KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Marks Scored:

Level : B.E.
Year : III

Course : GEOM 307
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 08 AUG 2024

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and encircle in the most appropriate option from each set of choices

1. Theory of errors is applied to minimize:
   a. Mistakes b. Systematic errors c. Random errors d. Both a and b

2. Correlate is used to determine the most probable values by multiplying it with:
   a. Normal equation b. Observation equation
   c. Condition equation d. Condition imposed by least square

3. Most Probable Value (MPV) of a quantity is equal to:
   a. Observed value + Correction b. Observed value - Correction
   c. True value + Correction d. True value - Correction

4. Variance of a quantity is an indicator of:
   a. Precision b. Accuracy c. Randomness d. Regular Nature

5. When the sample contains less than 30 values, the probability distribution used is:
   a. t - distribution b. χ^2 - distribution
   c. Normal distribution d. F - distribution

Choose and mark [X] in the option that includes only correct statement(s).

6. Statements:
   i. Error is the difference between measured value for any quantity and its true value.
   ii. Small error in reading the graduated scales is an example of systematic error.
   iii. Systematic error is also known as bias.
   iv. Least square method is applied to eliminate the systematic errors.
   [ ] i and iii [ ] i only [ ] i, ii and iii [ ] Only i

7. Statements:
   i. Relative worthiness of an observation is measure by its weight.
   ii. A more weighted observation implies observation with high variance.
   iii. Corrections should be directly proportional to weights.
   iv. Weights are used to control the sizes of corrections applied to measurements in an adjustment.
   [ ] i, ii and iv [ ] i, iii and iv [ ] i and iv [ ] Only i

8. Following are the characteristics of random errors:
   i. Small errors occur as frequently as the larger errors.
   ii. Positive errors occur more frequently than the negative errors.
   iii. Small errors occur more frequently than the larger errors.
   iv. Larger errors may occur more frequently.
   [ ] i and ii [ ] ii and iv [ ] i and iv [ ] Only iii

9. Statements:
   i. If multiple observations are made of the same quantity and small discrepancies result, this indicates high precision.
   ii. If multiple observations are made of the same quantity and small discrepancies result, this indicates high accuracy.
   iii. The degree of precision attainable is dependent on equipment sensitivity and observer skill.
   iv. Accuracy denotes the absolute nearness of observed quantities to their true values.

   [ ] i and iii [ ] ii and iv [ ] ii,iii and iv [ ] i, iii and iv

10. Statements:
   i. The size of the sample is an important criteria when determining the reliability of a computed mean or variance.
   ii. χ^2 - distribution plot is asymmetric in nature.
   iii. The χ^2 - distribution is used in sampling statistics to determine the range in which the variance of the population can be expected to occur.
   iv. The nature of plot of the t-distribution is symmetric and is used to construct confidence intervals for the population variance.

   [ ] i, ii and iv [ ] ii, iii and iv [ ] i, ii and iii [ ] i, iii and iv

Fill in the blanks using appropriate words.

11. The value of 90% error of an observation is given by ± _____ σ.

12. If a quantity x with weight w is divided by a factor α, then the resulting weight is _____.

13. In the number 0.0004913, the least significant number is _____.

14. If n be the number of observations, then the degree of freedom is given by _____.

15. 2-D affine transformation is also called as _____parameter transformation.

Write T for True and F for False statement.

16. 2-D affine transformation is commonly used in photogrammetry for interior orientation. [ ]

17. A small non-orthogonality between X and Y axes is accounted in 2-D conformal transformation. [ ]

18. Rotation matrix used in 3-D conformal transformation is not orthogonal. [ ]

19. Normal equations in least square adjustment are always equal to number of unknowns. [ ]

20. Semi-major axis of a error ellipse exist in the direction of smallest uncertainty. [ ]

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Time : 2 hrs. 30mins.

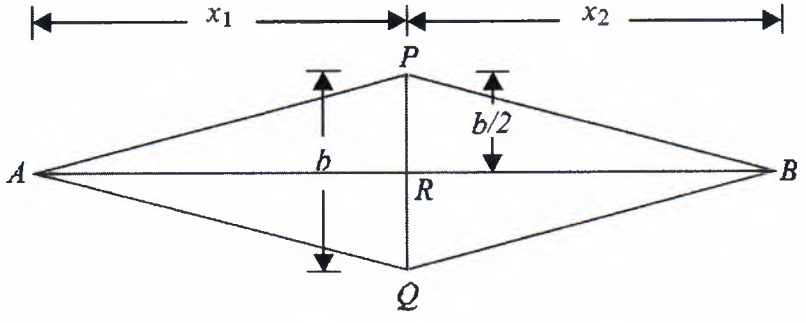
08 AUG 2024

Course : GEOM 307
Semester : II
F. M. : 40

SECTION "B"
[6 Q. × 5 = 30 marks]

Attempt *ANY SIX* questions.

