4
SOALAN 4

CLO1
C1

(a)   State the meaning of each symbol and its units.

Nyatakan maksud setiap simbol dan unitnya.

$$\frac{\tau}{R} = \frac{T}{J}$$

[4 marks]
[*4 markah*]

CLO1
C2

(b)   A shaft with a diameter of 60 mm and 0.8 m long is subjected to a torque of 1300N.m. Given G = 70GPa. Determine;

Sebuah aci berdiameter 60mm dan panjang 0.8m dikenakan daya kilas sebanyak 1300N.m. Diberi G = 70GPa. Tentukan;

i.   Polar second moment of area of the shaft.

Momen luas kedua kutub aci.

[3 marks]
[*3 markah*]

ii.   Angle of twist for the shaft.

Sudut putaran bagi aci.

[5 marks]
[*5 markah*]

CLO1
C3

(c)   A shaft with a diameter 120mm and 2.5m length is transmitting 50kW power at 600rpm. Calculate:

Sebuah aci berdiameter 120mm dan panjang 2.5m memindahkan kuasa sebanyak 50kW pada 600 ppm. Kirakan:

i.   Shear stress induced in the shaft.

Tegasan ricih yang terhasil di dalam aci.

[9 marks]
[*9 markah*]

ii.   Modulus of rigidity of the material, if the twisting angle is 0.0015 rad.

Modulus ketegaran bahan jika sudut putaran adalah 0.0015 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 $= \dfrac{\text{original cross - sectional - area at fracture}}{\text{original cross sectional area}} \times 100\%$

5. Strain Energy, $U = \dfrac{1}{2}PAL$

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.

$$\frac{P_1 L_1}{A_1 E_1} + \frac{P_2 L_2}{A_2 E_2} = \Delta t\left(\alpha_1 L_1 + \alpha_2 L_2\right)$$
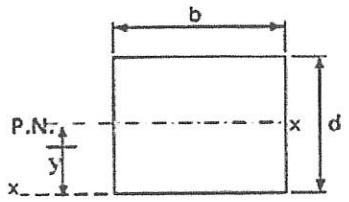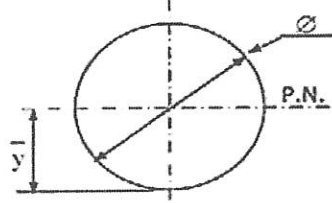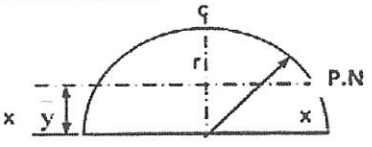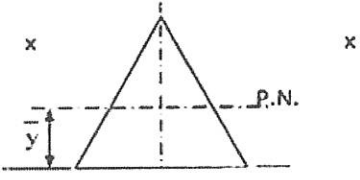
SHEAR FORCES AND BENDING MOMENT

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

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

BENDING STRESS

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

SHAPE	CENTROID	MOMENT OF INERTIA
rectangle (b × d), P.N.	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_{P.N.} = \dfrac{bd^3}{12}$ $I_{xx} = \dfrac{bd^3}{3}$
circle diameter $\varnothing$, P.N.	$\bar{x} = d/2$ $\bar{y} = d/2$	$I_{P.N.} = \dfrac{\pi d^4}{64} = \dfrac{\pi r^4}{4}$
semicircle radius r, P.N	$\bar{y} = \dfrac{4r}{3\pi}$	$I_{P.N.} = 0.11\,r^4$ $I_{xx} = \dfrac{\pi r^4}{8}$
triangle (b × h), P.N.	$\bar{y} = h/3$	$I_{P.N.} = \dfrac{bh^3}{36}$ $I_{xx} = \dfrac{bh^3}{12}$ $I_{yy} = \dfrac{hb^3}{48}$

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

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

$$\theta_{AC} = \theta_{AB} + \theta_{BC}$$

$$= \frac{T_1 L_1}{G_1 J_1} + \frac{T_2 L_2}{G_2 J_2}$$

$$= T\left(\frac{L_1}{G_1 J_1} + \frac{L_2}{G_2 J_2}\right)$$

4. PARALLEL COMPOSITE SHAFT

$$T = T_1 + T_2$$

$$0 = \left(\frac{T_1 L_1}{G_1 J_1}\right) = \left(\frac{T_2 L_2}{G_2 J_2}\right)$$