SULIT

POLITEKNIK MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN MATEMATIK, SAINS DAN KOMPUTER

PEPERIKSAAN AKHIR

SESI JUN 2015

BA501: ENGINEERING MATHEMATICS 4

TARIKH : 21 OKTOBER 2015
MASA : 11.15 AM - 1.15 PM (2 JAM)

Kertas ini mengandungi **TUJUH BELAS (17)** halaman bercetak.
Sila Jawab soalan mengikut mengikut Bahagian yang diperuntukkan bagi setiap jabatan seperti arahan setiap Bahagian.
Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SECTION A: 25 MARKS (JKE, JKP, JKA, JKPK, JPP and JKM)
***BAHAGIAN A: 25 MARKAH* (JKE, JKP, JKA,JKPK, *JPP* dan JKM)**

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 1
SOALAN 1

CLO1 C2

(a) Expand the following algebraic expression by using the method stated in the bracket :
Kembangkan ungkapan algebra yang berikut dengan menggunakan kaedah yang dinyatakan di dalam kurungan :

i. $(3+2x)^5$ [Pascal Triangle] [5 marks]
[5 *markah*]

ii. $\left(1-\frac{1}{x}\right)^5$ [Binomial Theorem] [5 marks]
[5 *markah*]

CLO1 C3

(b) Find the coefficient of x^6 in the expansion of $\left(2x^4+\frac{1}{3x^2}\right)^{12}$
Dapatkan pekali bagi x^6 dari pengembangan ungkapan $\left(2x^4+\frac{1}{3x^2}\right)^{12}$.

[7 marks]
[7 *markah*]

CLO1 C3

(c) Expand the expression of $(1+2x)^5$ up to the fourth term and find the value of $(1.04)^5$ to the correct 3 decimal places.
Kembangkan ungkapan $(1+2x)^5$ sehingga sebutan keempat dan cari nilai $(1.04)^5$ betul kepada 3 tempat perpuluhan.

[8 marks]
[8 *markah*]

QUESTION 2

SOALAN 2

CLO1
C3

(a) Expand the following functions up to the first four terms.

Kembangkan fungsi berikut sehingga empat sebutan pertama.

i. $\left(x+2x^2\right)e^{-2x}$ [6 marks]

[*6markah*]

ii. $\ln\left[(1+x)^3(1-2x)\right]$ [7 marks]

[*7markah*]

CLO1
C3

(b) Find the Taylor Series of $f(x)=\cos(1+3x)$ at $x_0=\frac{\pi}{3}$ up to and include the term x^3.

Carikan Siri Taylor bagi bagi $f(x)=\cos(1+3x)$ *apabila* $x_0=\frac{\pi}{3}$ *sehingga sebutan yang mempunyai* x^3.

[12 marks]

[*12 markah*]

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

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

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

CLO2
C3

(a) Given $\vec{A}=3i+2j-k$, $\vec{B}=i+4j+2k$ and $\vec{C}=k-3i-2j$. Find:

Diberi $\vec{A}=3i+2j-k$, $\vec{B}=i+4j+2k$ *dan* $\vec{C}=k-3i-2j$. *Dapatkan:*

i. $3\vec{A}-2\vec{C}$

[3 marks]

[*3 markah*]

ii. $5\vec{B}\bullet 3\vec{A}$

[3 marks]

[*3 markah*]

iii. $\left(\vec{A}\bullet\vec{B}\right)\vec{C}$

[3 marks]

[*3 markah*]

iv. $\left(\vec{A}\times\vec{B}\right)\times\vec{C}$

[6 marks]

[*6 markah*]

CLO2
C3

(b) If $\vec{A} = i + 3j - 4k$ and $\vec{B} = 2i - 2j + k$, find:
Jika $\vec{A} = i + 3j - 4k$ *dan* $\vec{B} = 2i - 2j + k$, *dapatkan:*

i. A vector that is perpendicular to both vector A and B.
Vektor yang berserenjang dengan kedua-dua vektor A dan B.

[4 marks]
[*4 markah*]

ii. The angle between two vectors.
Sudut di antara dua vektor.

[6 marks]
[*6 markah*]

QUESTION 4
SOALAN 4

CLO2
C3

Find the partial fraction for each of the following algebraic functions.
Dapatkan pecahan separa bagi setiap fungsi algebra yang berikut.

