POLITEKNIK
MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN MATEMATIK SAINS DAN KOMPUTER

PEPERIKSAAN AKHIR

SESI JUN 2016

BA501: ENGINEERING MATHEMATICS 4

TARIKH   : 24 OKTOBER 2016
MASA   : 2.30 PM – 4.30 PM (2 JAM)

Kertas ini mengandungi **ENAM BELAS (16)** 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) By using Binomial Theorem, expand to the first four terms for:
     Dengan menggunakan Teorem Binomial, kembangkan empat sebutan pertama bagi:

   i. $(-2x+5)^4$

                                                                      [5 marks]
                                                                      [5 *markah*]

   ii. $\left(2-\dfrac{x}{4}\right)^5$

                                                                      [5 marks]
                                                                      [5 *markah*]

   iii. $\dfrac{1}{(1+5x)}$

                                                                      [5 marks]
                                                                      [5 *markah*]

CLO1
C3

(b)   Find the coefficient of x^6 in the expansion $\left(x - \dfrac{1}{2x}\right)^{10}$.

   Cari pekali bagi x^6 dalam kembangan $\left(x - \dfrac{1}{2x}\right)^{10}$.

[5 marks]

[*5 markah*]

CLO1
C3

(c)   Find the value of $\dfrac{1}{(0.995)^6}$ by using Binomial expansion correct to 5 decimal places.

   Dapatkan nilai $\dfrac{1}{(0.995)^6}$ dengan menggunakan kembangan Binomial tepat kepada 5 tempat perpuluhan.

[5 marks]

[*5 markah*]

QUESTION 2
SOALAN 2

CLO1
C2

(a)   Find the first four terms for the expansion of the following functions:

   Dapatkan empat sebutan pertama bagi pengembangan fungsi-fungsi berikut:

   i. $e^{x + x^2}$

[6 marks]

[*6 markah*]

   ii. $\ln\left(1 - x - 6x^2\right)$

[6 marks]

[*6 markah*]

CLO1
C2

(b)   Find the coefficient of x^5 for the expansion of:

   Dapatkan pekali x^5 bagi pengembangan:

$$\left(3 - 2x^3\right)e^{4x}$$

[5 marks]

[*5 markah*]

CLO1
C3

(c)   Find the Mac Laurin Series for $f(x) = \dfrac{1}{4 - 3x}$ until the term with x^4 .

   Dapatkan Siri Mac Laurin bagi $f(x) = \dfrac{1}{4 - 3x}$ sehingga sebutan yang mengandungi x^4 .

[8 marks]

[*8 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

CLO 2
C2

(a)   Given that $\overrightarrow{OA} = 3i + 4j - k$ and $\overrightarrow{OB} = -2i + 5k$ Find :

   Diberi $\overrightarrow{OA} = 3i + 4j - k$ dan $\overrightarrow{OB} = -2i + 5k$ Cari :

   i. $\overrightarrow{AB}$

[3 marks]

[*3 markah*]

   ii. $\overrightarrow{OA} \bullet 2\overrightarrow{OB}$

[3 marks]

[*3 markah*]

   iii. $\overrightarrow{OB} \times \overrightarrow{OA}$

[3 marks]

[*3 markah*]

iv. $2\overrightarrow{OA} + 3\overrightarrow{OB}$

[3 marks]

[3 *markah*]

v.   Calculate the angle between the vector $\overrightarrow{OA}$ and $\overrightarrow{OB}$

Kira sudut antara vektor $\overrightarrow{OA}$ dan $\overrightarrow{OB}$

[7 marks]

[7 *markah*]

CLO 2
C3

(b)   Find the area of parallelogram ABCD when given $\overrightarrow{OA} = 4i + 7j + 7k$, $\overrightarrow{OB} = i + 3j + 2k$ and $\overrightarrow{OC} = 2i + 4j + 6k$,

Cari luas segiempat selari ABCD apabila diberi $\overrightarrow{OA} = 4i + 7j + 7k$, $\overrightarrow{OB} = i + 3j + 2k$, dan $\overrightarrow{OC} = 2i + 4j + 6k$,

[6 marks]

[6 *markah*]

QUESTION 4
SOALAN 4

Convert the following fractions into partial fractions:

Tukarkan pecahan berikut kepada pecahan separa:

CLO2
C2

(a) $\dfrac{x-5}{x^2+x-6}$

[6 marks]

[6 *markah*]

CLO2
C2

(b) $\dfrac{x^2-3}{(x+5)(x-2)^2}$

[9 marks]

[9 *markah*]

CLO2
C3

(c) $\dfrac{x^2}{x^2+3x+2}$

[10 marks]

[10 *markah*]

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)   Find the Laplace Transform for the following functions by using the definition $\int_0^{\infty} e^{-st} f(t)$.

