CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Autumn Examinations 2010/11

Module Title: Technological Mathematics 1
Technological Mathematics 1 (C.A.)

Module Code: MATH 6013

School: School of Science; National Maritime College of Ireland

Programme Title:
B.Sc. in Applied Biosciences – Year 1
B.Sc. in Analytical & Pharmaceutical Chemistry – Year1
B.Sc. in Analytical Chemistry & Quality Assurance – Year1
B.Sc. in Nutrition & Health Science – Year 1
B.Sc. in Pharmaceutical Biotechnology – Year 1
B.Sc. in Applied Physics & Instrumentation – Year 1
Bachelor of Engineering in Marine & Plant Engineering – Year 1

Programme Code:
SBIOS_7_Y1**:** SCHEM_7_Y1: SCHQA_8_Y1:
SHNSC_8_Y1: SPHB_8_Y1: SPHYS_7_Y1: EMARE_7_Y1

External Examiner(s): Dr. P. Kirwan
Internal Examiner(s): Dr. T. Creedon**,** Ms. J. English, Ms H. Lordan, Ms. M. Quirke, Ms. F. Wood.

Instructions: **Answer QUESTION 1 (compulsory - 30 marks) and TWO other questions (35 marks each)**

Duration: 2 Hours

Sitting: Autumn 2011

Requirements for this examination: Mathematical 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.

Q.1 Answer **each** of the following:

(a) Given that $\frac{M}{M_0} = 2^{kT}$, calculate a value for M_0 when $M = 1.32\times10^{-5}$, $k = 0.0218$ and $T = 345$.

(5 marks)

(b) Transpose the equation $S = W\left(L^2 + \frac{1}{a^2}\right)$ to make a the subject.

(5 marks)

(c) The temperature $\theta\ ^\circ\text{C}$ of an object at time t s is given by
$\theta = 15 + 85\text{e}^{-0.002t}$.
Determine (i) the temperature $\theta\ ^\circ\text{C}$ when $t = 120$ s

(ii) the time t s when the temperature is 40°C.

(5 marks)

(d) A graph of T^2 versus L produces a straight line which passes through the points (0.9, 3.6) and (1.3, 5.2) .
Obtain an expression for T in terms of L.

(5 marks)

(e) The sag l metres in a cable stretched between two supports, a distance x metres apart is given by $l = \frac{12}{x} + x$. Determine the distance between the supports when the sag is 20m.

(5 marks)

(f) Express $8\cos t - 6\sin t$ as a single wave function of the form $r\sin(t+\alpha)$.

(5 marks)

Q2. (a) Use the laws of indices to simplify each of the following expressions:

(i) $\dfrac{(2m^2n)^3}{\sqrt[3]{m^6n^{-3}}}\cdot\left(\dfrac{n}{m}\right)^2$

(4 marks)

(ii) $\dfrac{16^n}{2^n.8^{2n}}$

(3 marks)

(b) Solve for t in each of the following equations:

(i) $7^{3t}=18$

(3 marks)

(ii) $3+8\log_2 t=15$

(6 marks)

(iii) $\log_3(5+t)-\log_3(5-t)=2$

(6 marks)

(c) Transpose the equation $H=\dfrac{V(D^2+4L)}{D^2}$ to make D the subject.

(6 marks)

(d) The power P developed in an electrical circuit is given by $P=10I-8I^2$, where I is current in amperes. Determine the current necessary to produce a power of 2.5 watts in the circuit.

(7 marks)

Q3.(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) $\frac{b}{L} = a - M$ …. a and b are constants

(ii) $T = CH^n$ .... n and C are constants.

(10 marks)

(b) The solubility (S) of a substance at varying temperatures t (^{0}C) is shown in the following table:

t (^{0}C)	10	30	40	60	80	100
S	1.9	8.1	12.4	23.4	37.6	55.0

The relationship between S and t is thought to be of the form $S = at + bt^2$ where a and b are constants.

(i) Write the given relationship in linear form.

(4 marks)

(ii) Show by plotting a graph of $\frac{S}{t}$ against t that the data obey the given law.

(9 marks)

(iii) Use your graph to determine the values of the constants a and b and state the linear relationship.

(7 marks)

(iv) Find the value of S when $t = 50\,^0$C

(5 marks)

Q4. (a) A wave function is given by

$$v(t) = 15\sin\left(40\pi t - 0.45\right)$$

where v is measures in volts and t is time in seconds.

State the amplitude, periodic time, frequency and phase shift of the function.

(8 marks)

(b) Find all values of θ in the range $0^0 \le \theta \le 360^0$ for which

$$5\cos(2\theta - 40^0) = 3.5$$

(10 marks)

(c) The value of current i(mA) in a circuit at time t (ms) is given by

$$i(t) = 120\sin(15\pi t + 0.6)$$

Determine

(i) the value of $i(t)$ when $t = 0$

(ii) the value of $i(t)$ when $t = 30$ ms

(iii) the time when $i(t)$ is first a maximum

(iv) the time when $i(t)$ first reaches 85 mA.

(17 marks)