GWANDA STATE UNIVERSITY

FACULTY OF ENGINEERING AND THE ENVIRONMENT

DEPARTMENT OF GEOMATICS AND SURVEYING

ADJUSTMENT COMPUTATIONS I

EGS2209

Examination Paper

Semester II 2023

This examination paper consists of 5 pages

Time Allowed: **3 hours**

Total Marks: **100**

Examiner: **Mr. V. Mlilo**

INSTRUCTIONS

1. *Answer **ALL** Questions in chronological order.*
2. *Scientific Calculators may be used.*
3. *Programmable calculators are **not** allowed*

1. a) Give a concise explanation of why measurements are classified as random variables? *[5]*

b) Explain these terms as used in surveying measurements: *[10]*

i. Variance,

ii. Redundancy,

iii. Residual,

iv. True Value,

v. Misclosure.

c) In your own words and using illustrations define and clearly show the difference between precision and accuracy *[10]*

2 a i Given the matrix below *[5]*

$$\mathbf{B}\begin{bmatrix} 3 & -1 & 0 \\ -1 & 3 & -1 \\ 0 & -1 & 3 \end{bmatrix}$$

Find its inverse ($\mathbf{B^{-1}}$) using the adjoint method.

ii Formulate a Jacobian matrix from the functions given below *[5]*

$y_1 = 2x_1 + x_2^2 + 4x_3^2$

$y_2 = 6 + x_1 + 3x_2^2$

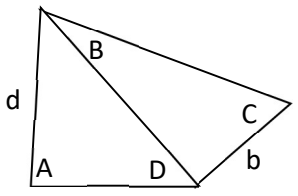
$y_3 = 6x_2^2 + 10$

$y_4 = 3x_1^2 + x_3^2$

$y_5 = 2x_1^3 + x_2 + 3x_3^4$

b) Measurements of a triangulation scheme are as follows

	Distance	Standard Deviations
d	2140.70m	0.018m
A	52^0 12' 40"	2"
B	51^0 37' 15"	2"
C	73^0 55' 11"	3"
D	79^0 04' 22"	3"



Where '**b**' can be calculated as $b = d\ \frac{SinA\ SinB}{SinD\ Sin\ C}$

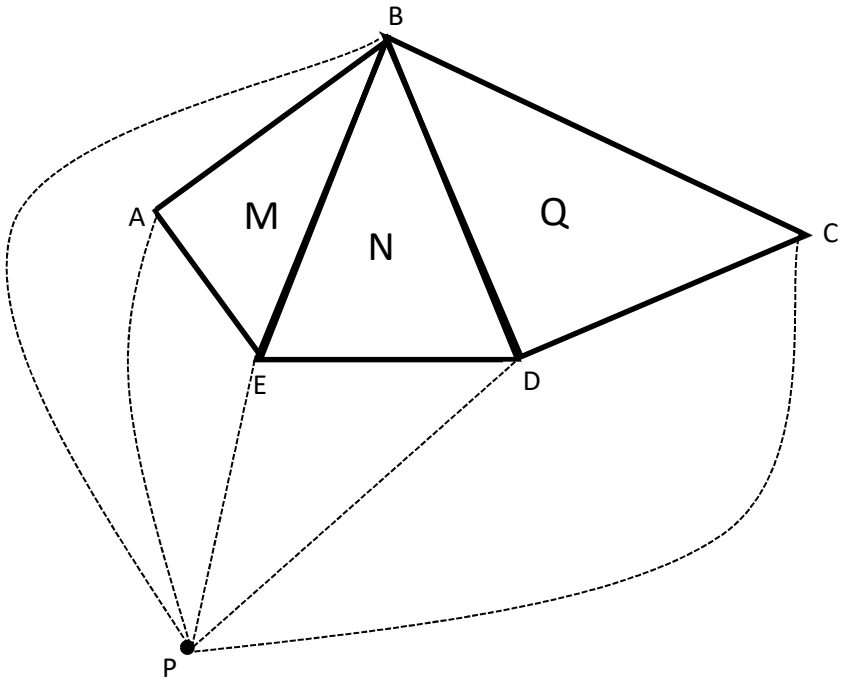
i Compute b and its standard deviation. *[9]*

c) A distance is measured using three different methods. The observed values and there standard deviations are shown below.

	Distance		Standard Deviations
A	352.095		0.020
B	352.147		0.030
C	352.062		0.060

i Calculate the weighted mean of the observed distances and the standard deviation of the weight mean distance. *[6]*

3 a



A paddock ABCDEA at Gwanda State University is to be subdivided into 3 paddocks M, N and Q. Measurements to A, B, C, D and E are made from a remote station P

From P	Observation	Standard. Dev.
A	127.96m	±2.0cm
B	287.69m	±2.5cm
C	131.10m	±1.3cm
D	323.02m	±5.2cm
E	233.77m	±3.1cm

Angles	Observation	Standard. Dev.
A**P**B	26^0 33' 43"	±2.1"
A**P**E	44^0 58' 49"	±2.5"
A**P**C	56^0 40' 32"	±2.3"
A**P**D	64^0 18' 29"	±1.3"

i) Calculate the length of fence needed to fence off the three paddocks and its standard deviation

[10]

ii) Calculate the area of each paddock M, N, Q and the standard deviations

[15]

4 a i Using the parametric least squares procedure show that you can get a unique solution in the form $\Delta = \mathbf{N^{-1}t}$

Where $\mathbf{N = B^TWB}$, $\mathbf{t = B^TWf}$ & Δ is the matrix of parameters

[7]

ii Explain these terms as used in least squares adjustment;
stochastic model,
condition equation,
normal equation,
mathematical model. *[6]*

iii Define the following terms
random error theory,
confidence intervals,
statistical testing. *[3]*

iv As a student of survey, outline the importance of error analysis, least squares adjustment and statistics in the profession of a geomaticians. *[7]*

v Why do we assign weights to measurements? *[2]*