STRUCTURED (100 MARKS)

INSTRUCTION:

This section consists of **EIGHT (8)** structured questions. Answer **FOUR (4)** questions only.

For **JKE & JKP** students: **Answer Four (4)** questions from question **1, 2, 3, 4, 5** or **6**
For **JKM** students: **Answer Four (4)** questions from question 1, **2, 3, 4, 7** or **8**

QUESTION 1

a) Find, in ascending power of x the first four terms in the expansion of :

i) $\left(1-\frac{x}{4}\right)^8$

(4 marks)

ii) $(4+4x)^{-2}$

(6 marks)

b) Expand $(1-x)^{30}$ in ascending power of x up to the first four terms. Then, find the value of $(0.973)^{30}$ correct to five decimal places.

(9 marks)

c) Using the Binomial Theorem, find the value up to five decimal places for

$$\frac{1}{(0.995)^3}$$

(6 marks)

POLITEKNIK
Jabatan Pengajian Politeknik

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION
(MINISTRY OF HIGHER EDUCATION)

MATHEMATICS, SCIENCE & COMPUTER DEPARTMENT

FINAL EXAMINATION

JUNE 2012 SESSION

B4001: ENGINEERING MATHEMATICS 4

DATE: 17 NOVEMBER 2012 (SATURDAY)
DURATION: 2 HOURS (8:30 AM – 10:30 AM)

This paper consists of **EIGHT (8)** pages including the front page

Structured questions (8 questions – answer only **4** questions)
For **JKE & JKP** students: Answer **Four (4)** questions from question **1, 2, 3, 4, 5 or 6**
For **JKM** students: Answer **Four (4)** questions from question **1, 2, 3, 4, 7 or 8**

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QUESTION 2

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

i) $\left(x+2x^2\right)e^{-2x}$

(6 marks)

ii) $ln\,[(1+x)^3(1-2x)]$

(7 marks)

b) Find the coefficient of x^4 for the expansion of $e^{\frac{x}{4}}$.

(4 marks)

c) Find the Taylor Series of $f(x)=\cos(1+3x)$ at $x_0=\frac{\pi}{3}$ until the term with x^3.

(8 marks)

QUESTION 3

a) If $\tilde{p}=5\tilde{i}-2\tilde{j}+7\tilde{k}$ and $\tilde{q}=2\tilde{i}-7\tilde{j}-6\tilde{k}$, find:

i) $4\tilde{p}\times 2\tilde{q}$

(5 marks)

ii) $(3\tilde{p}\bullet 6\tilde{q})\tilde{p}$

(5 marks)

b) Given vector $\overrightarrow{OA}=3\tilde{i}-3\tilde{j}+2\tilde{k}$, $\overrightarrow{OB}=4\tilde{i}+3\tilde{j}-5\tilde{k}$ and $\overrightarrow{OC}=-5\tilde{i}+\tilde{j}-3\tilde{k}$ determine :

i) $\overrightarrow{AB}$

(2 marks)

ii) $\overrightarrow{BC}$

(2 marks)

iii) $\overrightarrow{AB}\times\overrightarrow{BC}$

(3 marks)

c) Find the angle between vector $4\tilde{i}+\tilde{j}-3\tilde{k}$ and vector $2\tilde{i}-3\tilde{j}+3\tilde{k}$

(8 marks)

QUESTION 4

Express the following fractions into partial fractions:

a) $\frac{3}{(1-x)^3}$

(5 marks)

b) $\frac{x^2-1}{x^2(2x+1)}$

(6 marks)

c) $\frac{x^3}{(x+1)(x-3)}$

(7 marks)

d) $\frac{2x^3+x^2-15x-5}{(x+3)(x-2)}$

(7 marks)

QUESTION 5

a) Find the Laplace Transform for:

i) $f(t) = cos8t - \sin 8t$

(3 marks)

ii) $f(t) = 4e^{3t} \sin 5t$

(3 marks)

iii) $f(t) = t^7 - 6t^5 - 4t^3$

(4 marks)

iv) $f(t) = -4e^{-5t} \sinh t$

(4 marks)

b) Use the definition method to find the Laplace Transform for the following functions:

i) $f(t) = -7$

(5 marks)

ii) $f(t) = e^{-6t}$

(6 marks)

QUESTION 6

a) Find the Inverse Laplace Transform for the following expressions:

i. $F(s)=\left(\frac{5}{s+2}\right)+\left(\frac{5}{s^2-25}\right)$

(2 marks)

ii. $F(s)=\frac{3}{(4s^2-16)}$

(3 marks)

iii. $F(s)=\frac{7}{(s-4)^3}$

(4 marks)

b) Find the Inverse Laplace Transform for the following expressions using the Partial Fraction Method.

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

(7 marks)

ii. $\frac{7s^2-3}{(s+2)^2(s-4)}$

(9 marks)

QUESTION 7

a) Sketch the graph of the exponential function, $y=3e^{2x}$ for $-2\le x\le 2$.

