INSTITUT TEKNOLOGI SEPULUH NOPEMBER
FACULTY OF CIVIL, PLANNING AND GEO ENGINEERING
DEPARTMENT OF GEOMATICS ENGINEERING
UNDERGRADUATE PROGRAM

SEMESTER LEARNING PLAN (SLP)

COURSE NAME	CODE	COURSE GROUP	CREDITS		SEMESTER	COMPILATION DATE
Adjustment Computation	CM234311	Surveying and Cadastral	T=2	P=1	4	-

AUTHORIZATION	SLP DEVELOPER	COURSE GROUP COORDINATOR	HEAD OF UNDERGRADUATE PROGRAM
	Ira Mutiara Anjasmara, S.T., M.Phil., Ph.D.	Yanto Budisusanto, ST, M.Eng	Putra Maulida, ST, MT, Ph.D

Learning Outcome (LO)	**Expected Learning Outcomes (ELO) that Imposed in the Course**	
	ELO-4	Able to apply mathematics, science, and engineering in the fields of geodesy, surveying, hydrography, remote sensing, photogrammetry, geographic information systems, and cadastral to gain a thorough. understanding of the principles of engineering.
	ELO-6	Able to identify, formulate, analyze and solve problems in the fields of geodesy, surveying, hydrographic, remote sensing, photogrammetry, and cadastral.
	ELO-7	Able to perform spatial data acquisition using modern measurement methods, geospatial data processing, using industry standard software, and making standard designs and analyzes in the fields of geodesy, surveying, hydrography, remote sensing, photogrammetry, and cadastral.
	Course Learning Outcomes (CLO)	
	CLO-1	Able to explain the concept of measurement and error in the field of Geomatics Engineering.
	CLO-2	Able to explain and apply the concepts of error propagation and linearization in the field of Geomatics Engineering.

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<tr><td></td><td>CLO-3</td><td>Able to explain and apply the concept of adjustment computation in a simple way and with the principle of the least squares in the field of Geomatics Engineering.</td></tr>
<tr><td></td><td>CLO-4</td><td>Able to explain the concept of least square adjustment of indirect observation and least square adjustment of observation only.</td></tr>
<tr><td></td><td>CLO-5</td><td>Able to apply least square adjustments of indirect observation and observation only in the field of Geomatics Engineering.</td></tr>
<tr><td></td><td>CLO-6</td><td>Able to analyze the result of least square adjustments.</td></tr>
<tr><td></td><td>CLO-7</td><td>Able to present the quality of least square adjustment results either quantitatively and visually in the form of error ellipse</td></tr>
<tr><td></td><td></td><td>Matrix ELO – CLO
<table>
<tr><td>CLO</td><td>ELO-4</td><td>ELO-6</td><td>ELO-7</td></tr>
<tr><td>CLO-1</td><td>V</td><td></td><td></td></tr>
<tr><td>CLO-2</td><td>V</td><td></td><td></td></tr>
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<tr><td>CLO-7</td><td></td><td></td><td>V</td></tr>
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<tr><td>Course Description</td><td colspan="2">In this course, students will learn about the concept and how to solve measurement errors, especially using the calculation of the least-squares adjustment and analyze the results of the calculation of errors. The material provided includes the concept of measurement and error and measurement correlations. Also, it will be discussed the concept of variance, covariance, cofactors in observation, the concept of the least square adjustment, which is the development of the concept of propagation law, and analysis based on error ellipse. Students are expected will have a learning experience and be able to think critically about the application of calculating the least square adjustment in geodesy field, specifically terrestrial measurement.</td></tr>
<tr><td>Course Materials</td><td colspan="2">1. Concept of measurements and errors
2. Correlation, varians-covarians, cofactor, and weight matrices
3. Error propagation and linierization
4. The concept of least-squares adjustment
5. Least square adjustment of indirect observation
6. Least square adjustment of oservation only
7. Distance, angle, and azimuth conditions and their linierizations
8. Application of least squares adjustment in the field of surveying</td></tr>
</table>

	9. Pre-analysis of survey measurements 10. Error ellipse
References	**Main References :**
	1. Mikhail,E.M., 1976. Analysis and Adjustment of Survey Measurements. Dun Donnelley Publisher New York. 2. Wolf, P.R., and C.D. Ghilani, 1997. Adjustment Computations, John Wiley & Sons, Inc. 3. Ghilani, C. C., 2017. Adjustment Computation: Spatial Data Analysis, John Wiley & Sons, Inc.
	Additional References :
	1. Harvey, B.R., 1994. Practical Least Square. Monograph 13, University of new south Wales 2. E-learning Hitung Perataan (share.its.ac.id)
Lecturer	Ira Mutiara Anjasmara, S.T., M.Phil., Ph.D. Dr. Eko Yuli Handoko, ST, MT Husnul Hidayat, ST, MT Putra Maulida, ST, MT, Ph.D Prof. Mokhamad Nurcahyadi, ST, M.Sc, Ph.D Dr. Muhammad Aldila Syariz, S.T., M.S., Ph.D.
Prerequisite	Mathematics 2, Statistics, Advance Terrestrial Mapping

