SULIT

POLITEKNIK
Jabatan Pengajian Politeknik

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENGAJIAN POLITEKNIK
KEMENTERIAN PENGAJIAN TINGGI

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI DISEMBER 2012

JJ310 : STRENGTH OF MATERIAL

TARIKH : 30 APRIL 2013
TEMPOH : 2 JAM (8.30 AM - 10.30 AM)

Kertas ini mengandungi **TUJUH (7)** halaman bercetak.
Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

INSTRUCTION:
This paper consists of **SIX (6)** structured questions. Answer any **FOUR (4)** questions.

ARAHAN:
*Kertas ini mengandungi **ENAM (6)** soalan struktur. Jawab mana-mana **EMPAT (4)** soalan sahaja.*

QUESTION 1
SOALAN 1

CLO1 C1

a) State **FOUR (4)** types of force and their effect on the material.

*Berikan **EMPAT (4)** jenis beban serta kesannya terhadap bahan.*

[8 marks]
[8 *markah*]

CLO1 C3

b) A bar with 30 mm in diameter and 80 mm in length is subjected to a tensile load of 100 kN. The ultimate stress in the bar is 230 MN/m². Due to the applied load, the bar elongate 0.0585 mm and the diameter became 29.994 mm. Calculate;

Satu bar bergarispusat 30 mm dengan panjang 80 mm dikenakan daya tegangan sebanyak 100kN. Tegasan muktamad bagi bar tersebut ialah 230 MN/m². Akibat dari daya ini, bar memanjang sebanyak 0.0585 mm dan garis pusat berubah ke 29.994 mm. Kirakan;

i. Stress occurs in the bar
Tegasan yang berlaku

[4 marks]
[*4 markah*]

ii. Young's Modulus
Modulus Young

[5 marks]
[5 *markah*]

iii. Factor of safety
Faktor Keselamatan

[3 marks]
[3 *markah*]

iv. Poisson's Ratio
Nisbah Poisson

[5 marks]
[5 *markah*]

QUESTION 2
SOALAN 2

CLO1
C3

A parallel composite bar consists of brass and steel bar are bonded rigidly with initial temperature of 20 ^{0}C. The brass bar is inserted into the steel tube which has inner and outer diameter 20mm and 40mm respectively. The length of the bars is assumed to be the same. Calculate;

Sebuah bar komposit disambung secara selari terdiri daripada bar tembaga dan keluli yang dipasang secara tegar dengan suhu 20°C. Bar tembaga dimasukkan ke dalam bar keluli yang mempunyai diameter dalam 20 mm dan diameter luar 40mm. Panjang kedua-dua bar adalah sama. Kirakan;

Given;
Diberi;

E_s = 200 GPa, E_b = 100 GPa, $\alpha_s = 12 \times 10^{-6}$ / °C, $\alpha_b = 17.5 \times 10^{-6}$ / °C

a) Stress in each bar if the compressive load is 50 kN.
Tegasan di dalam setiap bar jika daya mampatan adalah 50 kN.

[12 marks]
[12 *markah*]

b) Stress in each bar when temperature is increased to 80°C.
Tegasan di dalam setiap bar apabila suhu dinaikkan kepada 80°C.

[9 marks]
[9 *markah*]

c) Sum of stresses in each bar due to compressive load and temperature changes.
Jumlah tegasan di dalam setiap bar disebabkan daya mampatan dan perubahan suhu.

[4 marks]
[4 *markah*]

QUESTION 3
SOALAN 3

CLO2
C3

Figure 3 shows a simply supported beam carrying a few loads. Based on Figure 3;

a) Calculate the reaction force at point A and D.
Kirakan daya tindakbalas pada penyokong A dan D.

[6 marks]
[6 *markah*]

CLO2
C3

b) Calculate the magnitude of shear force and bending moment at point A, B, C and D.
Kirakan magnitud daya ricih dan momen lentur pada setiap titik A, B,C dan D.

[9 marks]
[9 *markah*]

CLO2
C3

c) Draw the free body diagram, shear force diagram (SFD) and bending moment diagram (BMD)
Lakarkan rajah jasad bebas, rajah daya ricih dan rajah momen lentur.

[8 marks]
[8 *markah*]

CLO2
C3

d) Calculate the maximum bending moment and the distance from point A.
Kirakan momen lentur maksimum dan jaraknya dari titik A.

[2 marks]
[2 *markah*]

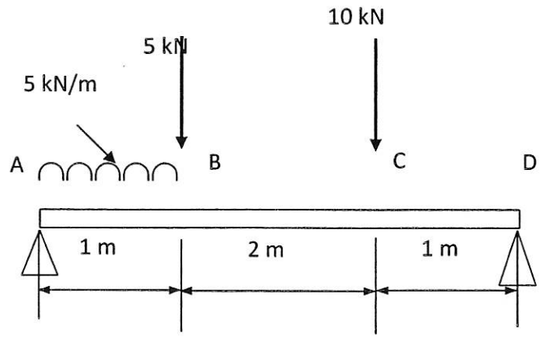


Figure 3/Rajah 3

QUESTION 4
SOALAN 4

CLO1
C3

Calculate the stress set on the top and bottom of the I-cross section beam shown in Diagram 4 when bending moment is 300 Nm. Sketch the stress distribution in the beam.

