UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualifications:-

B.Eng. *M.Eng.*

Mathematics E004: Mathematics For Engineers

COURSE CODE	:	**MATHE004**
UNIT VALUE	:	**0.50**
DATE	:	**13-MAY-04**
TIME	:	**14.30**
TIME ALLOWED	:	**2 Hours**

TURN OVER

All questions may be attempted but only marks obtained on the best **five** *solutions will count.*
The use of an electronic calculator **is** *permitted in this examination.*

1. Simplify the following expressions.

   (a) $\dfrac{(x-y)(x^3-4y)(x+y)(xy-1)}{(x+5y)(x^2-y^2)}$.

   (b) $\left((\sqrt[3]{x})^2\dfrac{y^5}{\sqrt[3]{z}}\right)\dfrac{\sqrt[3]{x}}{(x\,z^{1/3}\,y)^2}$.

   (c) $x(x-y+xy)^2-(x-y)^3-y(y-x)^2$.

2. (a) Find the values of $\sin\theta$ and $\cos\theta$, given $\tan\theta=-3/4$.

   (b By using the formulas for the summation and subtraction of angles, show that

   (i) $2\cos\theta\cos\phi=\cos(\theta+\phi)+\cos(\theta-\phi)$, and verify the identities

   (ii) $\sin 2\theta=2\sin\theta\cos\theta$ and (iii) $1=\sin^2\theta+\cos^2\theta$.

   (c) Find exact values of the following expressions:

   (i) $\cos(11\pi)$; (ii) $\tan(\dfrac{17\pi}{4})$; (iii) $\sin(\dfrac{7\pi}{2})$.

3. Differentiate the following expressions with respect to x.

   (a) $(x^2+1)^{1/2}$.

   (b) $e^x(x^2-2)$.

   (c) $\log(8+x^3)$.

   (d) $\cos(\sin(x^2))$.

4. (a) State the Binomial Theorem and use it to find the coefficient of x^4 in $(1+x)^{16}$.

(b) Write down Maclaurin's formula for expanding a function $f(x)$ as a power series in x and use it to find the power series for $f(x) = (1+x)^a$, a real, up to the term in x^n.

5. Find the following indefinite integrals :

(i) $\int xe^{3x}dx$

(ii) $\int x^2 sin(x^3)dx$

(iii) $\int \frac{1}{(x^2+x-2)}dx$

6. (a) Find the area enclosed between the x-axis and the part of the curve $y = x^2(1-x^4)$ for which $y \geqslant 0$.

(b) Find the equation of the plane passing through the following three points

$$(1,1,2) \ , \ (1,0,0) \ , \ (2,-1,-3).$$

7. (a) Find the stationary points of the function

$$y = 2x^3 + 3x^2 - 12x + 1.$$

Furthermore, at each stationary point, determine the type (local maximum, local minimum, point of inflexion) and the value of the function y.

(b) Solve the differential equation

$$\frac{dy}{dx} = \frac{2y}{x^2-1}$$

subject to the condition that $y = 2$ when $x = 2$.

Find also the value of y when $x = 5$.