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**Technological University of the Shannon:
Midlands Midwest**

Ollscoil Teicneolaíochta na Sionainne:
Lár Tíre Iarthar Láir

TECHNOLOGICAL UNIVERSITY OF THE SHANNON: MIDLANDS MIDWEST

SUMMER EXAMINATIONS 2022/2023

MODULE: MATH06095 - Mathematical Methods

PROGRAMME(S):

LC_KSOFM_KMY	Bachelor of Science (Honours) Software Development
LC_KMWCM_KMY	Bachelor of Science (Honours) Mobile and Web Computing
LC_KMWCM_JMY	Bachelor of Science Mobile and Web Computing
LC_KISYM_KMY	Bachelor of Science (Honours) Internet Systems Development
LC_KISYM_JMY	Bachelor of Science Internet Systems Development
LC_KGDSM_KTH	Bachelor of Science (Honours) Games Design and Development
LC_KCSYM_KMY	Bachelor of Science (Honours) Computer Networks and Systems Management
LC_KCSYM_IMY	Higher Certificate in Science Computer Networks and Systems Management
LC_KCPTM_JMY	Bachelor of Science Computing

YEAR OF STUDY: 1

EXAMINER(S):

Mike O Connell	(Internal)
Pamela O Brien	(Internal)
Dr. Fernando Perez-Tellez	(External)

TIME ALLOWED: TWO (2) HOURS

INSTRUCTIONS: You must answer Question One and any two other questions.

PLEASE DO NOT TURN OVER THIS PAGE UNTIL YOU ARE INSTRUCTED TO DO SO.

The use of programmable or text storing calculators is expressly forbidden.

Please note that where a candidate answers more than the required number of questions, the examiner will mark all questions attempted and then select the highest scoring ones.

Requirements for this paper:

1. Non-programmable Calculator

You must answer Question One

Q1. (a) Given $f(x) = 4e^{0.25x}$ and $g(x) = 12 - 3x$ evaluate

(i) $f(-2)$ (3 marks)

(ii) $g(6)$ (2 marks)

(iii) $f(g(2))$ (4 marks)

(iv) $g^{-1}(3)$ (3 marks)

(b) By determining the period and the amplitude, **sketch** the graph of $y=3\cos 2x$ for $0 \leq x \leq 360^\circ$ clearly labelling your axes.

(10 marks)

(c) (i) **Plot** a graph of $y = 4\sin 3x$ for $0 \leq x \leq 150^\circ$ using intervals of 10 (10 marks)

(ii) Use your graph to solve $4\sin 3x = -2$ for $0 \leq x \leq 150^\circ$. (4 marks)

(iii) Use your graph to find y when $x = 255^\circ$. (4 marks)

(Total 40 Marks)

Q2. (a) Given:

$$A = \begin{bmatrix} 4 & 2 \\ -1 & 5 \\ 6 & 7 \end{bmatrix} \quad B = \begin{bmatrix} 5 & 9 & 4 \\ 2 & 6 & -7 \end{bmatrix} \quad C = \begin{bmatrix} 7 & 3 \\ 1 & 4 \\ -4 & 5 \end{bmatrix}$$

Find **(i)** $3A - C$ **(4 marks)**

(ii) BC **(6 marks)**

(b) Given matrix $X = \begin{bmatrix} 4 & -5 \\ 1 & 2 \end{bmatrix}$

Find **(i)** X^{-1} , the inverse of X **(5 marks)**

(ii) show that $X.X^{-1} = I$, the identity matrix **(5 marks)**

(c) Find the determinant of the following matrix M :

$$M = \begin{bmatrix} 2 & 1 & -2 \\ 3 & -4 & 5 \\ 4 & -2 & 7 \end{bmatrix}$$

(10 marks)

(Total 30 Marks)

Q3. (a) Given $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16\}$

$$A = \{1, 2, 3, 6, 8, 10, 12\}$$

$$B = \{3, 6, 9, 12, 15\}$$

$$C = \{10, 11, 12, 13, 14, 15, 16\}$$

Evaluate (i) $A \cup B$ (3 marks)

(ii) $|B - C|$ (3 marks)

(iii) C' (3 marks)

(iv) $U - (A \cap C)$ (4 marks)

(b) From a group of 80 computer science students

42 studied networking

38 studied programming

41 studied design

25 studied networking and programming

20 studied programming and design

20 studied networking and design

9 studied none of the three modules

Draw a Venn diagram (8 marks)

and use the Venn diagram to answer the following

(i) how many studied all three (3 marks)

(ii) how many studied programming but not design (3 marks)

(iii) how many studied exactly one of the modules (3 marks)

(Total 30 Marks)

- Q4. (a)** Given $p(2,3)$ and $q(-7, 9)$ find
- (i)** the distance between p and q **(3 marks)**
 - (ii)** the equation of the line perpendicular to line pq containing $c(2,5)$ **(6 marks)**
- (b)** Given two lines $L: 2x + 3y = 10$ and $M: 5x - 2y = 6$
- (i)** What is the slope of line L ? **(3 marks)**
 - (ii)** Write an equation for any line perpendicular to M **(4 marks)**
 - (iii)** Find the coordinates of the point of intersection of L and M . **(6 marks)**
- (c)** Given the coordinates $a(0, 6)$, $b(-6, 2)$ and $c(2, -10)$ verify that the triangle **abc** is right-angled. **(8 marks)**

(Total 30 Marks)

Formula Sheet

Set Theory

$$|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |A \cap C| - |B \cap C| + |A \cap B \cap C|$$

Coordinate Geometry

Distance between two points (x_1, y_1) and (x_2, y_2)

$$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

Equation of a line containing one point (x_1, y_1) and slope m

$$y - y_1 = m(x - x_1)$$

Slope of a line containing two points (x_1, y_1) and (x_2, y_2)

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Midpoint of line containing two points (x_1, y_1) and (x_2, y_2)

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$