(8 marks)

b) Find the centre point and the radius of a circle $2x^2+2y^2-4x+6y+3=0$.

(7 marks)

c) Find the equations of the tangent and normal at the point (2,-3) to the circle $3x^2+3y^2+5x-4y-1=0$.

(10 marks)

QUESTION 8

a) Find the equation of each parabola based on the following conditions:

i. Vertex at (0, 0) and focus at (0, 6).

(5 marks)

ii. Focus at (6, 2) and directrix at x = 2 .

(7 marks)

b) Find the center, major vertex and minor vertex of an ellipse $x^2+4y^2-8x-32y=20$.

(13 marks)

Parabola

1.	Vertical	i. $x^2 = 4ay$	ii. $(x-h)^2 = 4a(y-k)$
2.	Horizontal	i. $y^2 = 4ax$	ii. $(y-k)^2 = 4a(x-h)$
3.	Vertex	$v = (h,k)$	
4.	Focus	$(h+a,k) - horizontal$	$(h,k+a) - vertical$
5.	Directrix	i. $x = h-a$	ii. $y = k-a$

Ellipse

1.	$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

Hyperbola

1.	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$	horizontal
2.	$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$	vertical

Laplace Transform

NUM	$f(t)$	$F(s)$	9	$e^{-at}\sin\omega t$	$\frac{\omega}{(s+a)^2+\omega^2}$
1	a	$\frac{a}{s}$	10	$e^{-at}\cos\omega t$	$\frac{s+a}{(s+a)^2+\omega^2}$
2	at	$\frac{a}{s^2}$	11	$\sinh\omega t$	$\frac{\omega}{(s^2-\omega^2)}$
3	e^{-at}	$\frac{1}{s+a}$	12	$\cosh\omega t$	$\frac{s}{(s^2-\omega^2)}$
4	te^{-at}	$\frac{1}{(s+a)^2}$	13	$f_1(t)+f_2(t)$	$F_1(s)+F_2(s)$
5	t^n	$\frac{n!}{s^{n+1}}$	14	$\frac{df}{dt}$	$sF(s)-f(0)$
6	$\sin\omega t$	$\frac{\omega}{(s^2+\omega^2)}$	15	$\int_0^t f(u)du$	$\frac{F(s)}{s}$
7	$\cos\omega t$	$\frac{s}{(s^2+\omega^2)}$	16	$f(t-a)u(t-a)$	$e^{-as}F(s)$
8	$\frac{t^{n-1}}{(n-1)!}$	$\frac{1}{s^n}$	17	$t^n.f(t)$	$(-1)^n\frac{d^n}{ds^n}[F(s)]$

Trigonometric Identities

1	$\sin 2x = 2\sin x\cos x$
2	$\cos 2x = 2\cos^2 x - 1 = 1 - \sin^2 x$

FORMULA OF ENGINEERING MATHEMATICS 4 (B4001)

Binomial Expansion

1.	$(a+x)^n = a^n + {}^nC_1 a^{n-1}x + {}^nC_2 a^{n-2}x^2 + \ldots\ldots + x^n$	(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 interger or fraction)

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.	$f(x) = f(0) + f'(0)x + \frac{f''(0)x^2}{2!} + \frac{f'''(0)x^3}{3!} + \ldots + \frac{f^n(0)x^n}{n!}$ (MACLAURIN)
4.	$f(x) = f(x_0) + f'(x_0)(x-x_0) + \frac{f''(x_0)(x-x_0)^2}{2!} + \frac{f'''(x_0)(x-x_0)^3}{3!} + \ldots + \frac{f^n(x_0)(x-x_0)^n}{n!}$ (TAYLOR)

Vector and Scalar

1.	$\overline{A} \bullet \overline{B} = a_1a_2 + b_1b_2 + c_1c_2$	3.	$\cos\theta = \frac{\overline{A} \bullet \overline{B}}{\lvert A\rVert B\rvert}$	5.	Direction Cosine $\overrightarrow{OP}$ $\cos\alpha = \frac{x}{\lvert\overrightarrow{OP}\rvert}$ $\cos\beta = \frac{y}{\lvert\overrightarrow{OP}\rvert}$ $\cos\gamma = \frac{z}{\lvert\overrightarrow{OP}\rvert}$
2.	$\overline{A} \times \overline{B} = \begin{pmatrix} i & j & k \\ a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{pmatrix}$	4.	Unit vector $\hat{u} = \frac{\overline{u}}{\lvert u\rvert}$	6.	Area of a triangle $\frac{1}{2}\lvert\overrightarrow{AB} \times \overrightarrow{BC}\rvert$

Non Linear Equation (Circle)

1.	$(x-a)^2 + (y-b)^2 = r^2$
2.	$x^2 + y^2 + 2gx + 2fy + c = 0$ $\quad r = \sqrt{g^2 + f^2 - c}$ $\quad center = (-g,-f)$
3.	Equation of a tangent , $y - y_1 = m(x - x_1)$