UNIVERSITY *of* LIMERICK
OLLSCOIL LUIMNIGH

College of Informatics and Electronics

MID TERM ASSESSMENT PAPER

MODULE CODE: MA4003 SEMESTER: Autumn 2005/06

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					
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 $(t-2)^2$ is

   (a) $\frac{1}{s^2}e^{-2s}$ (b) $\frac{2}{s^3}e^{-2s}$ (c) $\frac{2}{s^3}+\frac{4}{s^2}+\frac{4}{s}$ (d) $\frac{2}{s^3}-\frac{4}{s^2}+\frac{4}{s}$ (e) $\frac{1}{s^3}-\frac{4}{s^2}+\frac{4}{s}$

2. The *Laplace* Transform of $e^{-4t}\sin 2t$ is

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

3. The *Laplace* Transform of $f(t) = \begin{cases} 0, & \text{if } 0 \leq t < 2 \\ 2(t-2), & \text{if } t \geq 2 \end{cases}$ 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 $\frac{1}{s^2+2s+2}$ is

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

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

   (a) e^{-3t} (b) e^{-t} (c) $\frac{3}{4}e^{-t}+\frac{1}{4}e^{3t}$ (d) $-\frac{1}{4}e^{-t}+\frac{3}{4}e^{3t}$ (e) e^{3t}

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

   (a) $\frac{t^2}{6}$ (b) $\frac{t^2}{2}$ (c) $\frac{t^3}{6}$ (d) t^3 (e) $\frac{t^4}{12}$

7. The period of $\cos\left(\frac{4\pi x}{5}\right)$ is

   (a) $\frac{4}{5}$ (b) 1 (c) $\frac{5}{4}$ (d) $\frac{5}{2}$ (e) $\frac{5}{4}\pi$

8. The functions $f(x) = x^3$ for $-1 < x < 1$ and $g(x) = \begin{cases} -1, & \text{if } -1 < x < 0 \\ 1, & \text{if } 0 < x < 1 \end{cases}$ are
   (a) both even (b) both 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 $f(x) = x^2$ for $-2 < x < 2$ is periodic with period 4. It has a *Fourier* Series $\frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos(**)$ 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 $-1 < x < 1$ with period 2 is

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