



UNIVERSITY of LIMERICK  
OLLSCOIL LUIMNIGH

College of Informatics and Electronics

**MID TERM ASSESSMENT PAPER**

MODULE CODE: MA4003

SEMESTER: Autumn 2007

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 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  $e^{2t-2}$  is

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

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

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

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

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

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

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

5. The inverse Laplace transform of  $\frac{s+1}{s^2+4s+3}$  is

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

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

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

7. The period of  $\sin\left(\frac{4x}{3}\right)$  is

(a)  $\frac{2}{3}$  (b)  $3$  (c)  $\frac{3}{2}\pi$  (d)  $2\pi$  (e)  $3\pi$

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) neither is even nor odd

9. The function  $f(x) = x^3$  for  $-2\pi < x < 2\pi$  is periodic with period  $4\pi$ . It has a Fourier Series  $\sum_{n=1}^{\infty} b_n \sin(**)$  where  $**$  is given by

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

10. The coefficient  $a_0$  in the Fourier Series for the periodic function  $f(x) = x^4$  if  $-1 < x < 1$  with period 2 is

(a)  $0$  (b)  $\frac{1}{5}$  (c)  $\frac{1}{4}$  (d)  $\frac{1}{3}$  (e)  $\frac{2}{5}$