INSTITUTE OF TECHNOLOGY

BLANCHARDSTOWN

Year	Year 2
Semester	Semester 1
Date of Examination	[To be completed by the School Administrator] Tuesday 16th August 2011
Time of Examination	[To 1.00pm – 3.00pm inistrator]

Prog Code	BN002	**Prog Title**	Higher Certificate in Science in Computing in Information Technology	**Module Code**	Comp H2026
Prog Code	BN013	**Prog Title**	Bachelor of Science in Computing in Information Technology	**Module Code**	Comp H2026
Prog Code	BN104	**Prog Title**	Bachelor of Science (Honours) in Computing	**Module Code**	Comp H2026

Module Title	Information Technology Mathematics - REPEAT

Internal Examiner(s): *Dr. Markus Hofmann*
External Examiner(s): *Dr Richard Studdert, Mr John Dunnion*

Instructions to candidates:

1) **To ensure that you take the correct examination, please check that the module and programme which you are following is listed in the tables above.**
2) **Question One Section A is COMPULSORY. Candidates should attempt Question One and ANY other <u>two</u> questions in Section B**
3) **This paper is worth 100 marks. Question One is worth 40 marks and all other questions are worth 30 marks each.**

DO NOT TURN OVER THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A: COMPULSORY QUESTION

Question 1: This question is compulsory **(40 marks)**
Answer **ALL** eight parts.

a) Evaluate $(BB^T) + A$.

$$A = \begin{bmatrix} 1 & 4 & 5 \\ -2 & -1 & 1 \\ -3 & 2 & 3 \\ 5 & 10 & -7 \end{bmatrix} \qquad B = \begin{bmatrix} 10 & 3 & -1 & 1 \\ -2 & -2 & 2 & 0 \\ 2 & 0 & 3 & 6 \\ 4 & -2 & 0 & 1 \end{bmatrix}$$

(5 marks)

b) Using the matrices in part a) answer the following questions:

i) What are the ranks of matrices A, B and B^T?
ii) Write down the elements a_{23} and b_{43}.

(5 marks)

c) Define the terms Graphs and Trees. Using **one** example outline the differences.

(5 marks)

d) Draw a *Complete Graph* with **six** vertices. Further determine the *degree* of each vertex.

(5 marks)

e) Consider the following data: 12, 95, 78, 55, 44, 23, 1, 15, 19, 26
Compute the following (show all your work):
i) Arithmetic mean
ii) Standard Deviation

(5 marks)

f) Evaluate t(2), t(3), t(4) and t(5) for the following recursively defined sequence:

$t(1) = 2$
$t(n) = 4t(n-1)+2t(1)$

(5 marks)

g) Evaluate the following:

i) If a dice is rolled, what is the probability of getting a 6
ii) If two dice are rolled, what is the probability of not getting a pair?
iii) If two dice are rolled, what is the probability that the absolute value of the difference of the numbers is below 3?

(5 marks)

h) Outline the differences between random and stratified sampling

(5 marks)

SECTION B: Answer any TWO questions

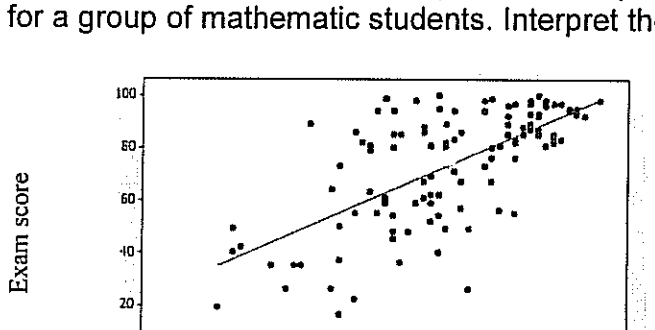
Question 2: Statistics & Probability
(30 marks)

a) Calculate the following:

i. Four people are asked to choose a number between 1 and 50. What is the probability that two or more people pick the same number?

(6 marks)

ii. The following diagram represents a *scatter plot* of exam performance versus attendance for a group of mathematic students. Interpret the results presented in the graph.



