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: 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 $e^{2t}\sin t$ is

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

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

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

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

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

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

   (a) $(t-1)^2$ (b) $(t-1)^2u_1(t)$ (c) $t^2u_1(t)$ (d) t^2e^{-t} (e) $t^2u_0(t)$

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

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

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

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

7. The function $f : \mathbb{R} \to \mathbb{R}$ satisfies $f(x+1) = f(x)$. The period of $f(x/2)$ is

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

8. The functions $f(x) = x^2$ and $g(x) = x\sin x$ 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 $f(x) = |x|$ for $-\pi < x < \pi$ is periodic with period 2π. It has a *Fourier* Series $a_0/2 + \sum_{n=1}^{\infty} a_n \cos(nx)$. a_2 is given by

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

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

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