UNIVERSITY *of* LIMERICK
OLLSCOIL LUIMNIGH

Faculty of Science and Engineering
Department of Mathematics & Statistics

MID TERM ASSESSMENT PAPER

MODULE CODE: MA4003 SEMESTER: Autumn 2012/13

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

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

1. The *Laplace* Transform of $\cosh 3t + \sinh 3t$ is

   $(a)\ \frac{s+3}{s^2+9}$ $(b)\ \frac{1}{s-3}$ $(c)\ \frac{s}{s^2-3^2}$ $(d)\ \frac{1}{s+3}$ $(e)\ \frac{s+3}{(s^2+9)^2}$

2. The *Laplace* Transform of $e^{2t}(3t+1)$ is

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

3. The *Laplace* Transform of $f(t) = \cos(2t-4)u_2(t)$ is

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

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

   $(a)\ e^{-4t}u_1(t)$ $(b)\ e^{-t}\sin 2t$ $(c)\ \sin t\, u_2(t)$ $(d)\ \sin 2(t-1)\, u_1(t)$ $(e)\ e^{-2(t-1)}u_1(t)$

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

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

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

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

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

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

8. The functions $f(x) = 1 - x^2/2$ 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 $\sum_{n=1}^{\infty} b_n \sin(nx)$. b_2 is given by

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

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

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