# POLITEKNIK
## MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN MATEMATIK SAINS DAN KOMPUTER

PEPERIKSAAN AKHIR

SESI DISEMBER 2015

**BA501: ENGINEERING MATHEMATICS 4**

TARIKH : 05 APRIL 2016
MASA : 8.30 AM - 10.30 AM (2 JAM)

Kertas ini mengandungi **LAPAN BELAS (18)** halaman bercetak.
Bahagian A : Sturuktur (2 soalan)
Bahagian B : Struktur (2 soalan)
Bahagian C : Struktur (2 soalan) (JKE, JKP, JKPK)
Bahagian D : Struktur (2 soalan) (JKM, JPP)
Bahagian E : Struktur (1 soalan)
Dokumen sokongan yang disertakan : Formula

**JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN**

(CLO yang tertera hanya sebagai rujukan)

SECTION A (JKE, JKP, JKPK, JPP and JKM): 25 MARKS

*BAHAGIAN A (JKE, JKP, JKPK, JPP dan JKM): 25 MARKAH*

INSTRUCTION:

This section consists of **TWO (2)** structured questions. Answer **ONE (1)** question only.

*ARAHAN :*

*Bahagian ini mengandungi DUA (2) soalan struktur. Jawab SATU (1) soalan sahaja.*

QUESTION 1

*SOALAN 1*

CLO1
C2

a) Expand the following algebraic expressions by using the method as stated in the bracket :

*Kembangkan ungkapan algebra yang berikut dengan menggunakan kaedah yang dinyatakan di dalam kurungan :*

    i.   $\left(y^2 - 3x\right)^5$   [ Binomial Theorem]

[4 marks]

[*4 markah*]

    ii.   $\left(4 - \dfrac{x}{5}\right)^4$    [Pascal's Triangle]

[4 marks]

[*4 markah*]

CLO1
C2

b) Find the coefficient of $x^{-3}$ in the expansion of $\left(x^3 + \dfrac{5}{x^6}\right)^{14}$.

*Dapatkan pekali bagi $x^{-3}$ dari pengembangan ungkapan $\left(x^3 + \dfrac{5}{x^6}\right)^{14}$.*

[6 marks]

[*6 markah*]

SECTION B (JKE, JKP, JKPK, JPP and JKM): 25 MARKS

*BAHAGIAN B (JKE, JKP, JKPK, JPP dan JKM): 25 MARKAH*

INSTRUCTION:

This section consists of **TWO (2)** structured questions. Answer **ONE (1)** question only.

*ARAHAN:*

*Bahagian ini mengandungi DUA (2) soalan berstruktur. Jawab SATU (1) soalan sahaja.*

**QUESTION 3**

*SOALAN 3*

The position vectors of point A, B and C are $\overrightarrow{OA} = 3i + 2j - 4k$, $\overrightarrow{OB} = 2i - j + 3k$ and $\overrightarrow{OC} = -i + 3j - 2k$. Determine;

*Vektor kedudukan titik A, B dan C adalah $\overrightarrow{OA} = 3i + 2j - 4k$, , $\overrightarrow{OB} = 2i - j + 3k$ dan $\overrightarrow{OC} = -i + 3j - 2k$ . Tentukan;*

| CLO2 C1 | a) | $\overrightarrow{AB}$ | | [2 marks] [2 *markah*] |
| CLO2 C3 | b) | $\overrightarrow{AB} \times \overrightarrow{BC}$. | | [8 marks] [8 *markah*] |
| CLO2 C2 | c) | $\overrightarrow{AB} \cdot \overrightarrow{BC}$ | | [3 marks] [3 *markah*] |
| CLO2 C2 | d) | $|\overrightarrow{AC}|$ | | [4 marks] [4 *markah*] |
| CLO2 C3 | e) | Angle between $\overrightarrow{AB}$ and $\overrightarrow{BC}$ | | |

SECTION C (JKE, JKP, JKPK) : 25 MARKS

*BAHAGIAN C (JKE, JKP, JKPK) : 25 MARKAH*

INSTRUCTION:

This section consists of **TWO (2)** structured questions. Answer **ONE (1)** question only.