Dapatkan jelmaan Laplace bagi fungsi berikut menggunakan definisi $\int_0^{\infty} e^{-st} f(t)$.

i. $f(t) = \dfrac{1}{5}$

[4 marks]

[4 *markah*]

ii. $f(t) = e^t$

[5 marks]

[5 *markah*]

CLO3
C3

(b) Calculate the Laplace Transform for the following functions below.

Kirakan jelmaan Laplace bagi fungsi berikut.

     i. $f(t) = -5t^2 + 2t + 3$

[4 marks]

[4 markah]

     ii. $f(t) = \frac{e^{3t}}{2} - 6\sin 2t$

[4 marks]

[4 markah]

     iii. $g(t) = e^{2t}\sin 3t$

[5 marks]

[5 markah]

     iv. $g(t) = t^2 e^{3t}$

[3 marks]

[3 markah]

QUESTION 6
SOALAN 6

CLO3
C2

(a) Determine the Inverse Laplace Transform for:

Tentukan songsangan bagi Penjelmaan Laplace berikut:

     i. $L^{-1}\left\{\frac{3}{s^2-16}\right\}$

[3 marks]

[3 markah]

     ii. $L^{-1}\left\{\frac{2}{s+6} + \frac{1}{s^2+100}\right\}$

[4 marks]

[4 markah]

CLO3
C3

(b) Write the expression in partial fraction and find the Inverse Laplace Transform for:

Tuliskan ungkapan berikut dalam bentuk pecahan separa dan dapatkan songsangan bagi Penjelmaan Laplace untuk:

     i. $\dfrac{5s-4}{s^2-s-2}$

[8 marks]

[8 markah]

     ii. $\dfrac{s^2-2s+3}{(s+1)(s^2+5)}$

[10 marks]

[10 markah]

SECTION D (JKM, JPP) : 25 MARKS
BAHAGIAN D (JKM, JPP) : 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 7
SOALAN 7

CLO4
C2

(a) Show the general equation of a circle with center $(4,-9)$ and radius 12.

Tunjukkan persamaan umum bulatan dengan nilai titik tengah $(4,-9)$ dan jejari 12.

[4 marks]

[4 markah]

CLO4
C3

(b) Determine the center and radius of the circle for $4x^2 + 4y^2 + 32x - 16y = -20$.

Tentukan titik tengah dan jejari bulatan bagi $4x^2 + 4y^2 + 32x - 16y = -20$.

[7 marks]

[*7 markah*]

CLO4
C2

(c) Find the vertex, focus point, and the directrix for the parabola $y^2 = -16x$.

Dapatkan vertex, titik fokus ,dan direktriks bagi parabola $y^2 = -16x$.

[4 marks]

[*4 markah*]

CLO4
C3

(d) Find the vertex, focus point and directrix for the parabola $(y+6)^2 = 8(x-2)$. Hence, sketch the graph by showing the vertex, focus point and the directrix of the parabola.

Dapatkan vertex, titik fokus dan direktriks bagi parabola $(y+6)^2 = 8(x-2)$. Seterusnya, lakarkan graf dengan menunjukkan vertex, titik fokus, dan direktriks bagi parabola tersebut.

[10 marks]

[*10 markah*]

QUESTION 8
SOALAN 8

CLO4
C3

(a) Find the center, major axis, focus point and vertex for the following ellipse. Then, sketch the graph.

Tentukan pusat, paksi major, titik fokus dan vertek bagi elips berikut. Seterusnya lakarkan graf.

$$\frac{x^2}{36} + \frac{(y-3)^2}{25} = 1$$

[10 marks]

[*10 markah*]

CLO4
C3

(b) Find the center, eccentric, focus point, vertex, asymptotes and directric for the following hyperbolic. Then, sketch the graph.

Tentukan pusat, esentrik, titik focus, vertek, asimptot dan direktrik bagi hiperbola berikut. Seterusnya lakarkan graf.

$$5x^2 - 4y^2 - 40x - 16y - 36 = 0$$

[15 marks]

[*15 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

FORMULA

Binomial Expansion

1.	$(a+x)^n = a^n + {}^nC_1 a^{n-1}x + {}^nC_2 a^{n-2}x^2 + {}^nC_r a^{n-r}x^r \dots$ (n = positive integer)
2.	$(1+x)^n = 1 + nx + \dfrac{n(n-1)x^2}{2!} + \dfrac{n(n-1)(n-2)x^3}{3!}$ (n = negative integer or fraction)
3.	The $(r+1)$ term, $T_{r+1} = {}^nC_r\, a^{n-r}\, x^r$

