



DUBLIN INSTITUTE OF TECHNOLOGY

DT211C BSc. (Honours) Computer Science (Infrastructure)

Year 1

SUMMER EXAMINATIONS 2016-2017

CMPU1018 MATHEMATICS 1

DR. BLATHNAID SHERIDAN
DR. DEIRDRE LILLIS

DATE: MONDAY 22ND MAY 2017

TIME: 09.30AM – 11.30AM

ANSWER **QUESTION 1** AND **TWO** OTHER QUESTIONS.

MATHEMATICAL TABLES AND GRAPH PAPER ARE AVAILABLE.
APPROVED CALCULATORS ALLOWED.

1.

a) Find the HCF (Highest Common Factor) of (2100,4410) by using prime factorisation.
(5 marks)

b) Solve the equation $3^{x+1} = 6561$ using the properties of logarithms.
(5 marks)

c) Let $f: N \rightarrow N$ be given by $f(x) = 8x^2 - 4x$
Let $g: N \rightarrow N$ be given by $g(x) = \sqrt{3x + 4}$
Calculate:

- i. $(f \circ g)(4)$
- ii. $(g \circ f)(y)$
- iii. $(g \circ g)(x)$

(5 marks)

d) Find the sum of the first 15 terms of the geometric progression whose first three terms are: 4, 12 and 36.

(5 marks)

e) Write the truth table of the proposition $(x \vee \bar{y}) \wedge y$.

(5 marks)

f) Let $A = \{a, b, c, d\}$, $B = \{b, c, d\}$ and $C = \{c, d, e, f\}$. Find $A \cap (B \cup C)$.

(5 marks)

g) Let $A = \{1, 3, 6, 7\}$ and $B = \{6, 9, 11, 12, 13\}$. A relation R from A to B is defined as $= \{(a, b): 2a < b\}$. List the elements of R .

(5 marks)

h) Find the inverse of the matrix $A = \begin{pmatrix} 3 & -2 \\ 4 & 4 \end{pmatrix}$.

(5 marks)

[40 marks]

2.

- a) Use Euclid's algorithm to calculate the HCF (Highest Common Factor) of (314, 4248). Also find integers m and n such that

$$314m + 4248n = \text{hcf}(314, 4248).$$

(10 marks)

- b) Use a truth table to verify if the following are equivalent formulae:

i) $a \wedge (b \vee c) \equiv (a \wedge b) \vee c$

ii) $\overline{(a \wedge b)} \equiv \bar{a} \vee \bar{b}$

(10 marks)

- c) A survey of a sample of students in DIT found that 22 walked to college, 19 used a bus, 24 used the Luas, 13 walked and used the Luas, 10 walked and used a bus, 9 used a bus and used a Luas and 6 used all 3 options.

- i) Construct a Venn diagram to illustrate this data.

(6 marks)

- ii) How many students used exactly one of these options?

(4 marks)

[30 marks]

3.

- a) Let $U = \{1, 2, 3, 4, 5, 6, 7, 8\}$, $A = \{2, 4, 6, 8\}$ and $B = \{1, 2, 3, 4, 5, 6\}$. Using **bit string notation** find:

i) \bar{A}

ii) $(A \cup B)$

iii) $(A \cap B)$

(9 marks)

- b) Let $A = \{2, 3, 7, 8\}$ and $B = \{3, 6, 7, 9, 10, 12\}$. Two relations R and S are defined as follows:

$$R = \{(a, b) : 3a < b\}$$

$$S = \{(a, b) : b = a + 4\}$$

List the elements of R , S , $(R \cup S)$ and $(R \cap S)$.

(10 marks)

- c) Let $f: \mathbb{N} \rightarrow \mathbb{N}$ be given by $f(x) = 4x - 2$ and let $g: \mathbb{N} \rightarrow \mathbb{N}$ be given by $g(x) = 3x^2 + 1$. Find:

i) $(f \circ g)(x)$

ii) $(g \circ f)(x)$

iii) $(f \circ g)(2)$

(11 marks)

[30 marks]

4.

- a) Find the inverse of the matrix $\begin{pmatrix} 2 & 3 \\ 4 & -5 \end{pmatrix}$. Hence or otherwise, solve the following system of equations

$$2x + 3y = -8$$

$$4x - 5y = 28$$

(8 marks)

- b) Let $A = \begin{pmatrix} 3 & 5 \\ 2 & -1 \end{pmatrix}$, $B = \begin{pmatrix} -1 & 5 \\ 0 & 6 \end{pmatrix}$, $C = \begin{pmatrix} 2 & 7 & 1 \\ 0 & 6 & -2 \\ 5 & 9 & 11 \end{pmatrix}$ and

$$D = \begin{pmatrix} -3 & 6 & -1 \\ 0 & 4 & 8 \\ 2 & 11 & 4 \end{pmatrix}.$$
 Carry out the following matrix calculations:

i) CD ii) DC

(10 marks)

- c) A rectangle has the following vertices A, B, C and D in homogeneous coordinates

$$A = \begin{pmatrix} 5 \\ -1 \\ 1 \end{pmatrix}, B = \begin{pmatrix} -10 \\ -1 \\ 1 \end{pmatrix}, C = \begin{pmatrix} -10 \\ 10 \\ 1 \end{pmatrix}, D = \begin{pmatrix} 5 \\ 10 \\ 1 \end{pmatrix}$$

Find the image of this rectangle under the rotation of the plane through an angle of $\frac{\pi}{2} \text{ rads} = 90^\circ$ counter-clockwise about the origin, given that the rotation of the plane counter-clockwise about the origin (0,0) through an angle θ radians is given by the matrix

$$R_\theta = \begin{pmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

(12 marks)

[30 marks]