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	:	**12-MAY-03**
TIME	:	**14.30**
TIME ALLOWED	:	**2 Hours**

03-C0938-3-30

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) $(x-y)\,(x^3+y\,x^2+y^2\,x+y^3+x+y)$,

   (b) $\left(\dfrac{x^3\,\sqrt[3]{z}}{y}\right)^2\left(\dfrac{1}{\sqrt{z}}\,y^{10}\right)$,

   (c) $(a+b+c)^2-(a-b+c)^2$.

2. (a) Find the points where the curve $y=x^2-9x+14$ meets the x-axis.

   (b) Find the equation of a straight line through the points $(1,13)$ and $(-1,7)$ and find the shortest distance of this line to the origin.

3. (a) Define the trigonometric functions $\sin\theta$, $\cos\theta$, $\tan\theta$ and $\cot\theta$ for a *general* angle θ. Assuming the formula $\sin(\theta+\phi)=\sin\theta\cos\phi+\cos\theta\sin\phi$ show that $\sin(\theta+\pi/2)=\cos\theta$ and $\cos(\theta+\pi/2)=-\sin\theta$. Deduce the formula for expanding $\cos(\theta+\phi)$ in terms of the functions $\cos\theta$, $\cos\phi$, $\sin\theta$ and $\sin\phi$

   (b) Find exact values for the following:

   (i) $\cos 20\pi$, (ii) $\cos\dfrac{9\pi}{4}$, (iii) $\sin\dfrac{5\pi}{3}$,
   (iv) $\cos\dfrac{7\pi}{6}$.

4. Differentiate the following with respect to x:

   (a) $(x^4+x^2+2x+3)(4x+1)$,

   (b) $\dfrac{x^4+2x+2}{x^2+3x+4}$,

   (c) $\log x^3+\cos x^2$,

   (d) $\cos(x-1/x^2)$.

5. Find the following:

(i) $\int xe^{-2x}\ dx$,

(ii) $\int \cos x / \sin^3 x\ dx$,

(iii) $\int 1/(x^2 - 3x + 2)\ dx$.

6. (a) Find the area enclosed between the positive x-axis and the curve $y = x(1 - x^2)^3$.

(b) Find the equation of the plane passing through the three points (1 2 1), (0 1 -2) and (3 1 -1).

7. (a) Find the stationary points of the function $y = x^5 - x^4$, determining whether each point is a maximum, minimum or neither.

(b) Solve the differential equation

$$\frac{dy}{dx} = \frac{(y^2 + 1)}{xy}$$

given that $y = 1$ when $x = 1$.

MATHE004 END OF PAPER