Kirakan tegasan pada permukaan atas dan bawah rasuk dengan keratan rentas I seperti dalam Rajah 4 apabila momen lentur adalah 300 N.m. Lukiskan taburan tegasan bagi rasuk berkenaan.

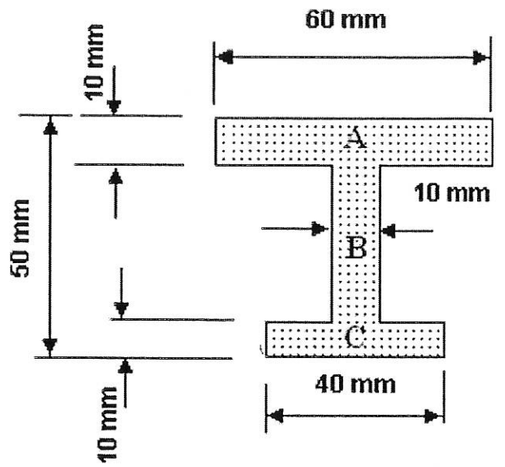


Diagram 4 / *Rajah 4*

[25 marks]
[*25 markah*]

QUESTION 5
SOALAN 5

CLO1
C3

A round steel bar is simply supported at both ends. The bar is subjected to 5 kN concentrated loads at the middle of the beam. If the diameter of the bar is 50 mm and the length is 3 m. Calculate the maximum deflection that occurs in the bar;
Sebuah bar keluli bulat disangga mudah dikedua-dua hujungnya. Bar tersebut dikenakan daya tumpu 5 kN di tengah-tengah bar. Jika diameter bar adalah 50 mm dan panjangnya 3m, ². Kirakan pesongan maksimum rasuk;
Given;
Diberi;
$\rho = 8000\ kg/m^3$ and $E=200\ GN/m^2$,

a) Due to 5 kN load, excluding the mass of the bar.
Disebabkan daya 5 kN, jisim bar diabaikan.

[12 marks]
[*12 markah*]

b) Due to 5 kN load, including the mass of the bar.
Disebabkan daya 5 kN, jisim bar diambil kira.

[13 marks]
[*13 markah*]

QUESTION 6
SOALAN 6

CLO1 C3

a) A shaft with 50 mm diameter and 0.7 m long is subjected to a torque of 1200 Nm. Calculate the shear stress and the angle of twist.
Sebuah aci berdiameter 50 mm dan panjang 0.7 m dikenakan daya kilasan sebanyak 1200 Nm. Kirakan tegasan ricih dan sudut putaran bagi aci tersebut.
Given;
Diberi;
G = 90 GPa.

[15 marks]
[*15 markah*]

CLO1 C3

b) A solid shaft transmit 20 kW of power at 300 rev/min. If the shear stress must not exceed 150 MPa, calculate the diameter of the shaft.
Sebuah aci padu menghantar kuasa sebanyak 20 kW pada 300 putaran/min. Jika tegasan ricih tidak boleh melebihi 150 MPa, kirakan diameter aci tersebut.

[10 marks]
[*10 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, $\nu = \frac{\text{laterial strain}}{\text{longitudinal strain}}$

3. Percent Elongation = $\frac{\text{Elongation}}{\text{Length}} \times 100\ \%$

4. Percent reduction in area = $\frac{\text{original cross - sectional - area at fracture}}{\text{original cross sectional area}} \times 100\ \%$

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

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.

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

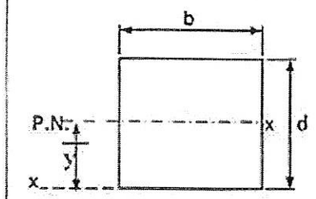
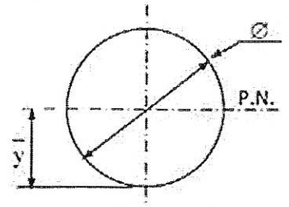
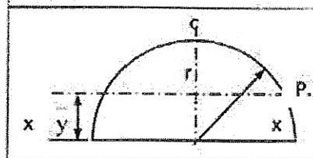
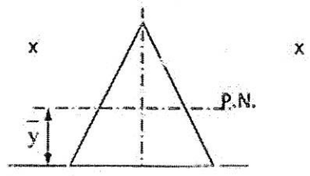
SHEAR FORCES AND BENDING MOMENT

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

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

BENDING STRESS

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

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

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

$$T = T_1 + T_2$$

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