Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## PEPERIKSAAN AKHIR
## SEMESTER I
## SESSI 2015/2016

| | | |
|---|---|---|
| NAMA KURSUS | : | MEKANIK BAHAN |
| KOD KURSUS | : | DAC 20703 |
| PROGRAM | : | 2 DAA |
| TARIKH PEPERIKSAAN | : | DISEMBER 2015/JANUARI 2016 |
| MASA | : | 3 JAM |
| ARAHAN | : | JAWAB **EMPAT (4)** SOALAN SAHAJA |
| | | SEMUA LANGKAH PENGIRAAN DAN JAWAPAN AKHIR MESTILAH DISERTAKAN DENGAN UNIT YANG BERSESUAIAN |

KERTAS SOALAN INI MENGANDUNGI **EMPAT BELAS (14)** MUKA SURAT

**BAHASA MELAYU**

**S1** (a) Takrifkan Hukum Hooke. Lukiskan graf untuk menunjukkan hubungan yang berkaitan.
(5 markah)

(b) **Rajah Q1(b)** menunjukkan satu bar terdiri daripada besi, gangsa dan aluminium telah dikimpal antara satu sama lain dan mempunyai daya paksi. Tentukan daya dan tegasan normal dalam setiap bar segmen jika P = 100 N. Diberikan $A_{besi}$ = 500 mm$^2$, $A_{gangsa}$ = 1250 mm$^2$ and $A_{aluminium}$ = 2000 mm$^2$.
(10 Markah)

(c) Berdasarkan data dalam unsur-unsur tegasan satah yang ditunjukkan dalam **Rajah Q1**

(i) Lukiskan gambar rajah *Mohr Circle.*
(ii) Kira tegasan prinsipal dan tegasan ricih maksimum.
(iii) Lukiskan orientasi tegasan utama dan tegasan ricih maksimum.
(10 Markah)

**Q2** (a) Terangkan prosedur untuk melukis gambarajah daya ricih (GDC) dan gambar rajah momen lentur (GML).
(3 Markah)

(b) Rasuk tergantung telah direka untuk menampung beberapa jenis daya yang ditunjukkan dalam **Rajah S2 (b)**. Kirakan daya yang tidak diketahui di rasuk ini.
(4 Markah)

(c) Lukiskan gambarajah daya ricih (GDC) bagi rasuk disokong mudah yang ditunjukkan dalam **Rajah S2 (c)** dan tentukan daya ricih maksimum tersebut.
(8 Markah)

(d) Rasuk disokong mudah telah dikenakan dengan daya yang berbeza seperti yang ditunjukkan dalam **Rajah S2 (d)**. Lukiskan gambarajah daya ricih (GDR) dan gambarajah momen lentur (BMD) bagi rasuk ini. Tunjukkan nilai-nilai penting pada gambarajah tersebut.
(10 Markah)

**Q3** Sebuah bar aluminium AB dipasaang kepada dua brackers yang disokong oleh 20 mm diameter keluli pin di Seperti yang ditunjukkan dalam **Rajah S3**. Ketebalan bar adalah 20 mm dan lebar 50 mm.

(a) Dapatkan beban yang dibenarkan bagi tegasan tegangan, tekanan galas dan tegasan ricih di bar aluminium
(10 Markah)

(b) Dapatkan beban yang dibenarkan untuk tekanan galas dan tegasan ricih dalam pin keluli.
(10 Markah)

(c) Tentukan nilai maksimum yang dibenarkan untuk beban P sekiranya sifat-sifat berikut diketahui.

(5 Markah)

- Untuk aluminium
  - tegasan tegangan yang dibenarkan= 120 $MN/m^2$
  - tegasan galas yang dibenarkan= 200 MN/m2
  - tegasssan ricih yang dibenarkan = 40 $MN/m^2$
- Untuk besi
  - tegasan galas yang dibenarkan = 400 $MN/m^2$
  - tegasan ricih yang dibenarkan = 100 $MN/m^2$

**Q4** (a) Rod komposit terdiri daripada segmen ADB, BC dan CD dengan panjang yang berbeza dan luas keratan rentas seperti yang ditunjukkan dalam **Rajah S4 (a)**. Beban paksi digunakan di posisi yang ditunjukkan. Andaikan bahawa ia dicantum dengan rembat yang sesuai untuk mengelakkan lengkokan dan membiarkan Ebesi = 200 GPa, $E_{gangsa}$ = 83 GPa dan $E_{aluminium}$ = 70 GPa. Kirakan jumlah perubahan dalam panjang rod komposit.