(6 marks)

b) Consider the following case: of a survey where employee's salaries were recorded as follows (Show all your work):

Salary (in thousands)	Observations
10-20	60
20-30	22
30-40	33
40-50	12
50-60	6
60-70	5
70-80	3

i) Draw a suitable *Diagram* of the grouped data

(3 marks)

ii) Calculate the *Relative Frequencies* of the above grouped data

(3 marks)

iii) Calculate the *Mean* of the grouped data

(3 marks)

iv) Calculate the *Standard Deviation* of the grouped data

(6 marks)

v) Comment on the *two statistical measures* that were calculated in iii) and iv)

(3 marks)

Question 3: Matrices **(30 marks)**

Use the following matrices:

$$A=\begin{pmatrix}5 & 7 & -1\\ 1 & -2 & -2\\ 6 & -4 & 0\end{pmatrix} \quad B=\begin{pmatrix}-3 & 6 & 0\\ -3 & -2 & -1\\ -2 & 1 & 0\end{pmatrix} \quad \textit{and} \quad C=\begin{pmatrix}5 & 6 & 0\end{pmatrix}$$

a) Calculate the following:

i. Evaluate $B + A$ *(2 marks)*

ii. Write down the *Identity* Matrix of A *(2 marks)*

iii. Can BC *and* CB be computed? Give reason(s) for your answer. *(2 marks)*

iv. Evaluate $(-2B^T + AB)$ *(6 marks)*

b) Calculate the *determinant* of matrix B.

(10 marks)

c) Perform the following transformation:

i. *Translate* the *x*-coordinate of the 2D point (1, 14) by a factor of 5.

(4 marks)

ii. *Scale* the *x*-coordinate of the 2D point (4, 76) by a factor or 2.

(4 marks)

Question 4: Graphs, Trees & Recursion **(30 marks)**

a) Give a definition of recursion and explain why it is an important concept in computer science?

(4 marks)

b) Evaluate t(3), t(4), and t(5) for the following recursively defined sequences:

(i) $t(1) = 3$
$t(n) = 4t(n-1) + 2 \quad (n>1)$

(5 marks)

(ii) $t(1) = 0$
$t(n) = 15t(n-1) - 5 \quad (n>1)$

(5 marks)

c) Draw a directed graph with 4 vertices a, b, c, d and edges connecting a to a, a to b, b to c, and a to d

(3 marks)

d) Draw the graphs with the following adjacency matrices:

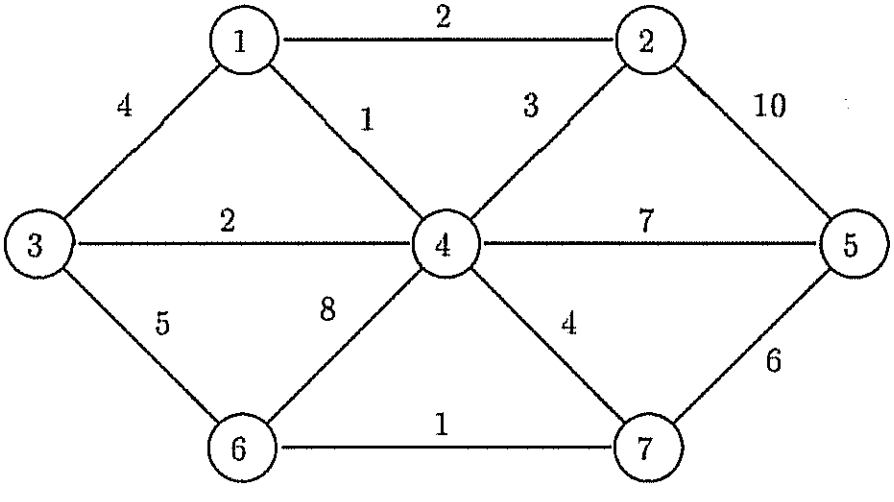
(i)
$$\begin{matrix} 1 & 3 & 1 & 0 \\ 3 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 2 \end{matrix}$$

(ii)
$$\begin{matrix} 1 & 0 & 1 & 2 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 3 & 1 \\ 2 & 1 & 3 & 0 & 1 \\ 1 & 0 & 1 & 1 & 2 \end{matrix}$$

(6 marks)

e) Design a minimum spanning tree to cost communications network connecting all the computer buildings represented by the graph below. Show all your work.

(7 marks)



Formula Sheet

Matrices:

$$\det A = ad - bc\ , \quad A^{-1} = \frac{1}{\det A}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$

Det A = $a_{11}c_{11} + a_{12}c_{12} + a_{13}c_{13} + \ldots$(using row 1)

Statistics:

Mean:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}, \quad \textbf{Frequency Mean: } \bar{x} = \frac{\sum_i f_i m_i}{\sum_i f_i}$$

Variance:

$$s^2 = \frac{\sum_{i=1}^{n} x_i^{\,2} - n(\bar{x})^2}{n-1}, \qquad \textbf{Frequency Variance: } s^2 = \frac{\sum_{i=1}^{M} f_i m_i^{\,2} - n(\bar{x})^2}{n-1}$$