CONFIDENTIAL

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	ENGINEERING MATHEMATICS I
COURSE CODE	:	DAS 10303
PROGRAMME	:	3 DAL
EXAMINATION DATE	:	DECEMBER 2013/JANUARY 2014
DURATION	:	3 HOURS
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS IN **SECTION A.** B) ANSWER **THREE (3)** QUESTIONS ONLY IN **SECTION B.**

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

CONFIDENTIAL

SECTION A

Q1 (a) Find the Laplace transforms for the functions below.

(i) $f(t) = 101$

(2 marks)

(ii) $f(t) = 4t^2$

(2 marks)

(iii) $f(t) = sin2t + 2\cos t$

(2 marks)

(iv) $f(t) = cosht - sinh2t$

(2 marks)

(v) $f(t) = (t-7)H(t-7)$

(2 marks)

(b) By using the **First Shift Theorem** or **Multiply with $\mathbf{t^n}$** method, find the Laplace transforms for the following functions.

(i) $f(t) = e^{2t}cos3t$

(2 marks)

(ii) $f(t) = t^2 sinh4t$

(2 marks)

(iii) $f(t) = t^3 e^{3t}$

(2 marks)

(c) Find the Laplace transforms for $g(t) = \begin{cases} 2 & 0 < t < 3 \\ 1 & 3 < t < 6 \\ 3 & t > 6 \end{cases}$.

Hint: $g_1 + (g_2 - g_1)H(t-a) + (g_3 - g_2)H(t-b) = \begin{cases} g_1 & 0 < t < a \\ g_2 & a < t < b \\ g_3 & t > b \end{cases}$

(4 marks)

Q2 (a) Find the inverse Laplace transforms for the functions below.

(i) $F(s) = \frac{91827}{s}$

(2 marks)

(ii) $F(s) = \frac{5}{(s-2)^2}$

(2 marks)

(iii) $F(s) = \frac{s}{s^2-13}$

(2 marks)

(iv) $F(s) = \frac{7}{(s-1)(s-2)}$

(2 marks)

(v) $F(s) = \frac{8}{s^2-2s+3}$

(2 marks)

(b) Solve the initial value problem for $2y' - 3y = 1$, with $y(0) = 1$.

(10 marks)

SECTION B

Q3 (a) Given $f(x) = x^2 - x + k$. Find the value of k if

(i) $f(3) = 11$.

(3 marks)

(ii) $f(2) = 3k - 8$.

(3 marks)

(b) Given $g(x) = 2x^2 - 5x + 3$.

(i) Find $g(10)$.

(3 marks)

(ii) Find x when $g(x) = 0$.

(5 marks)

(c) The function h is defined by $h : x \rightarrow 4x - 3$. The function k is such that $h \circ k : x \rightarrow 8x + 1$. Find the function k.

(6 marks)

Q4 (a) Let $f(x) = \begin{cases} 4 & x < 0 \\ 9 - 2x & 0 \leq x \leq 2 \\ x + 3 & x > 2 \end{cases}$. Find

(i) $f(-4)$, $f(1)$ and $f(3)$.

(3 marks)

(ii) $\lim_{x\to 0^-} f(x)$ and $\lim_{x\to 0^+} f(x)$.

(2 marks)

(iii) $\lim_{x\to 2^-} f(x)$ and $\lim_{x\to 2^+} f(x)$.

(2 marks)

(iv) $\lim_{x\to 0} f(x)$ and $\lim_{x\to 2} f(x)$.

(2 marks)

(b) Referring to **Q4**(a), check whether $f(x)$ is continues at $x = 0$ and $x = 2$.

(5 marks)

(c) Given $\lim_{x\to 1} g(x) = 15$ and $\lim_{x\to 1} h(x) = 7$. Calculate

(i) $\lim\limits_{x\to 1} g(x)$ - $2\lim_{x\to 1} h(x)$.

(2 marks)

(ii) $\lim_{x\to 1} \left(\frac{g(x)-h(x)}{g(x).h(x)}\right)^2$.

(4 marks)

Q5 (a) Differentiate:

(i) $y = (x^2 - 2x + 5)^3$

(6 marks)

(ii) $y = \frac{x \sin x}{\cos x^2}$

(8 marks)

(b) Find the implicit differentiation for

$$xy^2 - 3x^2 = 5xy$$

(6 marks)

Q6 (a) Water was filled from the tap into a cylinder with a volume, V, denoted as $V = \pi r^2 h$.