(13 Markah)

(b) Tentukan perubahan dalam diameter bar 25 mm yang dikenakan tekanan paksi yang telah dihadkan dengan 240 Mpa, memandangkan E = 210 GPa dan $\nu = 0.3$

(12 Marks)

**Q5** Sebuah motor telah menyalurkan 45 kW pada 200 rpm terhadap takal C, seperti yang ditunjukkan dalam **Rajah S5**. Selain itu, 7.5 kW dimstiksnkan oleh takal A, 22.5 kW oleh takal B dan 15 kW oleh takal D.

(a) Kirakan tork pada aci AB, BC dan CD.

(8 Markah)

(b) Tentukan diameter aci seragam yang diperlukan sekiranya tegasan ricih tidak melebihi 58.4 MPa

(8 Markah)

(c) Cari sudut pintalan antara takal A dan C.

(9 Markah)

**Q6** (a) Terangkan Tekanan Normal Beam

(5 Markah)

(b) Satu rasuk disokong mudah AB dalam **Rajah Q6** mempunyai luas keratan rentas yang ditunjukkan di sebelah rasuk angka disokong Satu beban diagihkan sebanyak 20 kN / m bertindak pada rasuk.

(i) Tentukan $y_a$ dan $y_b$

(5 Markah)

(ii) Kirakan momen Inersia, **I**

(5 Markah)

(iii) Tentukan tekanan mutlak lentur maksimum dalam rasuk.

(5 Markah)

(iv) Lukiskan agihan tegasan di keratan rentas di lokasi ini dan tuliskan nilai yang penting dalam gambar rajah

(5 Markah)

**- SOALAN TAMAT-**

**Q1** *(a)* *Define the Hooke's Law. Draw the graph to show the related relationship.*

*(5 marks)*

*(10* ***Figure Q1(b)*** *shows one bar consists of steel, bronze and aluminum were welded to each others and have axial force. Determine force and normal stress in each bar segment if P = 100 N. Given* $A_{steel}$ *= 500* $mm^2$*,* $A_{bronze}$ *= 1250* $mm^2$ *and* $A_{aluminum}$ *= 2000* $mm^2$*.*

*(10 marks)*

***(c)*** *Based on data in plane stress elements shown in* ***Figure Q1 (c)***

*(i)* *Draw Mohr Circle figure*
*(ii)* *Calculate principal stress and maximun shear stress*
*(iii)* *Draw principal stress and maximun shear stress orientations*

*(10 marks)*

**Q2** *(a)* *Describe the procedures to draw shear force diagram (SFD) and bending moment diagram (BMD).*

*(3 Marks)*

*(b)* *Overhang beam was design to sustain few types of forces shown in* ***Figure Q2 (b)****. Calculate unknown forces at these beam.*

*(4 Marks)*

*(c)* *Draw shear force diagram (SFD) for simply supported beam shown in* ***Figure Q2 (c)*** *and determine its maksimum shear force.*

*(8 Marks)*

*(d)* *Simply supported beam has been imposed with different forces as shown in* ***Figure Q2 (d)****. Draw shear force diagram (SFD and bending moment diagram (BMD) for these beam. Show importants values on the diagrams.*

*(10 Marks)*

**Q3** *An aluminum bar AB is attached to its two supported brackers by a 20 mm diameter steel pin at As shown in* ***Figure Q3****. The thickness of the bar is 20 mm and its width is 50 mm.*

*(a)* *Find allowable load for tensile stress, bearing stress and shearing stress in aluminum bar*