Class/ Week	**Lesson Learning Outcome (Sub-CLO)**	**Evaluation**		**Forms of Learning, Learning methods, Student Assignments/Task, [Estimated time]**		**Learning Materials [References]**	**Weight (%)**
		Indicator	**Criteria**	**Offline**	**Online**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
1	Able to explain the concept of measurement and error.		Completeness of materials, the depth of explanations, correctness of the answers,	Lecturer, Teacher-centered learning [1 x 45’]		The concept of measurements and errors	5
				Discussion, Student-centered learning [1 x 45’]		The concept of probability	

			communication effectiveness, proper attitude	Exercise, Problem-based learning [1 x 45’]		Realibility of measurements	
2	Able to explain correlated and uncorrelated measurements and apply them in determining the variance-covariance matrix, cofactor matrix and weight matrix		Completeness of materials, the depth of explanations, correctness of the answers, communication effectiveness, proper attitude	Lecturer, Teacher-centered learning [1 x 45’]		Variance and covariance	5
				Discussion, Student-centered learning [1 x 45’]		Correlation coeficient	
				Exercise, Problem-based learning [1 x 45’]		Variance-Covariance matrix	
				Tutorial assignment, []		Cofactor matrix	
						Weight matrix	
3	Able to explain the concept of error propagation and its linearization, as well as applying it in the field of Geomatics Engineering		Completeness of materials, the depth of explanations, correctness of the answers, communication effectiveness, proper attitude	Lecturer, Teacher-centered learning [1 x 45’]		Sistematic error propagation	10
				Discussion, Student-centered learning [1 x 45’]		Random error propagation	
				Exercise, Problem-based learning [1 x 45’]		Linierizatiom	
				Tutorial assignment, []			

4 -5	Able to explain the concept of simple adjustment calculations and the least squares adjustment and apply them in the field of Geomatics Engineering		Completeness of materials, the depth of explanations, correctness of the answers, communication effectiveness, proper attitude	Lecturer, Teacher-centered learning [2 x 45’]		Redudancy and degree of freedom	10
				Discussion, Student-centered learning [2 x 45’]		Simple adjustment computatiom	
				Exercise, Problem-based learning [2 x 45’]		Least-squares adjustment computation	
				Tutorial assignment, []		Example of simple least-square adjustment	
6	Able to perform the method least square adjustment of indirect observation		Completeness of materials, the depth of explanations, correctness of the answers, communication effectiveness, proper attitude	Lecturer, Teacher-centered learning [1 x 45’]		Condition equation	10
				Discussion, Student-centered learning [1 x 45’]		General equation of least square adjustment of indirect observation	
				Exercise, Problem-based learning [1 x 45’]		Example of simple least-square adjustment of indirect observation	
				Tutorial assignment, []			

7	Able to perform the method least square adjustment of observation only		Completeness of materials, the depth of explanations, correctness of the answers, communication effectiveness, proper attitude	Lecturer, Teacher-centered learning [1 x 45’]		Condition equation	10
				Discussion, Student-centered learning [1 x 45’]		General equation of least square adjustment of observation only	
				Exercise, Problem-based learning [1 x 45’]		Example of simple least-square adjustment of observation only	
				Assignment 1, []			
8	Mid Semester Exam						**50**
9 -10 . "	Able to calculate errors in the elevation difference measurements using least square adjustment of indirect observation method and observation only method		Completeness of materials, the depth of explanations, correctness of the answers, communication effectiveness, proper attitude	Lecturer, Teacher-centered learning [2 x 45’]		Adjustment for observation with equal precision (weight)	15
				Discussion, Student-centered learning [2 x 45’]		Adjustment for observation with unequal precision (weight)	
				Exercise, Problem-based learning [2 x 45’]		Solution of adjustment of indirect observation	
				Tutorial assignment, []		Solution of adjustment of observation only	

11	Able to linierize distance, angle, and azimuth observations for the least-square adjustment		Completeness of materials, the depth of explanations, correctness of the answers, communication effectiveness, proper attitude	Lecturer, Teacher-centered learning [2 x 45’]		The distance condition and its linierization	10
				Discussion, Student-centered learning [2 x 45’]		The angle condition and its linierization	
				Exercise, Problem-based learning [2 x 45’]		The azimuth condition and its linierization	
				Tutorial assignment, []			
12 - 13	Able to calculate errors in the coordinates determination using least square adjustment of indirect observation method and observation only method.		Completeness of materials, the depth of explanations, correctness of the answers, communication effectiveness, proper attitude	Lecturer, Teacher-centered learning [1 x 45’]		Adjustment for observation with equal precision (weight)	15
				Discussion, Student-centered learning [1 x 45’]		Adjustment for observation with unequal precision (weight)	
				Exercise, Problem-based learning [1 x 45’]		Solution of adjustment of indirect observation	
				Assignment 2, []		Solution of adjustment of observation only	
14	Able to perform pre-analysis of survey measurementsin the		Completeness of materials, the depth of	Lecturer, Teacher-centered learning [1 x 45’]		Procedure of pre-analysis	5

	field of Geomatics engineering		explanations, correctness of the answers, communication effectiveness, proper attitude	Discussion, Student-centered learning [1 x 45’]		Angle measurement with theodolite	
				Exercise, Problem-based learning [1 x 45’]		Distance measurement with EDM	
				Tutorial assignment, []		Elevation difference with direct levelling	
						Survey tolerance	
15	Able to calculate, present, and analyze the error ellipse		Completeness of materials, the depth of explanations, correctness of the answers, communication effectiveness, proper attitude	Lecturer, Teacher-centered learning [1 x 45’]		Error ellipse	5
				Discussion, Student-centered learning [1 x 45’]		Calculation of error elipse orientation and size	
				Exercise, []		Presenting error ellipse	
				Tutorial assignment, Problem-based learning [1 x 45’]			
16	**Final Semester Evaluation / Final Semester Examination**						**100**