CORK INSTITUTE OF TECHNOLOGY

INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Autumn Examinations 2007/08

Module Title: Technological Mathematics 1

Module Code: **MATH 6014**

School: School of Engineering:
Building & Civil Engineering
Electrical & Electronic Engineering
Mechanical Engineering
Biomedical Engineering
National Marine College of Ireland

Programme Title:
Bachelor of Engineering in Civil Engineering – Year 1
Bachelor of Engineering in Electronic Automation and Robotics – Year 1
Bachelor of Engineering in Applied Electronics Design – Year 1
Bachelor of Engineering in Communications Systems – Year 1
Bachelor of Engineering in Electrical Engineering – Stage 1
Bachelor of Engineering in Marine & Plant Engineering – Stage 1
Bachelor of Engineering in Mechanical Engineering – Stage 1
Bachelor of Engineering in Biomedical Engineering – Stage 1
Bachelor of Engineering in Building Services Engineering – Stage 1

Programme Code:

CCIVL_7_Y1	EELXE_7_Y1	EELEC_7_Y1	EMARE_7_Y1
EMECH_7_Y1	EBIME_7_Y1	EBSEN_7_Y1	

External Examiner(s): **Dr. P. Robinson**
Internal Examiner(s): **Ms. M. Brennan, Dr. T. Creedon, Dr. D. Cremin, Ms. J. English, Ms. H. Lordan, Dr. P. O'Connor, Mr. D. O'Shea, Dr. S. O'Rourke**

Instructions: **Answer QUESTION 1 (worth 40 points) and TWO other questions (worth 30 points each)**

Duration: 2 HOURS

Sitting: Autumn 2008

Requirements for this examination: Graph paper, Log Tables

Note to Candidates: Please check the Programme Title and the Module Title to ensure that you have received the correct examination paper.
If in doubt please contact an Invigilator.

1. (i) Given the formula: $x = f\left(t - \frac{\pi h^2}{5}\right)$. Evaluate x when $f = 2.1\times10^{-3}$, $t = 3.2\times10^{6}$ and $h = 6.7\times10^{3}$. (5 marks)

(ii) Solve for x: $5e^{3x} = 90$ (5 marks)

(iii) Express the following as the sum of two partial fractions:

$$\frac{3x+7}{(x-1)(x-2)}$$ (5 marks)

(iv) Show that the following quadratic equation has no real solutions:

$$3x^2 + 4x + 9 = 0$$

(5 marks)

(v) Use the data in the following table to find values for k and n in the relationship $H = \frac{k}{\sqrt{T}} + n$.

T	100	400
H	52	35

(5 marks)

(vi) A line passes through the point $\left(10, -2.4\times10^{-2}\right)$ and has a slope of 0.6. Find the value of x when $y = 84.6\times10^{-2}$. (5 marks)

(vii) Draw a rough sketch of the function $f(x) = 6\sin(4x - 20^{\circ})$, indicating the amplitude, period and the phase time. (5 marks)

(viii) Given the triangle ABC when $A = 40^{\circ}$, $B = 63^{\circ}$ and $a = 15$ cm determine angle C and side c. (5 marks)

2. (a) Using the laws of indices simplify the following, giving your final answers with positive indices.

(i) $\sqrt{\dfrac{4a^4b^7c^{-2}}{25a^6bc^{-8}}}$.

(ii) $\dfrac{7^{3-x}21^{3x+2}}{49^{x-1}27^{x+3}}$.

(10 marks)

(b) Solve for x:

(i) $\log_2(10x-4)-\log_2(x+2)=3$

(ii) $\log_4(2x+3)+\log_4(x-2)=1$

(iii) $2^{2x+1}=3^{5-3x}$.

(15 marks)

(c) Transpose the formula $a=\dfrac{c}{2s}\left(\dfrac{h^2}{d-h}\right)$ to make d the subject.

(5 marks)

3. (a) Solve for x,y,z:

$$\begin{aligned} 2x+3y-\ z &= -5 \\ x-4y+2z &= 21 \\ 5x+2y-3z &= -4 \end{aligned}$$

(10 marks)

(b) The total surface area of a closed cylinder is $135\,cm^2$. Given that the total surface area is $A=2\pi r^2+2\pi rh$ calculate the radius if the height is 7.25cm.

(10 marks)

(c) Show that $x=3$ is the only real root of the cubic equation:

$$3x^3-11x^2+10x-12=0$$ (10 marks)

4. (a) Express each of the following equations in linear form, indicating what you would plot on each axis and how each constant may be evaluated:

(i) $s = ut + \frac{1}{2}at^2$ ….. u and a are constants

(ii) $F = ab^T$ ….. a and b are constants.

(12 marks)

(b) In an experiment carried out two variables x and y were found to have the following values:

x	40	60	90	115	140
y	1.92	4.32	9.72	15.87	23.52

The relationship between x and y is thought to be of the form $y = ax^b$ where a and b are constants.

(i) Write the given relationship in linear form.
(ii) Show by plotting a graph of $\log y$ against $\log x$ that these results do in fact obey the given law.
(iii) Use your graph to calculate the values of the constants a and b and hence state the law.

(18 marks)

5. (a) A triangle ABC has sides $a = 20$ mm, $b = 36$ mm and $c = 42$ mm. Determine its three angles.

(9 marks)

(b) Given the function $y(t) = 150\sin(10\pi t - 1.64)$ where t is measured in seconds, determine the

(i) value of $y(t)$ when $t = 0$
(ii) value of $y(t)$ when $t = 15$ ms
(iii) time when $y(t)$ is first a maximum
(iv) time when $y(t)$ first reaches 120 (14 marks)

(c) Find the values of A in the range $0^o \le A \le 360^o$ which satisfy the equation $-\sin^2 A + 2\cos A + 2 = 0$. (7 marks)