*(10 Marks)*

*(b)* *Find allowable load for bearing stress and shearing stress in steel pin.*

*(10 Marks)*

(c) *Determine maximum allowable value for the load P if the following properties are known.*

*(5 Marks)*

- *For aluminum*
  - *allowable tensile stress = 120 MN/m$^2$*
  - *allowable bearing stress = 200 MN/m2*
  - *allowable shearing stress = 40 MN/m$^2$*
- *For steel*
  - *allowable bearing stress = 400 MN/m$^2$*
  - *allowable tensile stress = 100 MN/m$^2$*

**Q4** (a) *A composite rod consists of segments ADB, BC and CD with different lengths and cross-sectional area as shown in **Figure Q4 (a)**. Axial loads are applied at the posotions indicated. Assume that the assembly is suitably braced to prevent buckling and let Est = 200 GPa, Ebr = 83 GPa and Eal = 70 GPa. Compute the total change in the length of the composite rod.*

*(13 Marks)*

(b) *Determine the change in the diameter of a 25 mm bar which is subjected to its limiting axial stress of 240 Mpa, given E = 210 Gpa and $\nu = 0.3$.*

*(12 Marks)*

**Q5** *A motor delivers 45 kW at 200 rpm to pully C, as shown in Figure **Q5**. Of this 7.5 Kw off by pulley A, 22.5 kW by pulley B and 15 kW by pulley D.*

(a) *Calculate the torques in shafts AB, BC and CD.*

*(8 marks)*

(b) *Determine the required uniform shaft diameter if the shearing stress is not exceed 58.4 MPa.*

*(8 marks)*

(d) *Find the angle of twist between pullys A and C.*

*(9 marks)*

**Q6** (a) *Explain Normal Stresses in Beam*

*(5 marks)*

(b) *A simply supported beam AB in **Figure Q6** has the cross sectional area shown beside of the supported beam figure A distributed load of 20 kN/m is acting on the beam.*

(i) *Determine $y_a$ and $y_b$*

*(5 marks)*

(ii) *Calculate the moment of inertia, **I***

*(5 marks)*

(iii) *Determine the absolute maximum bending stress in the beam.*

*(5 marks)*

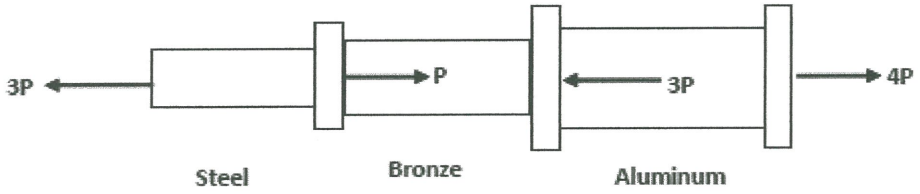
(iv) *Draw the stress distribution over the cross section at this location and write down important value in the diagram.*

*(5 marks)*

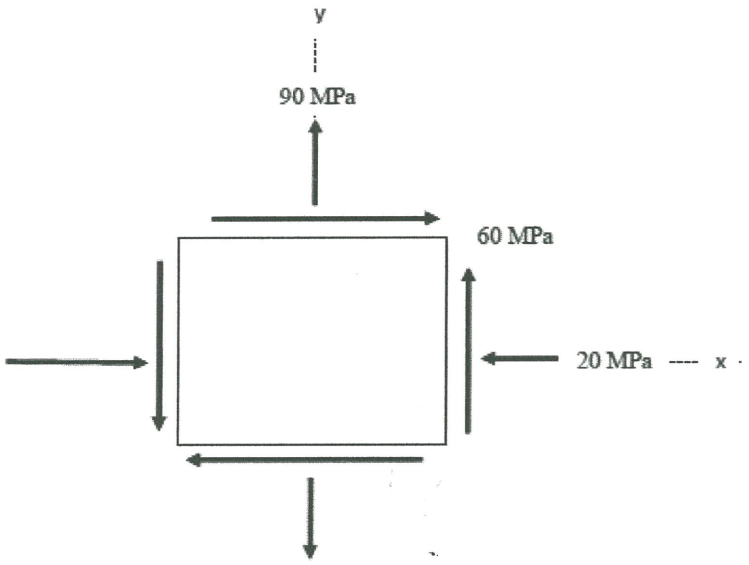
***- END OF QUESTION-***

**FINAL EXAMINATION**

| | | | |
|---|---|---|---|
| SEMESTER/SESI | : SEM I/ 2015/2016 | PROGRAM | : 2 DAA |
| NAMA KURSUS | : MEKANIK BAHAN | KOD KURSUS | : DAC 20703 |