Power Series

1.	$e^x = 1 + x + \dfrac{x^2}{2!} + \dfrac{x^3}{3!} + \dfrac{x^4}{4!} + \dots + \dfrac{x^n}{n!}$
2.	$\ln(1+x) = x - \dfrac{x^2}{2} + \dfrac{x^3}{3} - \dfrac{x^4}{4} + \dots + (-1)^{n-1}\dfrac{x^n}{n}$
3.	$\ln\left(\dfrac{m}{n}\right) = 2\left[\dfrac{m-n}{m+n} + \dfrac{1}{3}\left(\dfrac{m-n}{m+n}\right)^3 + \dfrac{1}{5}\left(\dfrac{m-n}{m+n}\right)^5 + \dots\right]$
4.	$f(x) = f(0) + f'(0)x + \dfrac{f''(0)x^2}{2!} + \dfrac{f'''(0)x^3}{3!} + \dots + \dfrac{f^n(0)x^n}{n!}$ (MACLAURIN)
5.	$f(x) = f(x_0) + f'(x_0)(x-x_0) + \dfrac{f''(x_0)(x-x_0)^2}{2!} + \dfrac{f'''(x_0)(x-x_0)^3}{3!} + \dots + \dfrac{f^n(x_0)(x-x_0)^n}{n!}$ (TAYLOR)

Vector & Scalar

1.	Unit Vector, $\hat{u} = \dfrac{\overline{u}}{\lvert u \rvert}$	2.	$\cos\theta = \dfrac{\overline{A}\bullet\overline{B}}{\lvert A\rvert\lvert B\rvert}$	3.	$\vec{A}\bullet\vec{B} = a_1a_2 + b_1b_2 + c_1c_2$
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** $\lvert \overrightarrow{AB}\times\overrightarrow{BC} \rvert$				

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.	$e^{-at}\cosh\omega t$	$\dfrac{s+a}{(s+a)^2 - \omega^2}$

8.	$t^n . f(t)$	$(-1)^n \dfrac{d^n}{ds^n}[F(s)]$	20.	$f_1(t) + f_2(t)$	$F_1(s) + F_2(s)$
9.	$\sin \omega t$	$\dfrac{\omega}{s^2 + \omega^2}$	21.	$\int_0^t f(u)\,du$	$\dfrac{F(s)}{s}$
10.	$\cos \omega t$	$\dfrac{s}{s^2 + \omega^2}$	22.	$f(t-a)u(t-a)$	$e^{-as}F(s)$
11.	$t\sin \omega t$	$\dfrac{2\omega s}{\left(s^2 + \omega^2\right)^2}$	23.	First derivative $\dfrac{dy}{dt}, y'(t)$	$sY(s) - y(0)$
12.	$t\cos \omega t$	$\dfrac{s^2 - \omega^2}{\left(s^2 + \omega^2\right)^2}$	24.	Second derivative $\dfrac{d^2 y}{dt^2}, y''(t)$	$s^2 Y(s) - sy(0) - y'(0)$

Non Linear Equation (Circle)

1.	$(x-a)^2 + (y-b)^2 = r^2$		
2.	$x^2 + y^2 + 2gx + 2fy + c = 0$	$r = \sqrt{g^2 + f^2 - c}$	$center = (-g, -f)$
3.	Equation of a tangent and normal line , $y - y_1 = m(x - x_1)$ $m_{\tan gent} = -\dfrac{(x+g)}{(y+f)}$		
4.	Radius , $r = \dfrac{ax + by + c}{\sqrt{(a)^2 + (b)^2}}$		

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	$x = \pm \dfrac{a^2}{c}$		$y = \pm \dfrac{a^2}{c}$	

ELLIPSE

The properties of the ellipse with center (h, k) as follows :

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

HYPERBOLA

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

Transverse axis	x - axis		y - axis	
Foci	$(c, 0)$	$(-c, 0)$	$(0, c)$	$(0, -c)$
Vertices	$(a, 0)$	$(-a, 0)$	$(0, a)$	$(0, -a)$
Equation	$\dfrac{x^2}{a^2} - \dfrac{y^2}{b^2} = 1$ $b^2 = c^2 - a^2$		$\dfrac{y^2}{a^2} - \dfrac{x^2}{b^2} = 1$ $b^2 = c^2 - a^2$	
Asymptotes	$y = \dfrac{b}{a}x$	$y = -\dfrac{b}{a}x$	$y = \dfrac{a}{b}x$	$y = -\dfrac{a}{b}x$
Directrix	$x = \dfrac{a}{e}$	$x = -\dfrac{a}{e}$	$y = \dfrac{a}{e}$	$y = -\dfrac{a}{e}$

HYPERBOLA

The properties of the hyperbola with center (h, k) as follows :

Transverse axis	x - axis		y - axis	
Foci	$(h + c, k)$	$(h - c, k)$	$(h, k + c)$	$(h, k - c)$
Vertices	$(h + a, k)$	$(h - a, k)$	$(h, k + a)$	$(h, k - a)$
Equation	$\dfrac{(x-h)^2}{a^2} - \dfrac{(y-k)^2}{b^2} = 1$ $b^2 = c^2 - a^2$		$\dfrac{(y-k)^2}{a^2} - \dfrac{(x-h)^2}{b^2} = 1$ $b^2 = c^2 - a^2$	

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