(a) $\dfrac{3}{x(x+5)}$

[5 marks]
[*5 markah*]

(b) $\dfrac{4x+1}{2x^2 - x - 3}$

[6 marks]
[*6 markah*]

(c) $\dfrac{x^2 + 6}{x^2(2x-1)}$

[7 marks]
[*7 markah*]

(d) $\dfrac{2 + x^2}{(x^2+1)(4x+9)}$

[7 marks]
[*7 markah*]

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

BAHAGIAN C: 25 MARKAH (JKE, JKP, JKA dan JKPK)

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 5

SOALAN 5

CLO3
C2

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

Cari Jelmaan Laplace dengan menggunakan definisi $\int_0^\infty e^{-st} f(t)\,dt$ *bagi fungsi yang berikut :*

i. $f(t)=1$ [3 marks]
[3 markah]

ii. $f(t)=e^{at}$ [3 marks]
[3 markah]

CLO3
C3

(b) Find the Laplace transform of the given functions.
Cari Jelmaan Laplace bagi fungsi yang diberikan.

i. $f(t)=3\sinh(2t)+3\sin(2t)$ [3 marks]
[3 markah]

ii. $f(t)=t\cosh(3t)$ [4 marks]
[4 markah]

iii. $f(t)= 6e^{-5t}+e^{3t}+5t^3 - 9$ [6 marks]
[6 markah]

iv. $f(t)=4\cos(4t) - 9\sin(4t)+2\cos(10t)$ [6 marks]
[6 markah]

QUESTION 6

SOALAN 6

CLO3
C3

(a) Find the inverse Laplace Transform for each of the following functions:
Cari Jelmaan Laplace Songsang bagi setiap fungsi yang berikut:

i. $-\frac{2}{s}$ [1 mark]
[1 markah]

ii. $\frac{5}{2s-6}$ [2 marks]
[2 markah]

iii. $\frac{4}{s^2-9}$ [3 marks]
[3 markah]

iv. $\frac{s+2}{s^2+16}$ [4 marks]
[4 markah]

v. $\frac{s+5}{(s+3)^2+9}$ [4 marks]
[4 markah]

CLO3
C3

(b) Determine the Inverse Laplace Transform for $\frac{4s^2-5s+11}{(s+1)(s^2+9)}$ by using Partial Fraction Method.

Tentukan Jelmaan Laplace Songsang bagi $\frac{4s^2-5s+11}{(s+1)(s^2+9)}$ *dengan menggunakan Kaedah Pecahan Separa.*

[11 marks]
[11 markah]

SECTION D : 25 MARKS (JPP and JKM)

BAHAGIAN D: 25MARKAH (JPP dan JKM)

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 7

SOALAN 7

CLO4 C2 (a) Find the equation of a circle with centre (-3,6) and radius 18.

Dapatkan persamaan bulatan dengan titik pusat (-3,6) dan jejari 18.

[6marks]

[6 markah]

CLO4 C3 (b) Given center (2,3) and tangent equation $3x - y + 5 = 0$. Find the radius and the equation of the circle.

Diberikan titik tengah (2,3) dan persamaan tangen $3x - y + 5 = 0$. *Cari jejari dan persamaan bulatan.*

[7 marks]

[7 markah]

CLO4 C3 (c) Find the coordinates of the vertex, focus point, directrix and the axis equation of parabola $y^2 + 4y + 20x + 4 = 0$. Then sketch the graph.

Dapatkan koordinat bagi vertek, titik fokus, direktrik dan persamaan paksi bagi parabola $y^2 + 4y + 20x + 4 = 0$. Seterusnya lakarkan graf.

[12 marks]

[12markah]

QUESTION 8

SOALAN 8

CLO4 C3 (a) Find the eccentric, focus and directrix for the following hyperbolic equation:

Dapatkan eksentrik, titik focus dan direktrik bagi persamaan hiperbola berikut:

$$\frac{x^2}{9} - \frac{y^2}{4} = 1$$

[5 marks]

[5 markah]

CLO4 C3 (b) Find centre, vertex and focus point for the following ellipse equation. Then, sketch the graph.

Tentukan vertek dan titik fokus, bagi persamaan elips berikut. Seterusnya lakarkan graf.

$$\frac{(x-2)^2}{12} + \frac{(y+3)^2}{4} = 1$$

[10 marks]

[10 markah]

CLO4 C3 (c) Find vertex, focus point, eccentric and directrix for the following ellipse equation. Then, sketch the graph.

Tentukan vertek, titik fokus, esentrik dan direktrik bagi persamaan elips berikut. Seterusnya lakarkan graf.

$$\frac{x^2}{9} + \frac{y^2}{25} = 1$$

[10 marks]

[10 markah]

SECTION E
BAHAGIAN E

INSTRUCTION:
Answer **One (1)** question from Section **A, B** or **C** (for **JKE, JKP, JKA** and **JKPK)** and Section **A,B** or **D** (for **JPP** and **JKM)** apart from the questions that have been answered.