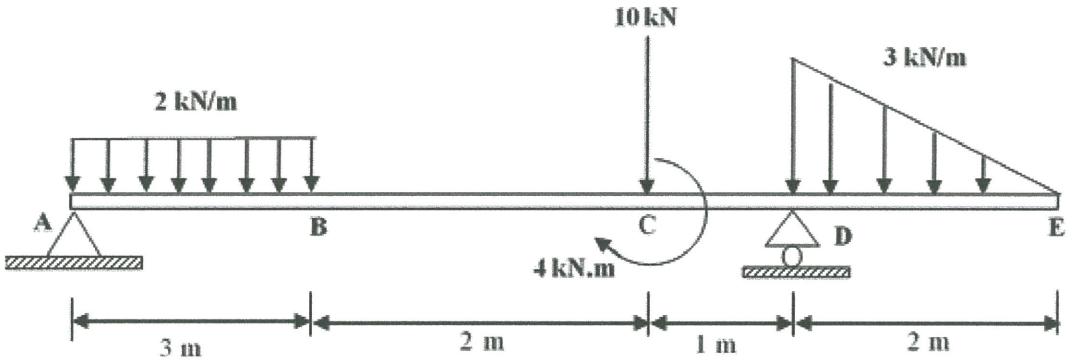

**Q1(b)**



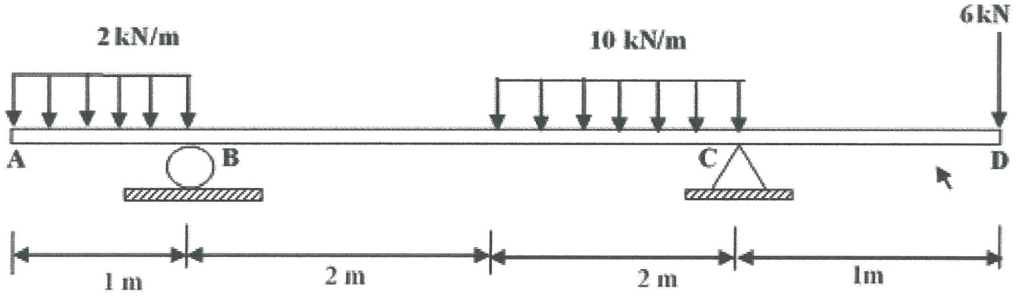

**Q1(c)**

**PEPERIKSAAN AKHIR**

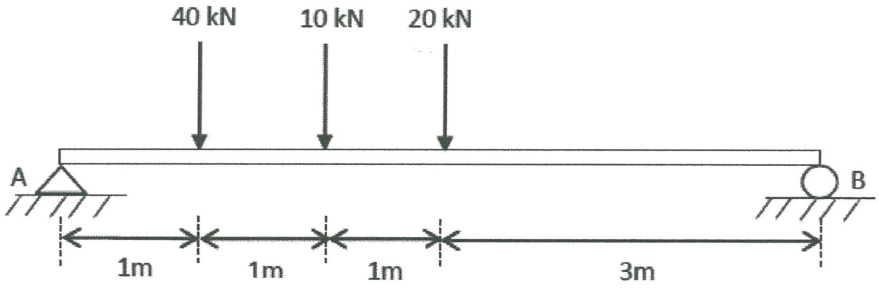
| | | | |
|---|---|---|---|
| SEMESTER/SESI | : SEM I/ 2015/2016 | PROGRAM | : 2 DAA |
| NAMA KURSUS | : MEKANIK BAHAN | KOD KURSUS | : DAC 20703 |




