UNIVERSITY *of* LIMERICK
OLLSCOIL LUIMNIGH

College of Informatics and Electronics

MID TERM ASSESSMENT PAPER

MODULE CODE: MA4003 SEMESTER: Autumn 2006/07

MODULE TITLE: Engineering Mathematics 3 DURATION OF EXAMINATION: 45 minutes

LECTURER: Dr. M. Burke PERCENTAGE OF TOTAL MARKS: 20 %

EXTERNAL EXAMINER: Prof. J. King

INSTRUCTIONS TO CANDIDATES: **Answer all questions. All questions carry equal marks. Use the Answer Sheet below.**

ANSWER SHEET

STUDENT'S NAME:
STUDENT'S ID NUMBER:

For each part of the question, place an "**X**" in the box of your choice.

Question	a	b	c	d	e	Do not write in this column
1			x			
2				x		
3					x	
4		x				See Results
5				x		
6					x	
7					x	
8	x					
9	x					
10		x				

Table of Laplace Transforms

$f(t),\ t \geq 0$	$F(s) = \mathcal{L}[f(t)]$
1	$\frac{1}{s}$
t	$\frac{1}{s^2}$
t^n	$\frac{n!}{s^{n+1}}$
e^{at}	$\frac{1}{s-a}$
$t^n e^{at}$	$\frac{n!}{(s-a)^{n+1}}$
$\sinh at$	$\frac{a}{s^2-a^2}$
$\cosh at$	$\frac{s}{s^2-a^2}$
$\frac{1}{a-b}(e^{at} - e^{bt})$	$\frac{1}{(s-a)(s-b)}$
$\frac{a}{a-b}e^{at} - \frac{b}{a-b}e^{bt}$	$\frac{s}{(s-a)(s-b)}$
$\sin at$	$\frac{a}{s^2+a^2}$
$\cos at$	$\frac{s}{s^2+a^2}$
$f'(t)$	$sF(s) - f(0)$
$f''(t)$	$s^2F(s) - sf(0) - f'(0)$
$\int_0^t f(\tau)\,d\tau$	$\frac{1}{s}F(s)$
$e^{at}f(t)$	$F(s-a)$
Heaviside $u_a(t)$	$\frac{e^{-as}}{s}$
$f(t-a)u_a(t)$	$e^{-as}F(s)$
Ramp $R(t-a)$	$\frac{e^{-as}}{s^2}$
$tf(t)$	$-F'(s)$
$\frac{f(t)}{t}$	$\int_s^\infty F(\sigma)\,d\sigma$
$(f * g)(t) \equiv \int_0^t f(t-\tau)g(\tau)\,d\tau$	$F(s)G(s)$
$f(t) = f(t+p)$	$\frac{1}{1-e^{-sp}}\int_0^p f(t)e^{-st}\,dt$

All $f(t)$ are defined for $t \geq 0$.

1. The *Laplace* Transform of $2t - 2$ is

   $(a)\ \frac{2}{s^2}e^{-s}$ $(b)\ \frac{2}{s^2}e^{-2s}$ $(c)\ \frac{2}{s^2} - \frac{2}{s}$ $(d)\ \frac{4}{s^2} - \frac{2}{s}$ $(e)\ \frac{2}{s^2} - 2$

2. The *Laplace* Transform of $e^{-3t}\sinh 2t$ is

   $(a)\ \frac{2}{(s+3)^2+2}$ $(b)\ \frac{2}{(s+3)^2+4}$ $(c)\ \frac{s}{(s+3)^2-4}$ $(d)\ \frac{2}{(s+3)^2-4}$ $(e)\ \frac{4}{(s+3)^2-2}$

3. The *Laplace* Transform of $f(t) = 2(t-2)u_2(t)$ is

   $(a)\ \frac{2}{s} - 4$ $(b)\ \frac{2}{s^2} - \frac{4}{s}$ $(c)\ \frac{2}{s^2}e^{-4s}$ $(d)\ \frac{1}{s^2}e^{-2s}$ $(e)\ \frac{2}{s^2}e^{-2s}$

4. The inverse *Laplace* transform of $\frac{s-1}{s^2-2s+2}$ is

   $(a)\ e^{-t}\cos t$ $(b)\ e^{t}\cos t$ $(c)\ e^{-t}\cos 2t$ $(d)\ e^{2t}-e^{-t}$ $(e)\ e^{-2t}-e^{t}$

5. The inverse *Laplace* transform of $\frac{s+1}{s^2-4s+3}$ is

   $(a)\ 2e^{-t}-e^{-3t}$ $(b)\ -e^{-t}+2e^{-3t}$ $(c)\ 2e^{t}-e^{3t}$ $(d)\ -e^{t}+2e^{3t}$ $(e)\ e^{3t}$

6. The convolution of t with t^2 (also denoted by $t * t^2$) is given by

   $(a)\ \frac{t^3}{6}$ $(b)\ t^3$ $(c)\ \frac{t^4}{4}$ $(d)\ \frac{t^4}{6}$ $(e)\ \frac{t^4}{12}$

7. The period of $\sin\left(\frac{2x}{3}\right)$ is

   $(a)\ \frac{2}{3}$ $(b)\ 3$ $(c)\ \frac{3}{2}\pi$ $(d)\ 2\pi$ $(e)\ 3\pi$

8. The functions $f(x) = x^2$ for $-1 < x < 1$ and $g(x) = \begin{cases} -x, & \text{if } -1 < x < 0 \\ x, & \text{if } 0 < x < 1 \end{cases}$ have the property that
   (a) both are even (b) both are odd (c) f is odd and g is even
   (d) f is even and g is odd (e) neither is even nor odd

9. The function $f(x) = x$ for $0 < x < 4$ is periodic with period 4. It has a *Fourier* Series $\frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos(**) + \sum_{n=1}^{\infty} b_n \sin(**)$ where ** is given by

   $(a)\ \frac{n\pi x}{2}$ $(b)\ \frac{n\pi x}{4}$ $(c)\ 2n\pi x$ $(d)\ \frac{nx}{2}$ $(e)\ nx$

10. The coefficient a_0 in the *Fourier* Series for the periodic function $f(x) = x$ if $-2 < x < 2$ with period 4 is

    $(a)\ -1$ $(b)\ 0$ $(c)\ \frac{1}{2}$ $(d)\ 1$ $(e)\ 2$