PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

SECOND SEMESTER EXAMINATIONS – 2023

SECOND YEAR BACHELOR OF GEOGRAPHIC INFORMATION SCIENCE (BGIS/2)
SECOND YEAR BACHELOR OF SURVEYING (BSVY/2)

MA 225 – MATHEMATICS 3 SV

TIME ALLOWED: 3 HOURS

INFORMATION FOR CANDIDATES

1 You have 10 minutes to read this paper. You must not begin writing during this time.

2 Write your name and student number clearly on the front of the examination answer booklet.

3 There are 6 questions. You should attempt **ALL questions**.

4 All answers must be written in the examination answer booklet(s) provided. No other written material will be accepted.

5 Start the answer for each question on a **new** page. Do **not** use red ink or pencil.

6 Notes and textbooks are not allowed in the examination room.

7 Mobile phones and other recording devices are not allowed in the examination room.

8 The last page is a formula sheet to assist you in this examination.

MARKING SCHEME
Marks are as indicated at the beginning of each question. Total mark is **100**.

QUESTION 1 [5 + (5 + 2) + 8 + 5 = 25 Marks]

a) If the vector $p = \langle 2,2,3 \rangle$ and the vector $q = \langle 2,4,k \rangle$. Find k such that p and q are orthogonal, that is $p \cdot q = 0$.

b) Consider the vectors $u = \langle 2,-1,1 \rangle$ and $a = \langle 1,1,2 \rangle$.
    i.   Find the orthogonal projection of u on a.
    ii.   Find the vector component of u orthogonal to a.

c) Find an equation for the plane passing through the points $P(5,4,3)$, $Q(4,3,1)$ and $R(1,5,4)$.

d) Find the distance between the point $(3,1,-2)$ and the plane $x + 2y - 2z = 4$

QUESTION 2 [8 + (6 + 6) = 20 Marks]

a) Let $A = \begin{bmatrix} 2 & 3 \\ -1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 9 \\ -3 & k \end{bmatrix}$. What value(s) of k, will make $AB = BA$.

b) Given the following matrices

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

Compute the following (where possible):
    i. AB
    ii. AC^T

QUESTION 3 [15 Marks]

Solve the following system of linear equations by Gaussian - Jordan Elimination
$$x + y + 2z = 8$$
$$-x - 2y + 3z = 1$$
$$3x - 7y + 4z = 10$$

QUESTION 4 [10 Marks]

The following values represent the number of days (in a year) several employees of Papindo missed work due to illness.

$$14, 10, 7, 10, 11, 8, 15, 6, 8, 9, 12, 1, 9, 19, 13, 12$$

Calculate the 10% trimmed mean of number of days that the employees missed work due to illness as presented above.

QUESTION 5 [3 + 6 + 6 = 15 Marks]

The following table summarizes the number of road accidents in Port Moresby caused by drunk drivers and the number of alcohol beverages consumed leading up to these accidents.

No. of alcohol beverages consumed	No. of road accidents
6 - 8	6
9 - 11	4
12 - 14	14
15 - 17	16
18 - 20	8
21 - 23	2

From the information presented above, calculate the **mean**, **mode** and **median** of the frequency distribution.

QUESTION 6 [10 + (4 + 1) = 15 Marks]

The following table summarizes the number of times a group of students were absent from a class and the marks that each student scored (out of 100) in the subsequent exam that followed.

No. of times absent (x)	7	11	9	13	15	17
Marks scored (y)	86	80	83	77	74	71

From the information presented above,
  a) Analyze the results in a table and calculate the **Pearson product moment correlation coefficient r.**

  b) Calculate the regression coefficient (b) and the y-intercept (a) of the regression line.

END OF EXAMINATION

$$D = \frac{|ax + by + cz + d|}{\sqrt{a^2 + b^2 + c^2}}$$

$$Mean = \frac{\sum fx}{n}$$

$$Mode = L + c\left[\frac{f_m - f_{-1}}{2f_m - f_{-1} - f_{+1}}\right]$$

$$Median = L + c\left[\frac{\frac{n}{2} - F_{-m}}{f_m}\right]$$

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

$$b = \frac{n\sum xy - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2}$$

$$a = \bar{y} - b\bar{x}$$