SULIT

POLITEKNIK
Jabatan Pengajian Politeknik

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENGAJIAN POLITEKNIK
KEMENTERIAN PENDIDIKAN MALAYSIA

JABATAN KEJURUTERAAN MEKANIKAL

PEPERIKSAAN AKHIR

SESI JUN 2013

JJ310: STRENGTH OF MATERIALS

TARIKH : 28 OKTOBER 2013
TEMPOH : 2 JAM (11.15 AM - 1.15 PM)

Kertas ini mengandungi **SEMBILAN (9)** halaman bercetak termasuk muka hadapan.

Bahagian ini mengandungi ENAM (6) soalan esei. Jawab EMPAT (4) soalan sahaja.

Dokumen sokongan yang disertakan : Rumus

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) Define in engineering term as below;

Definasikan mengikut istilah kejuruteraan;

i. Normal Stress
TegasanNormal

[2 marks]
[2 *markah*]

ii. Normal Strain
Terikan Normal

[2 marks]
[2 *markah*]

CLO1
C3

b) A steel tube with outer diameter of 40 mm and inner diameter of 15 mm has been given a tensile force of 65 kN. Given E_{steel} = 206 GN/m^2. Calculate the stress occur in the tube.

Sebatang tiub keluli mempunyai diameter luar sebanyak 40 mm dan diameter dalam sebanyak 15 mm dikenakan daya tegangan sebanyak 65 kN. Diberi E_{steel} = 206 GN/m^2. Kira nilai tegasan yang terhasil pada tiub.

[5 marks]
[*5markah*]

CLO1
C3

c) A 5.6 m rod with a cross sectional area of 1150 mm^2 elongates by 7.56 mm when a 70 kN tensile force is applied on both sides.

Sebatang rod yang panjangnya 5.6 m, mempunyai luas permukaan 1150 mm^2 dan mengalami pemanjangan 7.56 mm apabila dikenakan daya tegangan 70 kN pada kedua-dua sisi.

i. Draw a free body diagram for the above situation.

Lukis gambarajah badan bebas bagi situasi diatas.

[4 marks]
[*4 markah*]

ii. Calculate the tensile stress in the rod

Kirakan tegasan tegangan pada rod tersebut.

[3 marks]
[3 *markah*]

iii. Determine the strain

Tentukan nilai keterikan yang terhasil.

[3 marks]
[3 *markah*]

iv. Determine the Young's Modulus of the rod

Tentukan nilai Modulus Young pada rod tersebut.

[3 marks]
[3 *markah*]

v. Calculate the safety factor if the maximum allowable stress (or ultimate stress) is 330 MN/m^2

Kirakan nilai faktor keselamatan jika tegasan maksimum (atau tegasan muktamad) yang dibenarkan ialah 330 MN/m^2

[3 marks]
[*3 markah*]

QUESTION 2
SOALAN 2

A copper tube has an internal diameter of 27 mm, thickness of 5 mm and length of 0.9 m. Inside the copper tube is a steel bar with a diameter of 15 mm. The bar is rigidly fixed at both ends.

Satu tiub tembaga yang mempunyai diameter dalam 27 mm, tebal 5 mm dan panjang 0.9 m. Di bahagian dalamnya mengandungi rod keluli yang berdiameter 15 mm. Bar majmuk ini dipasang tegar pada kedua-dua hujungnya.

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

$E_{steel} = 210\ GN/m^2$ $\alpha_{steel} = 12 \times 10^{-6}/^oC$

Calculate:

Kirakan:

CLO1
C3

a) The stress in both bar if a compressive force is subjected until the composite bars experience elongation of 0.35 mm.

Tegasan pada kedua-dua bar jika satu daya mampatan dikenakan sehingga menyebabkan bar majmuk tersebut mengalami perubahan panjang sebanyak 0.35 mm.

[12 marks]
[*12 markah*]

CLO1
C3

b) The stress developed in both bar when the temperature is increased to 65 °C.

