

**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 : MATH 6016

**School(s):** School of Science; National Maritime College of Ireland

**Programme Title(s):**

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 – Year1

**Programme Code(s):**

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) Evaluate  $h$  given that  $h = \frac{0.03Lv^2}{2dg}$   
when  $v = 9.65 \times 10^{-1}$ ,  $L = 1.5 \times 10^2$ ,  $d = 3 \times 10^{-1}$  and  $g = 9.81$ .  
(5 marks)

- (b) Transpose the formula  $\frac{x}{y} = \sqrt{\frac{p+2q}{p-2q}}$  to make  $q$  the subject.  
(5 marks)

- (c) The temperature  $T$   $^{\circ}\text{C}$  of a cooling object varies with time,  $t$  minutes, according to the equation  $T = 120e^{-0.05t}$ . Determine  
(i)  $T$  when  $t = 3$  minutes,  
(ii)  $t$  when the temperature  $T = 80^{\circ}\text{C}$ .  
(5 marks)

- (d) The equation of a line is  $y = mx + c$  where  $m$  is the slope and  $c$  is the  $y$ -axis intercept. If the line passes through  $(1, -3)$  and  $(7, 21)$ , find the slope and the  $y$ -axis intercept.  
(5 marks)

- (e) Find the roots of the equation  $2x^2 + 5x = 4$ . Give your answers correct to two decimal places.  
(5 marks)

- (f) Sketch  $y = 3\sin 2A$  from  $A = 0^{\circ}$  to  $A = 360^{\circ}$ . From your sketch read  
(i) the values of  $A$  for which  $y = 3$   
(ii) the value of  $y$  where  $A = 360^{\circ}$ .  
(5 marks)

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

(i)  $\sqrt{\frac{9a^4b^8}{a^7b^3}} \cdot \left(\frac{a}{3b}\right)^2$  (4 marks)

(ii)  $\frac{8^n \cdot 4^{2n}}{2^n}$  (3 marks)

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

(i)  $5^{3t} = 12$  (3 marks)

(ii)  $3^t \cdot 4^{2t} = 5^{t-1}$  (6 marks)

(iii)  $\log_2(4+t) + \log_2(4-t) = 3$  (6 marks)

(c) Transpose the equation  $C = k\sqrt{\frac{F-A}{A}}$  to make  $A$  the subject. (6 marks)

(d) The bending moment  $M$  at a point in a beam is given by

$$M = \frac{3x(20-x)}{2}$$

where  $x$  metres is the distance from the point of support. Determine the value of  $x$  when the bending moment is 50 Nm.

(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)  $R = \frac{a}{d} + \frac{b}{d^2}$  where  $a$  and  $b$  are constants

(ii)  $PV^n = C$  where  $n$  and  $C$  are constants

(10 marks)

(b) The voltage  $v$  across an inductor is believed to be related to time  $t$  by the law

$$v = Ve^{t/T}$$

where  $V$  and  $T$  are constants. The following experimental results were obtained:

$v$ (volts)	883	347	90	55.5	18.6	5.2
$t$ (ms)	10.4	21.6	37.8	43.6	56.7	72.0

(i) Write the given relationship in linear form.

(4 marks)

(ii) Show by plotting a graph of  $\ln v$  against  $t$  that the data satisfy the given law.

(9 marks)

(iii) Use your graph to find the values of the constants  $V$  and  $T$  and state the linear relationship.

(7 marks)

(iv) Determine the value of the voltage after 25ms.

(5 marks)

Q4. (a) Determine the amplitude, periodic time, frequency and phase shift of the function

$$y(t) = 8\cos(20\pi t - 0.68)$$

(8 marks)

(b) Find all values of  $x$  in the range  $0 \leq x \leq 360^\circ$  for which

$$4\cos(2x - 20^\circ) = 3.62$$

(10 marks)

(c) The value of voltage in a circuit at any time  $t$  seconds is given by

$$v(t) = 200\sin(20\pi t + 1.24) \text{ volts.}$$

Determine

- (i) the value of  $v(t)$  when  $t = 0$
- (ii) the value of  $v(t)$  when  $t = 10$  ms
- (iii) the time when  $v(t)$  is first a maximum
- (iv) the time when  $v(t)$  first reaches 195 volts.

(17 marks)