**Q2 (b)**




**Q2 (c)**

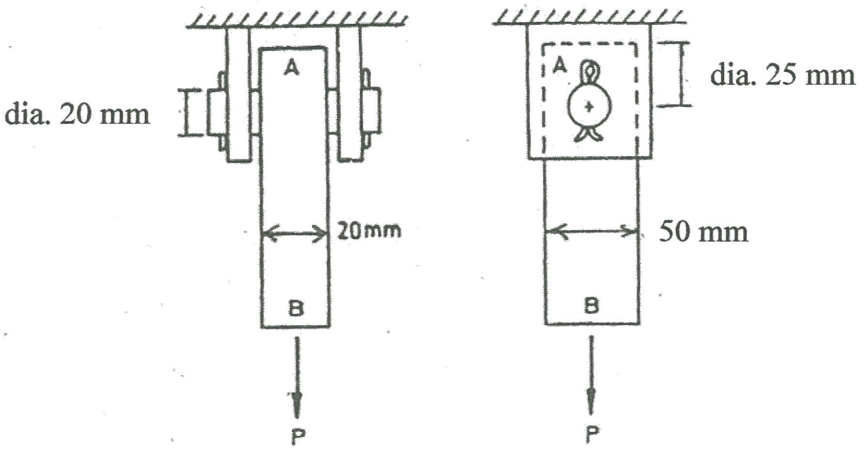



**Q2 (d)**

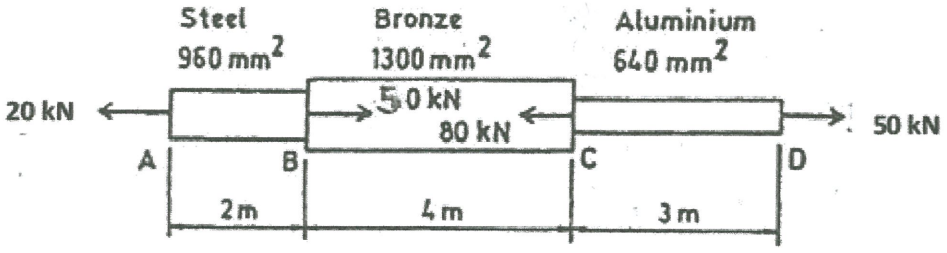
**PEPERIKSAAN AKHIR**

| | | | |
|---|---|---|---|
| SEMESTER/SESI | : SEM I/ 2015/2016 | PROGRAM | : 2 DAA |
| NAMA KURSUS | : MEKANIK BAHAN | KOD KURSUS | : DAC 20703 |

For aluminium – allowable tensile stress = 120 MN/m$^2$
– allowable bearing stress = 200 MN/m$^2$
– allowable shearing stress = 40 MN/m$^2$
For steel – allowable bearing stress = 400 MN/m$^2$
– allowable shearing stress = 100 MN/m$^2$




**Q3**




**Q4**

**FINAL EXAMINATION**

| | | | |
|---|---|---|---|
| SEMESTER/SESI | : SEM I/ 2015/2016 | PROGRAM | : 2 DAA |
| NAMA KURSUS | : MEKANIK BAHAN | KOD KURSUS | : DAC 20703 |

