GWANDA STATE UNIVERSITY

FACULTY OF ENGINEERING AND ENVIRONMENT

DEPARTMENT OF GEOMATICS AND SURVEYING

ADJUSTMENT COMPUTATIONS 1

ESG 2213

Examination Paper

April 2024

This examination paper consists of 4 pages

Time Allowed: **3 hours**

Total Marks: 100

Examiner: F. Shumba

INSTRUCTIONS

Calculator is required

Density of Coal is 0.85 ton/m^3

Answer all questions

QUESTION 1

a. An EDM instrument and reflector are set at the ends of a baseline that is 400.781 m long. Its length is measured 24 times, with the following results:
400.787 400.796 400.792 400.787 400.787 400.786 400.792 400.794 400.790 400.788
400.797 400.794 400.789 400.785 400.791 400.791 400.793 400.791 400.792 400.787
400.788 400.790 400.798 400.789.

i. What are the mean, median, and standard deviation of the data? (6)

ii. Construct a histogram of the data with five intervals and describe its properties.(3)

iii. On the histogram, lay off the sample standard deviation from both sides of the mean. How many observations are between $(y \pm S)$, and what percentage of observations does this represent? (5)

b. The calibrated length of a baseline is 402.167 m. An average distance of 402.151 m with a standard deviation of $\pm 0.0055\ m$ is computed after the line is observed five times with an EDM.

i. What is the 95% confidence interval for the measurement? (3)

ii. At a 95% level of confidence, can you state that the EDM is working properly? Justify your response statistically. (4)

iii. At a 90% level of confidence can you state that the EDM is working properly? Justify your response statistically. (4)

QUESTION 2

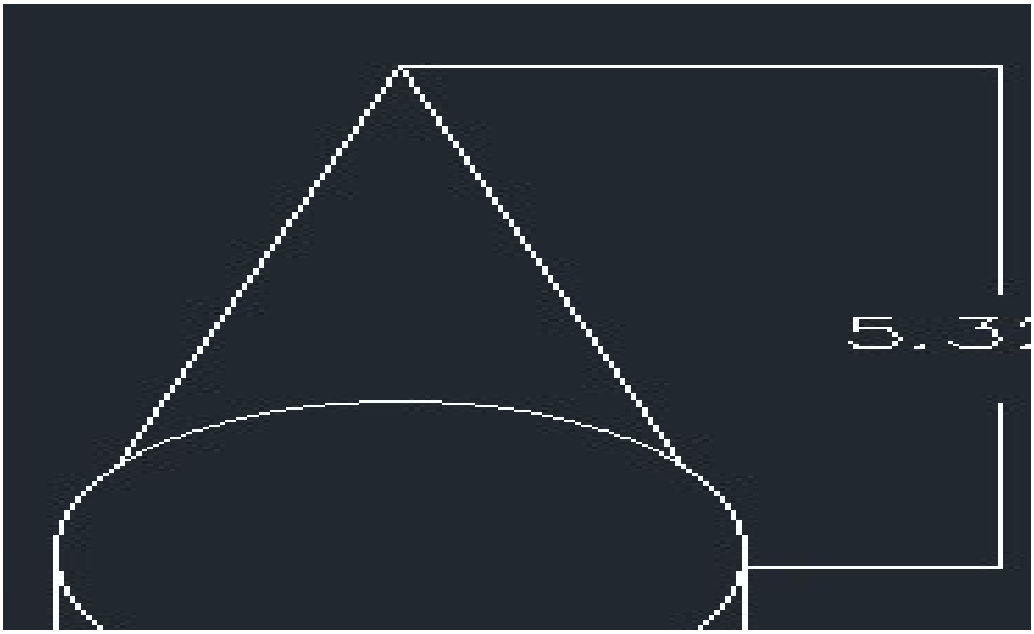
1. An angle was measured at four different times, with the following results:

Day	Angle	Standard Error
1	$134^0 14'34"$	$\pm 12.2"$
2	$134^0 14'36"$	$\pm 6.7"$
3	$134^0 14'28"$	$\pm 8.9"$
4	$134^0 14'26"$	$\pm 9.5"$

What is the most probable value for the angle and the standard deviation in the mean?

(10)

i. The Picture below shows a conical pile of Quarry Stones. Calculate the Volume of the pile and the tolerance? The distances were measured with a tape measure with an accuracy of
±0.007m.



The elevation of point C on the chimney shown in Figure below is desired. Field angles and distances are observed.

Station A has an elevation of 345.618 ± 0.008 m and station B has an elevation of 347.758± 0.008 m. The instrument height, hi_A , at station A is 1.249± 0.003 m, and the instrument height, hi_B , at station B is 1.155± 0.003 m. Zenith angles are read in the field.

The other observations and their errors are AB = 93.505± 0.006 m

A = $44^0 12'34" \pm 7.9"$ B= $39^0 26'56" \pm 9.8"$

$z_a = 81^0 41'06" \pm 12.3"$ $z_b = 84^0 10'25" \pm 11.6"$

What are the elevation of the chimney and the standard deviation in this elevation?

(15)

Question 3

i. Show from first principles that the Least Squares solution is equal to the most probable value? (9)

ii. Calculate the most probable values for A and B in the equations below by the method of least squares. Consider the observations to be of equal weight.

$3A + 2B = 7.80 + v_1$

$2A - 3B = 5.55 + v_2$

$6A - 7B = 8.50 + v_3$ (16)

Question 4

i. Suppose that the angles in an equilateral triangle ABC were observed by the same operator using the same instrument, but the number of repetitions for each angle varied. The results were A = $45^0 15'25''$, n = 4; B = $83^0 37'22''$, n= 8; and C= $51^0 07'39''$, n = 6. Adjust the angles. (12)

ii. A distance is measured as 192.43m using a cloth tape and a given weight of 1; it is measured again as 192.41m using a steel tape and assigned a weight of 2; and finally, it is measured a third time as 192.40m with an EDM instrument and given a weight of 4. Calculate the most probable value of the length (weighted mean), and find the standard deviation of the weighted mean? (13)

TOTAL 100 MARKS : IN GOD WE TRUST

Answers

QUESTION 1

- Calculate the mean, median, and standard deviation –Formula and Answer.
- Construct a histogram of the data with five intervals and describe its properties

- Divide the data into five intervals and create a histogram with the intervals
- Plot the mean on the histogram and lay off the sample standard deviation from both sides of the mean
- Calculate the number of observations between and the percentage it represents
- Count the number of observations between and calculate the percentage of observations this represents

i. Calculate the 95% confidence interval for the measurement

- Calculate the standard error and the margin of error
- Calculate the lower bound and upper bound of the confidence interval

ii. Determine if the EDM is working properly at a 95% confidence level (4 marks)

- State the null and alternative hypothesis
- Calculate the test statistic
- Compare the test statistic with the critical value and make a conclusion

iii. Determine if the EDM is working properly at a 90% confidence level

- State the null and alternative hypothesis
- Calculate the test statistic
- Compare the test statistic with the critical value and make a conclusion

Question 2

- Identify the shape of the pile and the appropriate formula to calculate the volume.
- Perform the calculations accurately and show the step-by-step process
- Determine the tolerance and define what tolerance means in the context of the pile volume measurement
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- Calculate the tolerance based on the acceptable range or limit
- Explain the significance of the tolerance and its implications for the volume measurement.

Question 3

- Set up the normal equations
- Solve the normal equations
- Calculate the most probable values
- Substitute the values of A and B into the original equations

QUESTION 4

- Calculate the weights for each vertex angle measurement
- Calculate the weighted adjustment for each angle
- Provide a clear and coherent explanation