COURSE SYLLABI

Course Number and Name	Survey Measurements Adjustment-CE486-3
Creditshours	3 Credithours
Contact hours	4 Contact hours; 2for lecture, 1 for tutorial
Instructor name	Dr. Mahmoud Abdelrahim Abdelgiom
Textbook	Adjustment Computations Spatial Data Analysis , (4th Edition) by Charles D. Ghilani and Paul R. Wolf (Hardcover - Jan 10, 2006).
Others References, upplementalmaterials	☒ Mikhail, E. M. [1998]: Observations and Least Squares. IEP-A dun- ☒ Digital library of jazan university.
Specific course information	
Catalog description	This course is intended to introduce the fundamentals of errors and methods for analyzing them. The first three chapters are devoted to the subject of error propagation in the various types of traditional surveying measurements. Then chapters follow that describe observation weighting and introduce the least-squares method for adjusting observations. Least-squares adjustments often require the formation and solution of nonlinear equations. Procedures for linearizing nonlinear equations by Taylor's theorem are therefore important in adjustment computations, and this topic is also presented. Application of least squares in adjusting basic types of surveys are then presented in separate chapters. Adjustment of level nets, trilateration, triangulation and traverses are included.
Prerequisite	**CE382-2**
Required / Elective	**Elective**
Specific goals for the course	

Course Learning Outcomes (CLO)	Upon successful completion of the course a student should have the ability to: 1- Distinguish between direct and indirect measurements. 2- Define precision and accuracy as they pertain to survey data. 3- Describe the basic error propagation equation and the concept of Least Squares in both equal-weight and weighed cases. 4- Evaluate error propagation model for surveying networks. 5- Recognize the stochastic model as it is used in the context of Least Squares. 6- Evaluate the observation equations of different surveying measurements. 7- Solve the different survey problems (leveling – triangulation - traverse network) using the method of Least Squares adjustment. 8- Compute error ellipse parameters from adjustment covariance matrix. 9- Calculate the adjusted parameters and their covariance matrix of the network point coordinates.
Student outcomes that addressed by the course	The following student outcomes are addressed by the course: SO#1 :An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. SO#6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. SO#7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
List of topics to be covered	**1- Propagation of Random Errors in Indirectly Measured Quantities** Basic Error Propagation Equation - Generic Example - Frequently Encountered Specific Functions - Standard Deviation of a Sum - Standard Deviation in a Series - Standard Deviation of the Mean - Error Sources in Horizontal Angles - Effects of Leveling Errors in Angle Observations Errors in Electronic Distance Observations. **2- Error Propagation in Traverse Surveys** Derivation of Estimated Error in Latitude and Departure - Derivation of Estimated Standard Errors in Course Azimuths - Computing and Analyzing Polygon Traverse Misclosure – Computing and Analyzing Link Traverse Misclosure Errors. **3- Error Propagation in Elevation Determination**

	Systematic Errors in Differential Leveling - Earth Curvature and Refraction - Combined Effects of Systematic Errors on Elevation Differences - Random Errors in Differential Leveling - Instrument Leveling Errors Rod Plumbing Error - Estimated Errors in Differential Leveling - Error Propagation in Trigonometric Leveling. **4- Weights of Observations** Weighted Mean - Relation between Weights and Standard Errors - Statistics of Weighted Observations - Standard Deviation - Standard Error of Weight *w* and Standard - Error of the Weighted Mean - Weights in Angle Observations - Weights in Differential Leveling - Practical Examples **5- Principles of Least Squares** Fundamental Principle of Weighted Least Squares - Stochastic Model - Functional Model - Observation Equations- Elementary Example of Observation Equation Adjustment - Systematic Formulation of the Normal Equations - Equal-Weight Case - Weighted Case - Advantages of the Systematic Approach - Using Matrices to Form the Normal Equations - Equal-Weight Case - Weighted Case - Least Squares Solution of Nonlinear Systems - Least Squares Fit of Points to a Line or Curve - Least Squares Adjustment Using Conditional Equations - Examples Using Observation Equations. **6- Adjustment of Level Nets** Observation Equations – Unweighted Example – Weighted Example - Reference Standard Deviation – Formulation of the Normal Equations – Covariance matrix of the adjusted parameters – Standard Deviations of Computed Quantities. **7- Adjustment of Horizontal Surveys** Distance Observation Equations – Trilateration Adjustment Example – traverse network adjustment – Computer Solution of a Trilaterated Quadrilateral – Formulation of the Normal Equations – Iteration Termination - Method of Maximum Iterations – Covariance Matrix of the Adjusted Parameters.