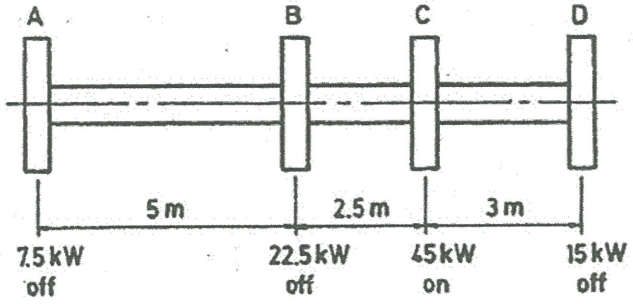



**FIGURE Q5**

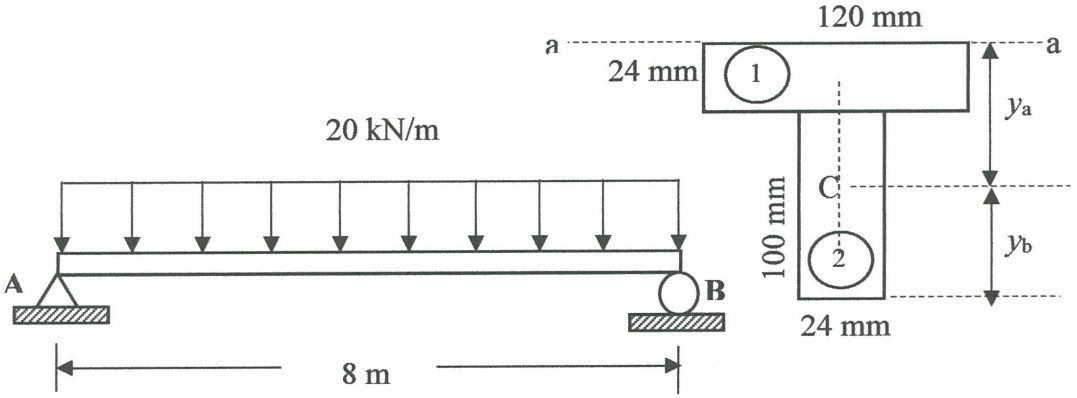



**FIGURE Q6**

## PEPERIKSAAN AKHIR

SEMESTER/SESI : SEM I/ 2015/2016 PROGRAM : 2 DAA
NAMA KURSUS : MEKANIK BAHAN KOD KURSUS : DAC 20703

## FORMULA

Normal Stress

$$\sigma_{ave} = \frac{N}{A}$$

Normal Strain:

$$\varepsilon = \frac{\delta}{L}$$

Safety Factor

$$F.S. = \frac{\sigma_{fail}}{\sigma_{allow}}$$

Shear Stress

$$\tau_{ave} = \frac{V}{A}$$

Shear Strain

$$\gamma = \frac{\text{angular deformation}}{\text{(in radians)}}$$

Poisson's Ratio

$$\nu = \frac{-\varepsilon_{lateral}}{\varepsilon_{longitudinal}}$$

Hooke's Laws:

$$\sigma = E\varepsilon \qquad \tau = G\gamma$$

Generalized Hooke's Law

$$\varepsilon_x = \frac{\sigma_x}{E} - \frac{\nu\sigma_y}{E} - \frac{\nu\sigma_z}{E}$$

Stress Concentration:

$$\sigma_{max} = K\sigma_{ave}$$

$$\varepsilon_y = \frac{\sigma_y}{E} - \frac{\nu\sigma_x}{E} - \frac{\nu\sigma_z}{E}$$

$$\varepsilon_z = \frac{\sigma_z}{E} - \frac{\nu\sigma_x}{E} - \frac{\nu\sigma_y}{E}$$

Axial Deformation:

Due to Force

$$\delta = \int_0^L \frac{P_x}{E_x A_x} dx \qquad \delta = \frac{F\,L}{E\,A}$$

Due to Temperature Change

$$\delta_{Temp} = \alpha\, L\, \Delta T$$

***Torsion:***

Circular or Round Tube section:

$$\tau = \frac{T\rho}{J} \quad \text{and} \quad \phi = \frac{TL}{GJ}$$

**Bending Stress:**

**for Horizontal moment**

$$\sigma = -\frac{Mc}{I} \quad , \tau = VQ/Ib$$

**Moments of inertia:**

**for circle:**

$$J_{circle} = \frac{\pi D^4}{32} \qquad I_{circle} = \frac{\pi D^4}{64}$$

**for rectangle:**

$$I_{rectangle} = \frac{1}{12} bh^3$$

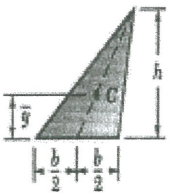
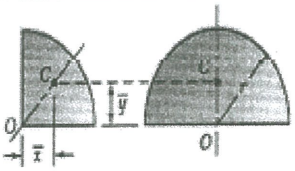
**Column**

