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's Name: **Mr. V Mlilo**

INSTRUCTIONS

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

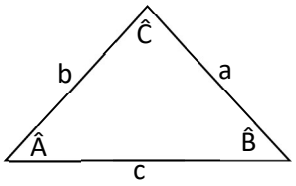
1 i) What is a measurement? *[2]*

ii) Explain the terms; best value, redundancy, residual, true value and misclosure *[5]*

iii) Give the three types of errors in measurements and examples of ways you can eliminate or minimize the error effects *[12]*

iv) What is a stochastic variable *[1]*

v) In the triangle shown below, the measurements and their errors are as follows: *[5]*



Â	45^0 00' 00"	δA	15"
B̂	32^0 00' 00"	δB	14"
b	120.000 m	δb	0.010m

Calculate the distance of '**a**' hence the error in that distance

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

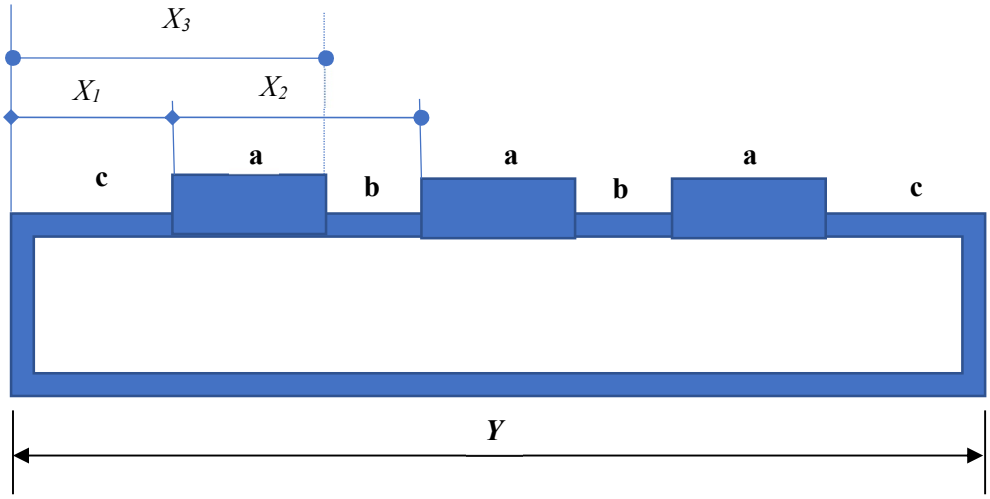
$$\mathbf{A}\begin{pmatrix} 4 & 3 & 2 \\ 3 & 4 & 1 \\ 2 & 3 & 4 \end{pmatrix}$$

Find its inverse ($\mathbf{A^{-1}}$) using the elementary row transformation method or the adjoint method.

ii State any 3 properties of the covariance matrix. *[3]*

iii State the law of propagation of error. *[2]*

b) i A building wall shown in plan view below has 3 windows with width ***a,*** spacing between windows ***b,*** and the distance from each building corner to the nearest window ***c.*** A surveyor made three measurements x_1, x_2 and x_3 to determine the length of the wall



	Observation	Errors
X_1	3.25m	5mm
X_2	4.76m	8mm
X_3	5.60m	9mm

b) i Calculate the distances of a, b and c and their errors respectively *[9]*

ii Determine the error in the length of the wall ***Y*** *[6]*

3. a) Using the laws of Expectations, prove that the *general law of propagation of variances* (GLOPOV), *[5]*

$$\sum_{yy} = A \sum_{xx} A^T$$

is found from the straight line equation $\boldsymbol{y = ax + b}$. where $\boldsymbol{y}$ is the derived quantity and $\boldsymbol{x}$ is the measured quantity, $\boldsymbol{a}$ & $\boldsymbol{b}$ are constants.

b) The volume of a cone is given by $V = \frac{1}{3}\pi r^2 h$. A storage basin at a farm in Mazowe has a shape of a cone, as a surveyor you are tasked to determine the volume of that storage basin as the new owners do not know its capacity. The height of the cone is measured to give 16.504m with an error of 0.03m and a radius of 25.652m with an error of 0.02m. Compute the basin's volume and its estimated error? *[7]*

c) The rectangular dimensions of a large building 1435.67 ± 0.025 m by 453.67 ± 0.010 m are laid out using an Electronic Distance Measurement instrument. Assuming only errors in distance observations, what are: *[6]*

(a) the area enclosed by the building and its standard deviation?

(b) the perimeter of the building and its standard deviation?

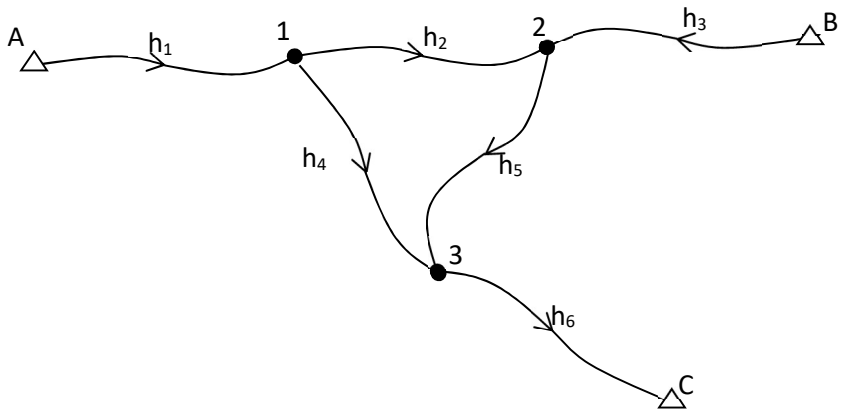
ii A distance is measured using three different methods. The observed values and their standard deviations are shown below *[7]*

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

Determine the weighted mean of the observed distances.

The variance of the weighted mean distance.

4 The diagram below shows a level network



	Height Difference		Standard Deviations
h_1	15.50m		0.02m
h_2	21.23m		0.02m
h_3	8.32m		0.03m
h_4	16.40m		0.02m
h_5	20.85m		0.01m
h_6	4.41m		0.01m

a)	i	From the parametric least squares procedure how many condition equations should be written?	*[2]*
	ii	Write all the condition equations for the level network above.	*[4]*
	iii	Formulate all the matrices for the level network, for use in adjusting the observations.	*[6]*
	iv	What is the difference between the arithmetic mean and the weighted mean.	*[2]*
	v	Briefly discuss what is meant by stochastic model and the functional model in adjustment computations.	*[5]*
	vii	What are the advantages of using the least squares method over all the other arbitrary rule-of-thumb procedures in geospatial and survey related applications.	*[6]*

THE END