

GPS and Adjustment Computation

1.1 Course Number: CS384

1.2 Contact Hours: 3-0-0 Credits: 9

1.3 Semester-offered: 3rd Year-Even

1.4 Prerequisite: A basic understanding of geoinformatics

1.5 Syllabus Committee Member: Dr. Sushum Biswas, Dr. Daya Sagar Gupta & Dr. Gargi Srivastava

2. Objective:

- To understand the concepts of adjustments of surveying observations by observation equations, condition equations and a combined method.
- To effectively apply adjustment concepts to real-world surveying problems
- To understand the weighting of observations and the resultant statistical computations.
- To introduce the student to the error ellipse.
- To give the student a knowledge of statistical analysis of measurement.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Adjustment computations	Introduction, observation/ measurements: True value, most probable value (MPV), true error, residual, discrepancy, types and sources of error, Gaussian law of accidental errors, precision and accuracy, measures of precision from Gaussian law, expectation operator, variance, covariances, correlation, weights and cofactors, various error measures on 1D, 2D, and 3D standards, propagation of errors, variance, covariance and cofactors, pre-analysis, introduction to statistical concepts, probability distributions, hypothesis testing	5
2	Geoinformatics methodology	Mathematical model, definition, elements and types of models: stochastic and function, linear, non-linear, over-determined, under-determined, unique, explicit, implicit, observation, condition, combined, Adjustment: purpose and types, Least squares adjustment: principle and techniques, assumptions,	5

		ordinary, weighted, generalized is, geometrical interpretation	
3	Observation equations	Model and solution strategy, adjustment of linear and non-linear forms, variance-covariance propagation of adjusted data in observations equations method	5
4	Condition equation	Model and solution strategy, adjustment of linear and non-linear forms, variance-covariance propagation of adjusted data in condition equations method	5
5	Combined method	Model and solution strategy, variance-covariance propagation of adjusted data in combined equations method observation and condition equations as simplification of combined method	5
6	Post-analysis of adjusted data	Absolute and relative error ellipse and error ellipsoid, significance and use in designing projects, outlier/blunder detection, redundancy, redundancy number, reliability and sensitivity analysis.	5
7	Applications of adjustment computations	Traversing, Tacheometry, EDM, photogrammetry, GNSS, network adjustment.	5
8	Introduction to Geostatistics	Geostatistical tools: Semivariance, variogram, various models Kriging.	5
		Total	40

4. Readings

4.1 Textbook:

Ghilani C. D., 2010. Adjustment Computations: Spatial Data Analysis (5th ed.), Wiley: NJ

Leick, A., 2004. GPS Satellite Survey (2nd ed.), Wiley: NY

Metheley, B. D. F., 1986. Computation Methods in Surveying and Photogrammetry, Blakie: London

Mikhail E. M. and Ackermann F., 1976. Observations and Least Squares, IEP Dun-Donnelley: NY

4.2 Reference books:

Mikhail, E. M. and Gracie, G., 1976. Analysis and Adjustment of Survey Measurement. Van Nostrand Reinhold: NY

Mikhail, E. M., 2001. Introduction to Modern Photogrammetry, Wiley: NY

Ogundare, J. O. 2019, Understanding Least Squares Estimation and Geomatics Data Analysis, Wiley: USA

Webster, R. and Oliver, M. A., 2007. Geostatistics for Environmental Scientists, Second Edition, Wiley: Chichester

5 Outcome of the Course: The students should be able to:

- select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies
- quality, timeliness, and continuous improvement
- utilize modern measurement technologies to acquire spatial data
- utilize industry standard software to solve technical problems
- design and implement procedures, and analyze data for conformance with precision and accuracy requirements