ARAHAN :
*Jawab **SATU (1)** soalan daripada mana-mana Bahagian **A, B** atau **C (untuk JKE, JKP, JKA dan JKPK)** dan Bahagian **A, B,** atau **D (untuk JPP dan JKM)** selain daripada soalan yang telah dijawab*

SOALAN TAMAT

FORMULA

Binomial Expansion

1.	$(a+x)^n = a^n + {}^nC_1 a^{n-1}x + {}^nC_2 a^{n-2}x^2 + {}^nC_r a^{n-r}x^r \ldots\ldots + x^n$ (n = positive integer)
2.	$(1+x)^n = 1 + nx + \frac{n(n-1)x^2}{2!} + \frac{n(n-1)(n-2)x^3}{3!} + \ldots\infty$ (n = negative integer or fraction)
3.	*The* $(r+1)^{th}$ *term* $= {}^nC_r\, a^{n-r}\, x^r$

Power Series

1.	$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots. + \frac{x^n}{n!}$
2.	$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \ldots. + (-1)^{n-1}\frac{x^n}{n}$
3.	$\ln\left(\frac{m}{n}\right) = 2\left[\frac{m-n}{m+n} + \frac{1}{3}\left(\frac{m-n}{m+n}\right)^3 + \frac{1}{5}\left(\frac{m-n}{m+n}\right)^5 + \ldots.\right]$
4.	$f(x) = f(0) + f'(0)x + \frac{f''(0)x^2}{2!} + \frac{f'''(0)x^3}{3!} + \ldots.. + \frac{f^n(0)x^n}{n!}$ (MACLAURIN)
5.	$f(x) = f(x_0) + f'(x_0)(x-x_0) + \frac{f''(x_0)(x-x_0)^2}{2!} + \frac{f'''(x_0)(x-x_0)^3}{3!} + \ldots. + \frac{f^n(x_0)(x-x_0$ (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.	$\overline{A}\times\overline{B}=\begin{vmatrix} i & j & k \\ a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{vmatrix}$	5.	*Scalar triple product= Volume of parallelepiped* $\equiv\tilde{a}\bullet(\tilde{b}\times\tilde{c})$	6.	*Vector triple product* $\tilde{a}\times(\tilde{b}\times\tilde{c})=\tilde{b}(\tilde{a}\bullet\tilde{c})-\tilde{c}(\tilde{a}\bullet\tilde{b})$
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.	$\int_o^t f(u)du$	$\dfrac{F(s)}{s}$
10.	$\cos\omega t$	$\dfrac{s}{s^2+\omega^2}$	22.	$f(t-a)u(t-a$	$e^{-as}F(s)$
11.	$t\sin\omega t$	$\dfrac{2\omega s}{(s^2+\omega^2)^2}$	23.	First derivative $\dfrac{dy}{dt}, y'(t)$	$sY(s)-y(0)$
12.	$t\cos\omega t$	$\dfrac{s^2-\omega^2}{(s^2+\omega^2)^2}$	24.	Second derivative $\dfrac{d^2y}{dt^2}, y''(t)$	$s^2Y(s)-sy(0)-y'(0)$

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 , $y-y_1=m(x-x_1)$		$\mathrm{m}=-\dfrac{(\mathrm{x}+\mathrm{g})}{(\mathrm{y}+\mathrm{f})}$

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	$(a,0)$	$(\ \ a,0)$	$(0,a)$	$(0,\ \ a)$
Vertices	$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$		$\frac{x^2}{b^2}+\frac{y^2}{a^2}=1$	
Equation	$a>b>0$ and $b^2 = a^2 - c^2$		$a>b>0$ and $b^2 = a^2 - c^2$	

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	$\frac{(x-h)^2}{a^2}+\frac{(y-k)^2}{b^2}-1$		$\frac{(x-h)^2}{b^2}+\frac{(y-k)^2}{a^2}-1$	
	$a>b$ and $b^2 = a^2 - c^2$		$a>b$ and $b^2 = a^2 - c^2$	

HYPERBOLA

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	$\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$		$\frac{y^2}{a^2}-\frac{x^2}{b^2}=1$	
	$b^2 = c^2 - a^2$		$b^2 = c^2 - a^2$	
Asymptotes	$y=\frac{b}{a}x$	$y=-\frac{b}{a}x$	$y=\frac{a}{b}x$	$y=-\frac{a}{b}x$
Directrix	$x=\frac{a}{e}$	$x=-\frac{a}{e}$	$y=\frac{a}{e}$	$y=-\frac{a}{e}$

HYPERBOLA

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	$\frac{(x-h)^2}{a^2}-\frac{(y-k)^2}{b^2}=1$		$\frac{(y-k)^2}{a^2}-\frac{(x-h)^2}{b^2}=1$	
	$b^2 = c^2 - a^2$		$b^2 = c^2 - a^2$	

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

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