KATHMANDU UNIVERSITY
End Semester Examination
August/September, 2017

Mark Scored:

Level : B. E.
Year : III
Course : GEOM 307
Semester : II

Exam Roll No. :
Time: 30 min
F. M. : 10

Registration No.:
Date : SEP 10 2017

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Tick the most appropriate answer (Assume suitable data if necessary).

1. Which one of the following is not the characteristics of random variable?
   a. Small errors occur more frequently than large ones.
   b. Positive and negative errors of same size occur with equal frequency.
   c. Positive and negative errors of same size occur with different frequency.
   d. Very large errors seldom occurs.

2. Besides yielding most probable values for unknowns, least square adjustment does not enable:
   a. Making possible optimum design of survey procedures in the office before going into the field to take measurements.
   b. Determining precisions of adjusted quantities
   c. Determining redundant survey data observations.
   d. Revealing the presence of large errors and mistakes so that steps can be taken to eliminate them.

3. Accuracy is a term which indicates the degree of conformity of a measurement to its _____
   a. most probable value
   b. mean value
   c. true value
   d. standard error

4. Precision is a term which indicates the degree of conformity of _____
   a. measured value to its true value.
   b. measured value to its mean value.
   c. measured value to its weighted mean value.
   d. repeated measurements of the same quantity to each other.

5. Residual of a measured quantity is the _____
   a. difference of the observed value from its most probable value.
   b. value obtained by adding the most probable value to its true value.
   c. remainder of the division of the true value by its most probable value.
   d. product of the most probable value and the observed value.

6. If the standard deviation of a quantity is ± 1″, the maximum error would be _____
   a. 2.39″ b. 3.29″ b. 9.23″ d. 2.93″

7. The adjusted value of an observed quantity may contain _____
   a. small gross errors
   b. small systematic errors
   c. small random errors
   d. small blunders

8. The rules to be observed while assigning weights to the observations made are:
   i. The weight of an angle varies directly as the number of observations made on an angle.
   ii. For an angle repeated for a great number of times, the weight is inversely proportional to the square of the probable error.
   iii. For a line of levels, the weight varies inversely as the length of the route
   Of the above rules, the correct ones are:
   a. Only i
   b. i and ii
   c. i, ii and iii
   d. ii and iii

9. The most probable value of angle A from the following observation equation is:
   A = 30°00'20'', weight = 2
   2A = 60°00'00'', weight = 1
   a. 30°00'6.66''
   b. 30°00'10''
   c. 30°00'2.22''
   d. 30°00'30''

10. If an error under the same condition always be of same size, it is known as
   a. Cumulative error
   b. Systematic error
   c. Uniform error
   d. Either cumulative or systematic

11. Which of the following method is used to align an unreferenced dataset with one that has spatial reference information?
   a. Spatial projection
   b. Spatial scaling
   c. Reprojection
   d. Georeferencing

12. The normal probability density function curve is symmetrical about the mean, μ, i.e. the area to the right of the mean is the same as the area to the left of the mean. This means $P(X < \mu) = P(X > \mu)$ is equal to:
   a. 0
   b. 1
   c. 0.25
   d. 0.5

13. In a normal curve, $\mu \pm 0.6745\sigma$ covers:
   a. 50% area
   b. 68.27% area
   c. 95.45% area
   d. 99.73% area

14. Systematic errors lead to a lack of:
   a. Significant digits in the measurement
   b. Precision in the measurement
   c. Gradation of the measuring instrument
   d. Accuracy in the measurement

15. A student uses a balance with a stated uncertainty of ±0.002 g to weigh a quantity of a reagent by difference. If the student's empty beaker weighed 40.301g and the beaker plus reagent weighed 40.689g, what is the relative error in the weight of the reagent?
   a. ±0.004
   b. ±0.01
   c. ±0.02
   d. ±0.002

16. Assuming that any distance of 100 feet can be chained with an error of ±0.02 ft, the error in chaining 5000 feet is:
   a. ±0.02 feet
   b. ±0.14 feet
   c. ±0.0014 feet
   d. ±0.014 feet

17. Assume that a rod level bubble is within ±5'of level and the rod reading is at 4 m. What is the estimated error in the rod reading?
    a. 0.004 mm
    b. 0.004 m
    c. 0.04 mm
    d. 0.4 mm

18. Pick out the wrong statement:
    a. A mean value computed from weighted observations is called the weighted mean.
    b. Correction sizes should be inversely proportional to weights.
    c. Angle weights are proportional to the number of times angle are turned.
    d. Weights are directly proportional to the number of stations in levelling.

19. If you only need to rescale, translate or rotate a map, which one would be the best transformation?
    a. Affine Transformation
    b. Projective Transformation
    c. Mobius Transformation
    d. Conformal Transformation

20. Which of the following relationship is TRUE provided all symbols represent their usual meaning?
    a. $|A| = n^2\sigma_x$
    b. $\sigma^2 = \sqrt{\frac{\Sigma(X_i-\mu)}{N-1}}$
    c. $E_{50} = 0.6745\sqrt{\frac{\Sigma v^2}{n-1}}$
    d. $e_{LS} = \frac{r}{2}\sin 2\beta$

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SECTION " B"
[6Q × 4=24 marks]

Attempt *ANY SIX* questions. Assume suitable data if necessary.

