GWANDA STATE UNIVERSITY

FACULTY OF ENGINEERING AND ENVIRONMENT

DEPARTMENT OF GEOMATICS AND SURVEYING

ADJUSTMENT COMPUTATIONS II

EGS 3209

Examination Paper

May 2023

This examination paper consists of 4 pages

Time Allowed: **3 hours**

Total Marks: **100**

Examiner's Name: **Mr A Sibanda**

INSTRUCTIONS

1. Answer ALL 4 questions
2. Each question carries 25 marks
3. Use of calculators is permissible, but programmable calculators are not allowed in the exam
4. Statistical tables

QUESTION 1

In your own words, discuss when it is appropriate to use:
(a) a t test. [3]
(b) a $\chi 2$ test. [3]
(c) an F test [3]

Explain the difference of mathematical, Functional and stochastic model [6]
Solve the following nonlinear equations using the least squares method. [6]
Use initial approximations of $x_0 = 9$ and $y_0 = 4$.

$$x^2 + 3y = 115$$
$$5x + y^2 = 75$$

What is a posteriori statistical analysis? [4]

QUESTION 2

Consider a scenario where a control point C (x, y, z) is to be established from two fixed points A and B (referring to Figure 3.0) using GPS survey. The coordinates of the fixed points are given in three-dimensional GNSS system as

A(x=402 351m, y= -4 652 995 301m, z= 4 349 760 778m)

B(x=8086 032m, y= -4 642 712 847m, z= 4 360 439 083m)

The measured GPS baseline vector as shown in Table 3.0 assuming the standard deviation of each observation is 0.010m

Table 3

From	**To**	**dx(m)**	**dy(m)**	**dz(m)**
C	A	-1116.452	-4569.161	-4355.906
C	B	6567.231	5686.293	6322.392
B	C	-6567.231	-5686.303	-6322.381

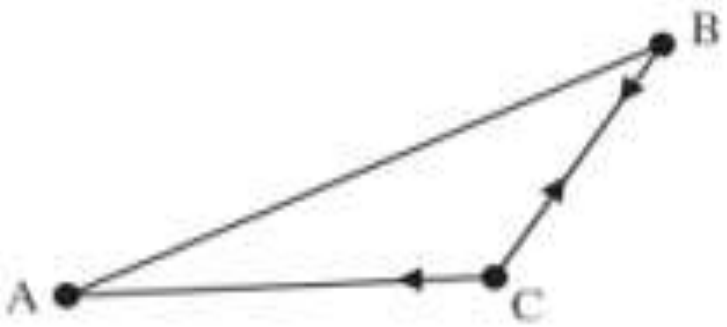

Figure 3.0 GNSS Baselines

a) Compute the least squares adjusted coordinates of point c using the condition equation method [13]
b) Compute the standard deviation of the vector of the adjusted observations [12]

QUESTION 3

a) Describe the five elements of a hypothesis test. [5]
b) An angle is measured 10 times. Each measurement is independent and made with the same precision. The sample standard deviation is s= 7.3". Test at a significance level of 5% the hypothesis that the population standard deviation δ of the measurement is 2.0 against the alternative that δ is not 20". [5]
c) The sample mean of the 20 independent measurements of a distance was found to be 537.615m

i. If the standard deviation of each measurement is known to be 0.033m, construct a 95% confidence interval for the population mean μ. [5]
ii. If the sample standard deviation is calculated to be 0.035m, construct a 95% confidence interval for the population mean. [5]
iii. Construct a 95% confidence interval of $\boldsymbol{\delta^2}$ and the corresponding confidence interval for $\boldsymbol{\delta}$ if the sample standard deviation is calculated to be 0.035m. [5]

QUESTION 4

a) Define the three terms Scaling, Rotation and Translations in terms of two-dimensional conformal coordinate transformation. [5]

b) Show the development of the transformation equation shown below; [5]

$$X = (S\ cos\ \theta)x - (S\ sin\ \theta)y + T_X$$
$$Y = (S\ sin\ \theta)x + (S\ cos\theta)y + T_Y$$

c) Points A, B, C, D, and E have their coordinates known in both an XY system and a XY system. Points F and G have their coordinates known only in the XY system. These coordinates are shown in the table below. Using a two-dimensional conformal coordinate transformation Determine:

Point	*X*	*Y*	*x*	*y*
A	535,802.071	245,462.419	1221.35	1031.87
B	544,118.703	252,826.247	4607.03	1046.02
C	539,001.505	256,629.861	4200.13	2946.31
D	541,979.517	252,118.983	3974.84	1314.28
E	539,287.964	253,248.381	3585.50	2114.28
F			2767.73	1621.58
G			2596.55	2693.00

i. The transformation parameters [5]

ii. The most probable coordinates in the XY coordinate system. [5]

iii. The rotation angle and scale factor. [5]