Tegasan yang terhasil pada kedua-dua bar apabila suhu dinaikkan sehingga 65 °C.

[13 marks]

[*13 markah*]

QUESTION 3

SOALAN 3

A simply supported beam carrying a few loads as shown in figure 3 below.

Sebatang rasuk disangga mudah menanggung beberapa beban seperti gambarajah 3 dibawah.

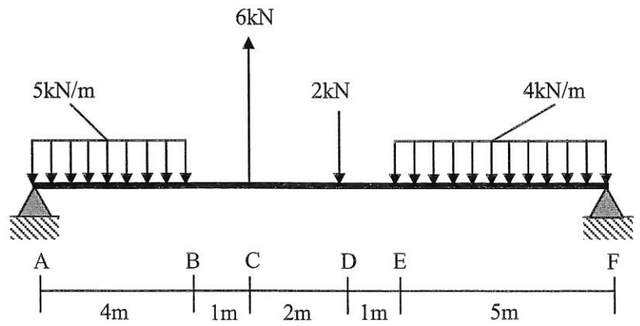


Figure 3

CLO1
C3

a) Calculate the reaction force at point A and F

Kirakan daya tindak balas yang terhasil pada titik A dan F

[5 marks]

[*5 markah*]

CLO1
C3

b) Calculate the shear force and bending moment value that occurred.

Kirakan nilai daya ricih dan momen lentur yang terhasil.

[16 marks]

[*16 markah*]

CLO2
C2

c) Sketch the free body diagram (FBD), shear force diagram (SFD) and bending moment diagram (BMD).

Lakarkan gambarajah badan bebas(FBD), gambarajah daya ricih (SFD) dan gambarajah moment lentur(BMD).

[4 marks]

[*4 markah*]

QUESTION 4
SOALAN 4

Figure 4 shows the cross sectional of a beam.

Gambarajah 4 menunjukkan keratan rentas bagi sebatang rasuk.

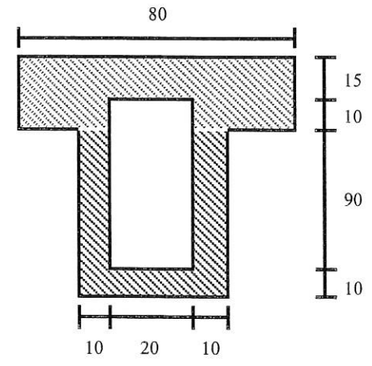


Figure 4/*Rajah 4*

* All units in mm.

* *Semua unit dalam mm.*

CLO1 C3

a) Calculate the centroid point and moment of inertia along neutral axis

Kirakan titik sentroid dan momen inersia sepanjang paksi neutral

[10 marks]
[*10 markah*]

CLO1 C3

b) If the beam that simply supported at both ends carries a uniformly distributed load of 5 kN/m along its 10m length. Calculate the maximum compressive and tensile bending stress.

Jika rasuk ini disangga mudah pada kedua-dua hujung membawa beban teragih seragam sebanyak 5 kN/m pada keseluruhan rasuk yang panjangnya 10 m. Kirakan tegasan lentur mampatan dan tegangan lentur maksimum.

[12 marks]
[*12 markah*]

CLO1 C3

c) Sketch a bending stress distribution graph.

Lakarkan gambarajah agihan tegasan.

[3 marks]
[*3 markah*]

QUESTION 5
SOALAN 5

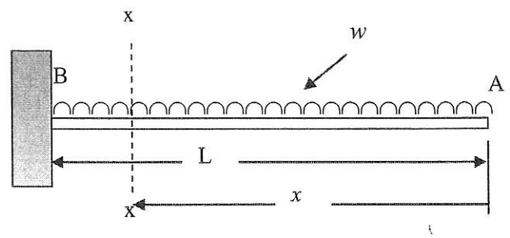


Figure 5/*Rajah 5*

Consider a cantilever AB of length L and carrying a uniformly distributed load of intensity w per unit length as shown in Figure 5.
Pertimbangkan satu rasuk julur AB dengan panjang L dan membawa beban teragih seragam w seperti ditunjukkan dalam Rajah 5.