*ARAHAN:*

*Bahagian ini mengandungi DUA (2) soalan berstruktur. Jawab SATU (1) soalan sahaja.*

## QUESTION 5
## *SOALAN 5*

CLO3
C3

a) Verify the Laplace Transform of $f(t) = e^{3t}$ is $\dfrac{1}{s-3}$ by using the Definition method of

$$F(s) = \int_0^\infty e^{-st} f(t)\, dt .$$

*Buktikan bahawa Jelmaan Laplace bagi $f(t) = e^{3t}$ adalah $\dfrac{1}{s-3}$ dengan menggunakan*

*kaedah Takrifan $F(s) = \int_0^\infty e^{-st} f(t)\, dt$ .*

[6 marks]

*[6 markah]*

CLO3
C3

b) Determine the Laplace Transform for the following functions by using the Laplace Transform Table.

*Tentukan Jelmaan Laplace bagi fungsi-fungsi yang berikut dengan menggunakan Jadual Jelmaan Laplace.*

   i.     $f(t) = 10 + e^{4t} + 3e^{-t}$

[3 marks]

*[3 markah]*

   ii.    $f(t) = 2t + 9t^2 + t^2 e^{3t}$

[6 marks]

*[6 markah]*

i. $\dfrac{s}{(s+2)(s-4)}$

[9 marks]

*[9 markah]*

ii. $\dfrac{2s^2-3}{s(s^2+1)}$

[11 marks]

*[11 markah]*

CLO4
C3

c) Determine the focus, vertex and directrix then sketch the following curves of parabola:

*Tentukan fokus, verteks dan direktriks kemudian lakarkan lengkungan parabola yang berikut :*

  i.      $(x+3)^2 = 8y$

[6 marks]

[*6 markah*]

  ii.     $3y^2 + 12x - 3 = 0$

[7 marks]

[*7 markah*]

## SECTION E : 25 MARKS
*BAHAGIAN E : 25 MARKAH*

**INSTRUCTION:**

Answer **ONE (1)** question from section A, B or C (for **JKE, JKP** and **JKPK**) and section A, **B** or **D** (for **JKM, JPP**).

*ARAHAN:*

*Jawab SATU(1) soalan dari bahagian A, B atau C (untuk JKE, JKP dan JKPK) dan bahagian A, B atau D (untuk JKM, JPP).*

## SOALAN TAMAT

## Vector & Scalar

| | | | | | |
|---|---|---|---|---|---|
| 1. | Unit Vector, $\hat{u} = \dfrac{\overline{u}}{|u|}$ | 2. | $\cos\theta = \dfrac{\overline{A} \bullet \overline{B}}{|A||B|}$ | 3. | $\vec{A} \bullet \vec{B} = a_1 a_2 + b_1 b_2 + c_1 c_2 \cdot$ |
| 4. | $\overline{A} \times \overline{B} = \begin{pmatrix} i & j & k \\ a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{pmatrix}$ | 5. | Scalar triple product= Volume of parallelepiped $\equiv a \bullet (b \times c)$ | 6. | Vector triple product $a \times (b \times c) = b(a \bullet c) - c(a \bullet b)$ |
| 7. | Area of paralellogram ABC $\left| \overrightarrow{AB} \times \overrightarrow{BC} \right|$ | | | | |

## Laplace Transform

| No. | $f(t)$ | $F(s)$ | No. | $f(t)$ | $F(s)$ |
|---|---|---|---|---|---|
| 1. | $a$ | $\dfrac{a}{s}$ | 13. | $e^{-at} \sin \omega t$ | $\dfrac{\omega}{(s+a)^2 + \omega^2}$ |
| 2. | $at$ | $\dfrac{a}{s^2}$ | 14. | $e^{-at} \cos \omega t$ | $\dfrac{s+a}{(s+a)^2 + \omega^2}$ |
| 3. | $t^n$ | $\dfrac{n!}{s^{n+1}}$ | 15. | $\sinh \omega t$ | $\dfrac{\omega}{s^2 - \omega^2}$ |
| 4. | $e^{at}$ | $\dfrac{1}{s-a}$ | 16. | $\cosh \omega t$ | $\dfrac{s}{s^2 - \omega^2}$ |
| 5. | $e^{-at}$ | $\dfrac{1}{s+a}$ | 17. | $e^{at} \sinh \omega t$ | $\dfrac{\omega}{(s-a)^2 - \omega^2}$ |
| 6. | $te^{-at}$ | $\dfrac{1}{(s+a)^2}$ | 18. | $e^{-at} \sinh \omega t$ | $\dfrac{\omega}{(s+a)^2 - \omega^2}$ |
| 7. | $t^n . e^{at}$, n=1,2,3 | $\dfrac{n!}{(s-a)^{n+1}}$ | 19. | $e^{-at} \cosh \omega t$ | $\dfrac{s+a}{(s+a)^2 - \omega^2}$ |