$P_{cr} = \pi^2 EI/L_e^2$

## PEPERIKSAAN AKHIR

SEMESTER/SESI : SEM I/ 2015/2016
NAMA KURSUS : MEKANIK BAHANK
PROGRAM : 2 DAA
KOD KURSUS : DAC 20703

## FORMULA

| Shape | | $\bar{x}$ | $\bar{y}$ | Area |
|---|---|---|---|---|
| Triangular area |  | | $\frac{h}{3}$ | $\frac{bh}{2}$ |
| Quarter-circular area |  | $\frac{4r}{3\pi}$ | $\frac{4r}{3\pi}$ | $\frac{\pi r^2}{4}$ |
| Semicircular area | | 0 | $\frac{4r}{3\pi}$ | $\frac{\pi r^2}{2}$ |

Due to Force $\delta = \frac{F\,L}{E\,A}$ Due to Temperature Change $\delta_{Temp} = \alpha\, L\, \Delta T$

$$\tau = \frac{T\rho}{J} \quad \text{and} \quad \phi = \frac{TL}{GJ}$$

$$\sigma = -\frac{Mc}{I}$$

$$J_{circle} = \frac{\pi D^4}{32} \qquad I_{circle} = \frac{\pi D^4}{64} \qquad I_{rectangle} = \frac{1}{12} bh^3$$

Normal Stress $\sigma_{ave} = \frac{N}{A}$ Normal Strain: $\varepsilon = \frac{\delta}{L}$ Safety Factor $F.S. = \frac{\sigma_{fail}}{\sigma_{allow}}$

Shear Stress $\tau_{ave} = \frac{V}{A}$ Shear Strain $\gamma = \frac{\text{angular deformation}}{(\text{in radians})}$ Poisson's Ratio $\nu = \frac{-\varepsilon_{lateral}}{\varepsilon_{longitudinal}}$

Hooke's Laws: $\sigma = E\varepsilon \qquad \tau = G\gamma$

Generalized Hooke's Law

$$\varepsilon_x = \frac{\sigma_x}{E} - \frac{\nu\sigma_y}{E} - \frac{\nu\sigma_z}{E}$$

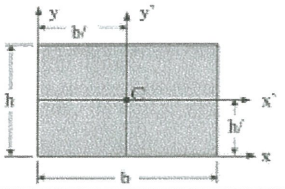
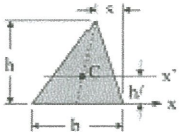
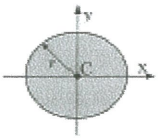
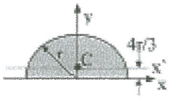
$$\varepsilon_y = \frac{\sigma_y}{E} - \frac{\nu\sigma_x}{E} - \frac{\nu\sigma_z}{E}$$

$$\varepsilon_z = \frac{\sigma_z}{E} - \frac{\nu\sigma_x}{E} - \frac{\nu\sigma_y}{E}$$

## FINAL EXAMINATION

| | | | |
|---|---|---|---|
| SEMESTER/SESI | : SEM I/ 2015/2016 | PROGRAM | : 2 DAA |
| NAMA KURSUS | : MEKANIK BAHAN | KOD KURSUS | : DAC 20703 |

## FORMULA

| | |
|---|---|
| **Rectangle:**<br>$\bar{I}_x = \frac{1}{12}bh^3$<br>$\bar{I}_y = \frac{1}{12}b^3h$ |  |
| **Triangle:**<br>$\bar{I}_x = \frac{1}{36}bh^3$ |  |
| **Circle:**<br>$\bar{I}_x = \bar{I}_y = \frac{1}{4}\pi r^4$ |  |
| **Semi-circle:**<br>$I_x = \bar{I}_y = \frac{1}{8}\pi r^4$<br>$\bar{I}_x = \left(\frac{\pi}{8} - \frac{8}{9\pi}\right)r^4$ |  |
| **Parallel axis theorem**<br>$I_x = \bar{I}_x + Ad^2$ $\quad I_y = \bar{I}_y + Ad^2$ | |