UNIVERSITY *of* LIMERICK
OLLSCOIL LUIMNIGH

Faculty of Science and Engineering
Department of Mathematics & Statistics

MID TERM ASSESSMENT PAPER

MODULE CODE: MA4003 SEMESTER: Autumn 2011/12

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

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

Colour: Green

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 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 $\cos 2t + \sin 2t$ is

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

2. The *Laplace* Transform of $e^{-5t}(2t+1)$ is

$$(a)\ \frac{2s+5}{(s+2)^2} \quad (b)\ \frac{s+7}{(s+5)^2} \quad (c)\ \frac{2s+1}{(s+5)(s+2)^2} \quad (d)\ \frac{2s+1}{s^2(s+5)} \quad (e)\ \frac{s+2}{s^2}e^{-5s}$$

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

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

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

$$(a)\ (1-4t)e^{-4t} \quad (b)\ te^{2t} \quad (c)\ (1-2t)e^{-2t} \quad (d)\ e^t\cos 2t \quad (e)\ (1+t)e^{2t}$$

5. The inverse *Laplace* transform of $\frac{s-2}{s^2+s-6}$ is

$$(a)\ e^{-3t} \quad (b)\ \frac{4}{5}e^{-2t}+\frac{1}{5}e^{3t} \quad (c)\ 2e^{-2t}-e^{3t} \quad (d)\ \frac{3}{7}e^{-t}+\frac{4}{7}e^{6t} \quad (e)\ e^{3t}$$

6. The convolution of e^{-t} with e^{-t} (also denoted by $e^{-t} * e^{-t}$) is given by

$$(a)\ e^{-2t} \quad (b)\ te^{-t} \quad (c)\ -\frac{1}{2}e^{-t} \quad (d)\ \sin t \quad (e)\ \sinh t$$

7. The function $f : \mathbb{R} \to \mathbb{R}$ satisfies $f(x+2) = f(x)$. The period of $f(2x)$ is

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

8. The functions $f(x) = 1 - x^5$ and $g(x) = x^3$ defined on $-1 < x < 1$ 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) at least one is neither even nor odd

9. The function $f(x) = -x$ for $-\pi < x < \pi$ is periodic with period 2π. It has a *Fourier* Series $\sum_{n=1}^{\infty} b_n \sin(nx)$ where b_n is given by

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

10. The coefficient a_0 in the *Fourier* Series for the periodic function $f(x) = |x|$ if $-1 < x < 1$ with period 2 has the value

$$(a)\ -\frac{1}{4} \quad (b)\ 0 \quad (c)\ \frac{1}{4} \quad (d)\ 1 \quad (e)\ 2$$