1. A base line AB was measured accurately using a subtense bar 1 m long. From a point R near the center of the base, the lengths AR and RB were measured as 9.375 m and 9.493 m, respectively. If the standard error in the angular measurement is ±1", determine the error in the length of the line. Refer the figure below.

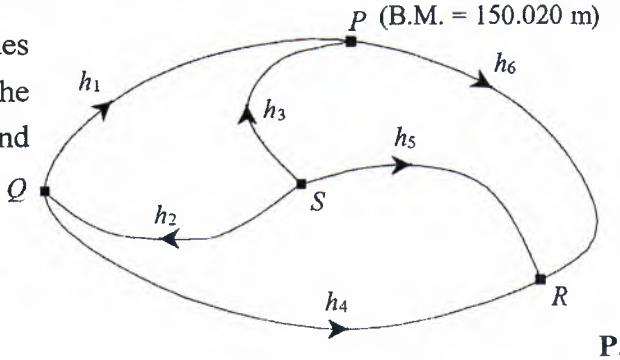


2. In the figure provided below, the observed values of the distances AB, BC, CD, AC and BD are as 50.000 m, 50.070 m, 50.050 m, 100.090 m and 100.010 m respectively. Determine the adjusted values of AD assuming that all the observations are of equal reliability and uncorrelated.

3. The observed differences in level for the points in a level net are given below:

From (Lower Point)	To (Upper Point)	Level Difference (m)
Q	P	$h_1 = 6.226$
S	Q	$h_2 = 5.133$
S	P	$h_3 = 11.368$
Q	R	$h_4 = 23.521$
S	R	$h_5 = 28.639$
P	R	$h_6 = 17.275$

Determine the most probable values of the elevations of Q, R and S if the observations are uncorrelated and of equal reliability.



P.T.O.

4. Given the following inverse matrix and a standard deviation of unit weight of 1.45, determine the parameters of error ellipse. Also, compute S_x and S_y.

$$\begin{bmatrix} q_{xx} & q_{xy} \\ q_{yx} & q_{yy} \end{bmatrix} = \begin{bmatrix} 0.0004894 & 0.0000890 \\ 0.0000890 & 0.0002457 \end{bmatrix}$$

5. Provide the fundamental statement of Least Square for weighted case and also derive the statement.

6. Survey observations are inherently subjected to various forms of errors. By providing the examples in Surveying and Geo-informatics domain, explain the notion of **error propagation**. Also, provide relevant examples where **Error of Sum** and **Error of Product** can be employed in adjustment of survey observations.

SECTION "C"

[1 Q. × 10 = 10 marks]

Attempt *ANY ONE* questions.

7.

a. The EN and XY coordinates for points A through C are given in the table below. It is necessary to convert the XY coordinates into the EN system using 2-D conformal transformation. Determine the following:

i. Scale factor [1]
ii. Rotation angle [1]
iii. Translations in X and Y [2]
iv. Transformed coordinates of point C (i.e., in the EN system). [1]

Point	State Plane Coordinates (m)		Arbitrary Coordinates (ft)	
	E	N	X	Y
A	639940.832	642213.266	2154.08	5531.88
B	641264.746	641848.554	6488.16	4620.34
C	?	?	5096.84	5995.7392

b. In order to check the precision of a theodolite measurement, 31 direction readings of a single line were measured. The mean (seconds' portion only) of the readings was 25.2, and the standard deviation of the mean measurement is ±0.4. Answer the following:

i. Determine the 95% confidence interval for the population mean. [2.5]
ii. Compute the 99% confidence range for the population variance. [2.5]

8. Adjust the figure aside by least squares if the measured angles are of equally weighted. Control points are given as following:

$\theta_1 = 50^0 06' 50''$ $\theta_2 = 101^0 30' 47''$ $\theta_3 = 98^0 41' 17''$ $\theta_4 = 59^0 17' 01''$

X_a = 865.40 X_b = 2432.55 X_c = 2865.22

Y_a = 4527.15 Y_b = 2047.25 X_a = 27.15