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

SEMESTER LEARNING PLAN (SLP)

COURSE NAME	**CODE**	**COURSE GROUP**	**CREDITS (SKS)**		**SEMESTER**	**Date of Preparation**
Underground Surveying	CM234957	Geodesy and Geodynamics	**T=2**	**P=-**	Elective Course	-

AUTHORIZATION	**SLP Developer**	**Course Group Coordinator**	**Head of Study Program**
	Prof. Mokhamad Nur Cahyadi, S.T., M.Sc., Ph.D	Prof. Dr. Eko Yuli Handoko, ST, MT	Putra Maulida, ST, MT, Ph.D

Learning Outcomes (LO)

Expected Learning Outcomes (ELO) that Imposed in the Course	
ELO-3	Able to manage self-learning, and develop a personal lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability, and understanding technology-based entrepreneurship.
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.
Course Learning Outcomes (CLO)	
CLO-1	Know the Differences in the Concepts of Terrestrial Surveys and Underground Surveys
CLO-2	Know the Underground Survey Methods
CLO-3	Knowledge of underground survey equipment
CLO-4	Understand underground survey applications

Matrix ELO – CLO

CPMK	ELO-3	ELO-4	ELO-6
CLO-1	V		
CLO-2			V
CLO-3		V	
CLO-4	V	V	V

Course Description	Underground Survey is an application of Terrestrial Mapping which is used to carry out measurements and mapping under the ground in 3 dimensions. This course explains the theory of measurement, mapping and technology in underground surveys.
Course Materials	1. Mapping Theory 2. Direction and Orientation 3. Horizontal Position Determination 4. Leveling 5. Detailed Measurement of Situations 6. Volume calculation 7. Underground Surveying Equipment 8. Terrestrial Laser Scanner 9. Ground Penetrating Radar and Geoelectric 10. Layout for Line and Grade 11. Underground Survey Application
References	**Main:**
	1. Elementary Surveying 10th Edition . Paul R Wolf and Charles Ghilani. 2. Adjusment Computation.Paul R Wolf 3. Element of Photogrammetry. Paul R Wolf and Bon Dewitt 4. Satellite of Geodesy. Gunter Seeber 5. Route Survey. Lien Tumewu 6. Ground Penetraring Radar Theory and Practise. Harry M Jol 7. The Geometry of Terrestrial Laser Scanning. Soudarissanane
	Additional :
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Lecturer	1. Prof. Mokhamad Nur Cahyadi, S.T., M.Sc., Ph.D
Prerequisite	

Class/ Week	Lesson Learning Outcome (Sub-CLO)	Evaluation		Forms of Learning, Learning methods,Student Assignments/Task, [Estimated Time]		Learning Materials [References]	Weight (%)
		Indicators	Criteria and Form	Offline	Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Introduction to Mapping Theory for Underground Applications		1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [1 x 50'] 2. Discussion [1 x 50']		1. Explanation of syllabus, teaching plan, assignments and evaluation 2. Terrestrial mapping concept	5
2	Direction and Orientation in Underground Surveying		1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [2 x 50'] 2. Discussion [1 x 50'] 3. Task [1 x 50']		1. Explanation of Azimuth, Bearing and orientation direction 2. Unity of horizontal, vertical and azimuth magnitude	5
3	Determination of Horizontal Position in Underground Surveys		1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [2 x 50'] 2. Discussion [2 x 50']		1. determining the position of the polygon method 2. determining the position using intersection method 3. determining the position of the resection method 4. The reference of the measurement	10
4	Detailed Measurements in Underground Surveys		1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [2 x 50'] 2. Discussion, Task [1 x 50'] 3. Response/Exercise [1 x 50']		1. measurement of tachimetry 2. measurement of trigonometry 3. use of Total Station and Theodolite in the	10

						measurement of detailed situations	
5	Height difference measurements in underground surveys		1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [2 x 50'] 2. Discussion, Task [1 x 50'] 3. Response/Exercise [1 x 50']		1. Height Difference Measurement Method 2. Height Difference Calculation Method 3. Height Difference Measurement Quality 4. Height Difference Measurement Equipment	10
6	Area and Volume Calculations		1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [2 x 50'] 2. Discussion, Task [1 x 50'] 3. Response/Exercise [1 x 50']		1. Volume calculation method 2. Borrow pit, trapezoidal and contour methods	5
7	Area and Volume Calculations		1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [2 x 50'] 2. Discussion, Task [1 x 50'] 3. Response/Exercise [1 x 50']		1. Volume calculation method 2. Borrow pit, trapezoidal and contour methods	5
8	**Midterm Evaluation / Midterm Exam**						**50**
9	Control Points in Underground Surveys		1. Completeness of the material	1. Lecture [2 x 50'] 2. Discussion, Task [1 x 50'] 3. Response [1 x 50']			10

			2. Depth of explanation and effectiveness of communication				
10 - 11	Underground Survey Equipment		1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [2 x 50'] 2. Discussion, Task [1 x 50'] 3. Response/exercise [1 x 50']			15
12 -13	Digital Surface Models in Underground Surveying		1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [2 x 50'] 2. Discussion, Task [1 x 50'] 3. Response/exercise [1 x 50']			15
14 - 15	Line, grade and layout measurements in underground surveys		1. Completeness of the material 2. Depth of explanation and effectiveness of communicatio n	1. Lecture [1 x 50'] 2. Discussion, Task [1 x 50']		1. Methods of designing and making Line and Grade in underground surveys 2. Line and Grade equipment	10
16	**Final Semester Evaluation / Final Semester Examination**						**100**