(i) Find the rate of change of the volume of water increasing in the cylinder with respect to its radius when the height, h is 7 cm.

(5 marks)

(ii) Calculate the water volume changing with respect to its radius when the height is 13 cm.

(5 marks)

(b) A farmer decided to fence his rectangular land by using two kinds of fencing. One side will use heavy-duty fencing selling for RM10 a meter, while the remaining three sides will use standard fencing selling for RM6 a meter. Could you help the farmer to calculate the dimensions of the rectangular plot of greatest area that can be fenced in at a cost of RM2000?

(10 marks)

Q7 (a) Find the Laplace transforms for the functions below.

(i) $f(t) = 5t^3 - 4t^2 + e^{2t}$

(3 marks)

(ii) $f(t) = sin3t + e^{-t}cos5t$

(3 marks)

(iii) $f(t) = (2t + 1)H(t - 4)$

(4 marks)

(b) (i) Factorize $x^3 - 2x^2 - 3x$.

(3 marks)

(ii) Decompose $\frac{x^2+2}{x^3 - 2x^2 - 3x}$ into partial fractions.

(4 marks)

(iii) Find the inverse Laplace transforms for $\frac{s^2+2}{s^3 - 2s^2 - 3s}$.

(3 marks)

- END OF QUESTIONS -

FINAL EXAMINATION

SEMESTER / SESSION : SEM 1 / 2013/2014 PROGRAMME: 3 DAL
COURSE : ENGINEERING MATHEMATICS I COURSE CODE: DAS 10303

FORMULAE

Differentiations

$$\frac{d}{dx}(ax^n) = nax^{n-1}$$

$$\frac{d}{dx}(\sin u) = \cos\ u.\frac{du}{dx}$$

$$\frac{d}{dx}(u^n) = nu^{n-1}.\frac{du}{dx}$$

$$\frac{d}{dx}(\cos u) = -\sin\ u.\frac{du}{dx}$$

$$\frac{d}{dx}\left(\frac{1}{\sqrt{u}}\right) = \frac{1}{2\sqrt{u}}.\frac{du}{dx}$$

$$\frac{d}{dx}(\tan u) = sec^2\, u.\frac{du}{dx}$$

$$\frac{d}{dx}(e^u) = e^u.\frac{du}{dx}$$

$$\frac{d}{dx}(\sec\ u) = \sec\ u.tan\, u.\frac{du}{dx}$$

$$\frac{d}{dx}(\ln u) = \frac{1}{u}.\frac{du}{dx}$$

$$\frac{d}{dx}(uv) = uv' + vu'$$

$$\frac{d}{dx}(\mathrm{k}u) = k.\frac{du}{dx}$$

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{vu' - uv'}{v^2}$$

Laplace Transforms

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

$f(t)$	$F(s)$
k	$\frac{k}{s}$
$t^n, n = 1, 2, 3, \ldots$	$\frac{n!}{s^{n+1}}$
e^{at}	$\frac{1}{s-a}$

FINAL EXAMINATION

SEMESTER / SESSION : SEM 1 / 2013/2014 PROGRAMME: 3 DAL
COURSE : ENGINEERING MATHEMATICS I COURSE CODE: DAS 10303

$\sin at$	$\frac{a}{s^2 + a^2}$
$\cos at$	$\frac{s}{s^2 + a^2}$
$\sinh at$	$\frac{a}{s^2 - a^2}$
$\cosh at$	$\frac{s}{s^2 - a^2}$
$\boldsymbol{f(t)}$	$\boldsymbol{F(s)}$
The First Shift Theorem	
$e^{at}.f(t)$	$F(s-a)$
Multiply with t^n	
$t^n.f(t)$, n = 1, 2, 3, …	$(-1)^n.\frac{d^n}{ds^n}F(s)$
The Unit Step Function	
$H(t-0)$	$\frac{1}{s}$
$H(t-a)$	$\frac{e^{-as}}{s}$
The First Shift Theorem	
$f(t-a).H(t-a)$	$e^{-as}.F(s)$
Heaviside Function	
$g(t) = g_1 + (g_2 - g_1)H(t-a) + (g_3 - g_2)H(t-b)$	
Initial Value Problems (IVP)	
$\mathcal{L}\{y(t)\} = Y(s)$	
$\mathcal{L}\{y'(t)\} = sY(s) - y(0)$	
$\mathcal{L}\{y''(t)\} = s^2Y(s) - sy(0) - y'(0)$	