CLO1 C2

a) Derive the maximum slope and maximum deflection equation at free end of beam using Double Intergration Method where x is the section x-x from free end.
Terbitkan persamaan kecerunan maksimum dan pesongan maksimum pada hujung rasuk menggunakan Kaedah Kamiran Berganda di mana x adalah jarak keratan x-x *dari hujung bebas.*

[17 marks]
[*17 markah*]

CLO1 C3

b) If the uniformly distributed load of intensity w, is 200 kN/m, the length L is 2 m and the flexural stiffness, EI is 30 MN/m^2, calculate the maximum slope and maximum deflection at free end of the beam.

Jika beban teragih seragam w, adalah sebanyak 200 kN/m, panjang L adalah 2 m dan kekukuhan lenturan, EI adalah 30 MN/m^2, kirakan kecerunan dan pesongan maksimum di hujung bebas rasuk.

[8 marks]
[*8 markah*]

QUESTION 6

SOALAN 6

CLO1 C3

a) A 10 m solid steel shaft is subjected to a torque of 15kNm resulting an angle of twist of 4^o from its origin state. Given G = 85 GPa. Calculate:

Sebatang aci keluli 10 m dikenakan daya kilas 15 kNm menyebabkan aci mengalami sudut piuh sebanyak 4^o dari kedudukan asalnya. Diberi G = 85 GPa. Kirakan:

i. The minimum diameter of the steel shaft.
Garispusat minimum aci keluli tersebut.

[5 marks]
[*5 markah*]

ii. The maximum shearing stress developed.
Tegasan ricih maksimum yang terhasil

[5 marks]
[*5markah*]

CLO1 C3

b) A steel propeller shaft in a length of 26 m transmit 5 MW of power at 210 rpm without exceeding a shearing stress of 50 MPa and twisting angle not more than 2^o. Calculate the diameter of the propeller, if G = 90 GPa.

Sebatang kincir aci keluli yang mempunyai panjang 26 m yang menghantar kuasa sebanyak 5 MW pada 210 rpm. Tegasan ricih tidak melebihi 50 MPa dan sudut piuhan tidak melebihi 2^o.
Kirakan diameter sebenar jika G = 90 GPa.

[15 marks]

[*15 markah*]

SOALAN TAMAT

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 = $\dfrac{\text{Elongation}}{\text{Length}} \times 100\,\%$

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.

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

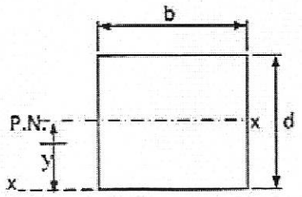
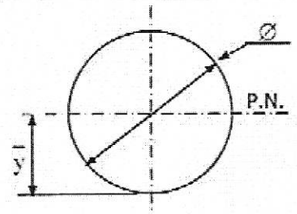
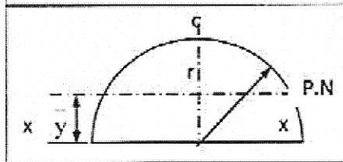
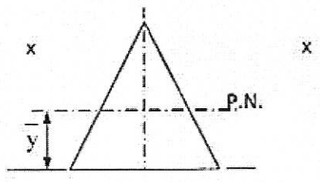
SHEAR FORCES AND BENDING MOMENT

$$\sum M_{\circlearrowleft} = \sum M_{\circlearrowright}$$

$$\sum F_{\uparrow} = \sum F_{\downarrow}$$

BENDING STRESS

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

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

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

$$T = T_1 + T_2$$

$$0=\left(\frac{T_1L_1}{G_1J_1}\right)=\left(\frac{T_2L_2}{G_2J_2}\right)$$