1. Define error propagation. Give an expression for the standard deviation of y for the function $y = f(x_1, x_2, \ldots, x_n)$.
The diameter D of the base of a cone is measured as 14.211 cm with a standard error of ±0.0002 cm. The height h of the cone is measured as 21.325 cm with a standard error of ±0.003 cm. What is the volume of the cone and the corresponding standard error? [1+1+2]

2. Explain the importance of redundant measurements in surveying with appropriate survey related examples. List out two important reasons why a prudent surveyors always make redundant observations in their work. [2+2]

3. Define random variable. [1+3]
Suppose that the following values (in cm) were obtained in 15 independent distance observations, D_i: 212.22, 212.25, 212.23, 212.15, 212.23, 212.11, 212.29, 212.34, 212.22, 212.24, 212.19, 212.25, 212.27, 212.20, and 212.25. Calculate the $\boldsymbol{E_{50}}$,$\boldsymbol{E_{95}}$ and check for any observations outside the 99.7% probability level.

4. Define systematic and random errors with one survey related example of each.
A surveyor measures the distance five times between two points R and S by pacing, taping and using Electromagnetic Distance Measurement (EDM). The observations are recorded in the field book as follows:

Observations	Pacing (cm)	Taping (cm)	EDM (cm)
1	571	567.17	567.133
2	563	567.08	567.124
3	566	567.12	567.129
4	588	567.38	567.165
5	557	567.01	567.114

Demonstrate the difference between precision and accuracy using distance measurement data from the table. [2+2]

5. "True value of a quantity is never known." Explain this with one suitable example. Identify the direct and indirect measurements used in computing traverse station coordinates. [2+2]

6. A line of levels is run from B.M. at A to B.M. at E, connecting the intermediate points B, C and D enroute. The observed data is given below.

Section	Distance (km)	Difference of elevations (m)
A to B	3	-1.455
B to C	2	+0.835
C to D	4	-2.420
D to E	5	+1.835

Calculate the elevations of B, C and D if the elevations of A and E are respectively, 100.000 and 98.645m. [4]

7. Which of the following method is more suitable: Normal equation method or Method of Correlates when there are a large number of condition equation? The three angles A, B and C of a triangle ABC are $49^0 20'13.4''$, $50^0 29'15.2''$ and $80^0 10'25.4''$, with weights of 1, 2 and 3 respectively. Determine the most probable values of A, B and C **using the method of correlates.** [1+3]

8. Explain why computer optimization techniques are necessary for performing least square adjustment of large dataset. Illustrate with a relevant example. [2+2]

SECTION "C"

[2Q × 8 = 16 marks]

Attempt *ALL* questions. Assume suitable data if necessary.

9. Establish the relationship between the weights of measurements to squares of their respective mean square error. State and explain the laws of weight with one example of each. [1+3]

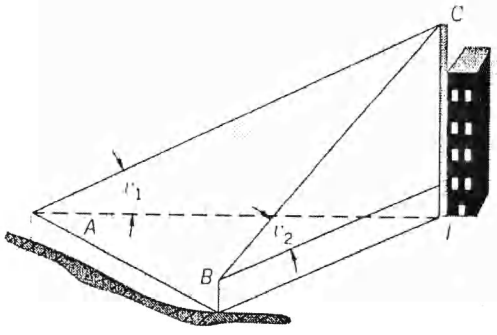
The elevation of point C on the chimney shown in the Figure below is desired. Field angles and distances are observed. Station A has an elevation of 1298.65±0.006m, and station B has an elevation of 1301.53±0.004m. The instrument height, hi_A, at station A is 5.25±0.005m, and the instrument height, hi_B, at station B is 5.18±0.005m. The other observations and their errors are

AB =136.45±0.018m

A = $44^0 12'34''$±8.6'' B = $39^0 26'56''$±11.3''

$v_1 = 8^0 12'47''$±4.1'' $v_2 = 5^0 50'10''$±5.1''

What are the elevation of the chimney and the error associated with the computed value? [4]



10. Describe why do different 2D coordinate transformations exist. List out the two main difference between projective and affine transformations.
What effect does affine and conformal transformations have on **scale factor, angular relationships, parallelism and in shape of the object**? [1+1+2]

The coordinates of two points A and B are listed in table given below for two separate coordinate systems e-n (an outdated system) and E-N (the revised system). A point C has co-ordinates on the old system of **e = 15,362.88 m.** and **n = 14,622.70 m.** *Estimate the conformal transformation parameters from the given control points. Finally, calculate the coordinates of point C on the E-N system.* [4]

Point	e (m)	n (m)	E (m)	N (m)
A	16,719.24	12,164.51	538,712.09	203,683.60
B	18,975.69	13,192.83	539,151.00	204,298.92

OR

State the principle of least square adjustment. Show that the maximum accuracy is achieved when $\varepsilon^2 = \frac{1}{2h^2}$ is minimum where symbols carry the usual meanings in error theory. Write one advantage and disadvantage of least square adjustment. [1+2+1]

The telescope of a theodolite is fitted with stadia wires. It is required to *find the most probable values of the constants K and C of tacheometer*. The staff was kept vertical at three points in the field and with line of sight horizontal, the staff intercepts observed were as follows:

Distance of Staff from Tacheometer D (m)	Staff Intercept S (m)
150	1.495
200	2.000
250	2.505

Finally write the distance equation with probable values of K and C. [3+1]