## PARABOLA

When the vertex lies at $(0,0)$ the standard equations for parabolas are:

| Axis of symmetry | $x$ - axis | $y$ - axis |
|---|---|---|
| Description | opens right | opens up |
| Vertex | $(0,0)$ | $(0,0)$ |
| Focus | $(a,0)$ | $(0,a)$ |
| Directrix | $x = -a$ | $y = -a$ |
| Equation | $y^2 = 4ax$ | $x^2 = 4ay$ |

## PARABOLA

When the vertex lies at $(h,k)$ the standard equations for parabolas are:

| Axis of symmetry | $x$ -axis | $y$-axis |
|---|---|---|
| Description | opens right / left | opens up / down |
| Vertex | $(h,k)$ | $(h,k)$ |
| Focus | $(h+a,k)$ | $(h,k+a)$ |
| Directrix | $x = h-a$ | $y = k-a$ |
| Equation | $(y-k)^2 = 4a(x-h)$ | $(x-h)^2 = 4a(y-k)$ |

## ELLIPSE

The properties of the ellipse with center $(0,0)$ as follows :

| Major axis | Parallel to $x$ - axis | | Parallel to $y$ - axis | |
|---|---|---|---|---|
| Foci | $(c,0)$ | $(-c,0)$ | $(0,c)$ | $(0,-c)$ |
| Vertices | $(a,0)$ | $(-a,0)$ | $(0,a)$ | $(0,-a)$ |
| Equation | $\dfrac{x^2}{a^2}+\dfrac{y^2}{b^2}=1$ $a>b>0$ and $b^2=a^2-c^2$ | | $\dfrac{x^2}{b^2}+\dfrac{y^2}{a^2}=1$ $a>b>0$ and $b^2=a^2-c^2$ | |
| Directrices | $x=\pm\dfrac{a^2}{c}$ | | $y=\pm\dfrac{a^2}{c}$ | |

| | | | | |
|---|---|---|---|---|
| Asymptotes | $y - k = \dfrac{b}{a}(x - h)$ | $y - k = -\dfrac{b}{a}(x - h)$ | $y - k = \dfrac{a}{b}(x - h)$ | $y - k = -\dfrac{a}{b}(x - h)$ |
| Directrix | $x = h + \dfrac{a}{e}$ | $x = h - \dfrac{a}{e}$ | $y = k + \dfrac{a}{e}$ | $y = k - \dfrac{a}{e}$ |

| Differentiation |
|---|
| $\dfrac{d}{dx}(k) = 0, \ k = \text{constant}$ |
| $\dfrac{d}{dx}(x^n) = nx^{n-1}$ |
| $\dfrac{d}{dx}(\ln|u|) = \dfrac{1}{u}\dfrac{du}{dx}$ |
| $\dfrac{d}{dx}(e^u) = e^u \dfrac{du}{dx}$ |
| $\dfrac{d}{dx}(\cos u) = -\sin u \dfrac{du}{dx}$ |
| $\dfrac{d}{dx}(\sin u) = \cos u \dfrac{du}{dx}$ |
| $\dfrac{d}{dx}(\tan u) = \sec^2 u \dfrac{du}{dx}$ |
| $\dfrac{d}{dx}(\cot u) = -\csc^2 u \dfrac{du}{dx}$ |
| $\dfrac{d}{dx}(\sec u) = \sec u \tan u \dfrac{du}{dx}$ |
| $\dfrac{d}{dx}(\csc u) = -\csc u \cot u \dfrac{du}{dx}$ |