UNIVERSITY *of* LIMERICK
OLLSCOIL LUIMNIGH

Faculty of Science and Engineering
Department of Mathematics & Statistics

MID TERM ASSESSMENT PAPER

MODULE CODE: MA4003

SEMESTER: Autumn 2013/14

MODULE TITLE: Engineering Mathematics 3

DURATION OF EXAMINATION: 45 minutes

LECTURER: Dr. M. Burke

PERCENTAGE OF TOTAL MARKS: 20 %

Colour: Yellow

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 $R(t-a)$	$\frac{e^{-as}}{s^2}$
$tf(t)$	$-F'(s)$
$\dfrac{f(t)}{t}$	$\displaystyle\int_s^\infty F(\sigma)\, d\sigma$
$(f * g)(t) \equiv \displaystyle\int_0^t f(t-\tau)g(\tau)\, d\tau$	$F(s)G(s)$
$f(t) = f(t+p)$	$\dfrac{1}{1-e^{-sp}} \displaystyle\int_0^p f(t)e^{-st}\, dt$

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

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

$(a)\ \dfrac{s}{(s+1)(s^2+4)}$ $(b)\ \dfrac{s}{s^2+2s+5}$ $(c)\ \dfrac{s+1}{s^2+2s+5}$ $(d)\ \dfrac{s}{s^2-2s+5}$ $(e)\ \dfrac{s-1}{s^2-2s+5}$

2. The *Laplace* Transform of $t\sin t$ is

$(a)\ \dfrac{1}{s(s^2+1)}$ $(b)\ \dfrac{1}{s^2(s^2+1)}$ $(c)\ \dfrac{1}{(s^2+1)^2}$ $(d)\ \dfrac{2s}{(s^2+1)^2}$ (e) non existent

3. The *Laplace* Transform of $(t-1)^3u_1(t)$ is

$(a)\ \dfrac{6}{s^4}e^{-s}$ $(b)\ \dfrac{2}{s-1}e^{-3s}$ $(c)\ \dfrac{1}{s^4}-\dfrac{3}{s^3}+\dfrac{3}{s^2}-\dfrac{1}{s}$ $(d)\ \dfrac{6}{s^4}-\dfrac{6}{s^3}+\dfrac{3}{s^2}-\dfrac{1}{s}$ $(e)\ \dfrac{6}{(s-1)^4}$

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

$(a)\ \sinh 2(t-1)u_1(t)$ $(b)\ \sinh(t-2)u_2(t)$ $(c)\ \sin t\, u_2(t)$ $(d)\ \sinh t\, u_2(t)$ $(e)\ \sinh(t-2)$

5. The inverse *Laplace* transform of $\frac{s+2}{s^2+2s-8}$ is

$(a)\ e^{8t}$ $(b)\ \dfrac{1}{3}e^{-4t}+\dfrac{2}{3}e^{2t}$ $(c)\ e^{4t}$ $(d)\ \dfrac{1}{3}e^{4t}+\dfrac{2}{3}e^{-2t}$ $(e)\ 4^{-4t}$

6. The convolution of e^{-t} with $u_0(t)$ (also denoted by $e^{-t} * u_0(t)$) is given by

$(a)\ e^{-t}$ $(b)\ u_0(t)$ $(c)\ u_1(t)$ $(d)\ e^{-t}u_1(t)$ $(e)\ 1-e^{-t}$

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

$(a)\ 2$ $(b)\ \dfrac{\pi}{2}$ $(c)\ \pi$ $(d)\ 2\pi$ $(e)\ 4\pi$

8. The functions $f(x)=x-x^2/2$ and $g(x)=x$ 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 $f(x)=\begin{cases} 1, & \text{if } -\pi<x<0 \\ 0, & \text{if } 0<x<\pi \end{cases}$ is periodic with period 2π. It has a *Fourier* Series $\frac{1}{2}+\sum_{n=1}^{\infty} b_n\sin(nx)$; b_4 is given by

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

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

$(a)\ 2\sinh 1$ $(b)\ 2\cosh 1$ $(c)\ 0$ $(d)\ \cosh 1$ $(e)\ -2\sinh 1$