



UNIVERSITY *of* LIMERICK  
OLLSCOIL LUIMNIGH

Faculty of Science and Engineering

**MID-SEMESTER ASSESSMENT PAPER**

MODULE CODE: MA4002

SEMESTER: Spring 2009

MODULE TITLE: Engineering Mathematics 2

DURATION OF EXAMINATION: 45 minutes

LECTURER: Dr. N. Kopteva

PERCENTAGE OF TOTAL MARKS: 30%

**INSTRUCTIONS TO CANDIDATES:**

Write all your answers and rough work on the examination paper.

Do not write on anything else.

Under no circumstances should you use your own tables or be in possession of any writing material other than this exam paper.

**Calculators are not permitted.**

Answer **all questions**.

To obtain maximum marks you must show all your work **clearly and in detail**.

The examination rules of the University apply to this midterm. Any breaches of these rules (and in particular any attempt at cheating) will result in disciplinary proceedings. For a first offence this can result in a year's suspension from the University.

**Your Name:** (PLEASE PRINT) \_\_\_\_\_

**Your UL ID:** \_\_\_\_\_

## ROUGH WORK

1 (a) Evaluate the indefinite integral  $\int \frac{3x^{5/4} - 2\sqrt{x}}{x^{3/2}} dx$ . 2%

(b) Calculate the area between  $y = \frac{1}{\cos^2(x/2)}$  and the  $x$ -axis for  $-\frac{\pi}{2} \leq x \leq \frac{\pi}{2}$ . 2%

(c) Express as a definite integral and *evaluate* the limit of the Riemann sum  $\lim_{n \rightarrow \infty} \sum_{i=1}^n (\cos(3x_i) + \sin(x_i^3)) \Delta x$ , where  $P$  is the partition with  $x_i = -1 + \frac{2i}{n}$  for  $i = 0, 1, \dots, n$  and  $\Delta x \equiv x_i - x_{i-1}$ . 3%

(d) Evaluate  $\frac{d}{dx} \int_{2x}^{x^3} \sqrt{\cos(t+1)} dt$ . 2%

(e) Find an upper bound for the error  $E_T$  in the Trapezoidal Rule approximation of the definite integral  $\int_0^2 \cos(3x) dx$ , using  $n$  subintervals.

Choose  $n$  such that  $E_T \leq 10^{-3}$ . Hint: evaluate  $M_2 \equiv \max_{x \in [0, 2]} \left| \frac{d^2}{dx^2} \cos(3x) \right|$ . 2%

2 Evaluate the indefinite integral  $\int \sin^4 x \cos^3 x dx$ . 4%

3 Find the average value of the function  $\ln^2 x$  on the interval  $[1, e]$ .

5%

4 Evaluate the definite integral  $\int_{-2}^2 \frac{x+1}{x^2+6x+9} dx$ .

5%

5 Perform a partial fraction expansion of  $\frac{18x - 12}{(x^2 - 1)(x^2 - 4)}$ .  
(but do not integrate this function.)

5%