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

SEMESTER LEARNING PLAN (SLP)

COURSE NAME	**CODE**	**COURSE GROUP**	**CREDITS (SKS)**		**SEMESTER**	**Date of Preparation**
Physical Geodesy	CM235026	Geodesy and Geodynamics	**T=2**	**P=1**	5	-

AUTHORIZATION	**SLP Developer**	**Course Group Coordinator**	**Head of Study Program**
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Learning Outcomes (LO)		
	Expected Learning Outcomes (ELO) that Imposed in the Course	
	ELO-4	Able to apply mathematics, science, and engineering in the fields of Geodesy and Surveying, Hydrography, Photogrammetry and Remote Sensing also 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 and Surveying, Hydrography, Photogrammetry and Remote Sensing also Geographic Information Systems 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 and Surveying, Hydrography, Photogrammetry and Remote Sensing also Geographic Information Systems and Cadastral.
	Course Learning Outcomes (CLO)	
	CLO-1	Able to explain the main objectives of geodetic science in terms of determining the shape and size of the Earth.
	CLO-2	Able to explain basic theories and measurement methods to determine the shape and size of the Earth.
	CLO-3	Able to perform simple calculations to determine the shape and size of the Earth.
	CLO-4	Able to explain the physical dynamics of the earth and its influence in determining the shape and size of the Earth
	CLO-5	Able to apply the use of Earth's shape and size models for practical purposes in the field of surveying and mapping based on their understanding of the theoretical basis and application of the shape and size of the Earth.

Matrix ELO – CLO

CLO	ELO-4	ELO-6	ELO-7
CLO-1	V		
CLO-2		V	V
CLO -3	V	V	
CLO -4		V	
CLO-5			V

Course Description	In this course, students will study one of the main objectives of geodesy, namely the determination of the shape and size of the Earth through gravity measurements. Basic theory about gravity and the methods of measurement and reduction will be given so that students will know how the characteristics and data acquisition for determining the shape and size of the Earth. Students will be given tasks such as perform simple calculations to model the shape and size of the Earth in order to understand and gain experience in determining the shape and size of the Earth. Earth dynamics phenomena that affect variations in the shape and size of the Earth will also be introduced in this course. Students will be stimulated to think critically about the use of Earth's shape and size models in practical use in the field of surveying and mapping.
Course Materials	1. Basic geopotential theory 2. Normal gravity / reference gravity 3. Gravity anomalies 4. Height system and coordinate system 5. Method of measuring and reducing gravity data on a datum 6. Earth gravity modeling 7. Determination of geoid via Stokes integral 8. The influence of the dynamics of the Earth on changes in the value of gravity
References	**Main:**
	1. Bomford, G. 1980. Geodesy, Oxford University Press, Oxford 2. Heiskanen, W.A. and H. Moritz.1967. Physical Geodesy. Freeman, San Francisco 3. Hofmann-Wellenhof, B. and H. Moritz. 2005. Physical Geodesy. Vienna: Springer 4. Torge, W. 2001. Geodesy. de Gruyter, Berlin 5. Vaníček, P. and E.J. Krakiwsky.1986. Geodesy: the Concepts. 2nd ed. Amsterdam: Elsevier 6. Torge, W. 1989. Gravimetry. de Gruyter, Berlin 7. Chuji Tsuboi. 1979. Gravity, Allen & Unwin, London 8. Garland, G.D.1977. The Earth's Shape and Gravity, Pergamon Press
	Additional:
	1. Blakely, R.J. 1994. Potential Theory in Gravity and Magnetic Applications, Cambridge University Press, Cambridge

	2. Stacey, F. D and P.M. Davis. 2008. Physics of the Earth (4th Ed). Cambridge University Press, New York
Lecturer	1. Ira Mutiara Anjasmara, S.T., M.Phil, Ph.D 2. Putra Maulida, S.T., M.T., Ph.D 3. Akbar Kurniawan, S.T., M.T.
Prerequisite	1. Advanced Terestris Mapping 2. Global Navigation Satellite System Survey

Class/ Week	Lesson Learning Outcome (Sub-CLO)	Valuation		Learning Forms, Learning Methods, Student Assignments/Task [Estimated Time]		Learning Materials [References]	Weight (%)
		Indicators	Criteria	Offline	Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1 – 2	Able to explain the basic objectives of the science of Geodesy, especially the determination of the shape and size of the Earth	Accuracy in explaining the basic objectives of the science of Geodesy, especially the determination of the shape and size of the Earth	1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [2 x 50'] 2. Discussion [2 x 50'] 3. Response, Exercise [1 x 50'] 4. Self-Study [1 x 50']		1. The main objectives of Geodesy 2. Definitions in Physical Geodesy 3. Review of physical and mathematical formulas in Physical Geodesy	5
3	Able to explain basic geopotential concepts	Accuracy in explaining basic geopotential concepts	1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [1 x 50'] 2. Discussion [1 x 50'] 3. Exercises and Quizzes [1 x 50']		1. Force, Acceleration 2. Gravitational force, gravitational acceleration and gravitational potential 3. Centrifugal force, centrifugal acceleration and centrifugal potential	10

						4. Gravity, acceleration of gravity, and potential of gravity	
4 - 5	Able to explain the concept of reference gravity and able to calculate the value of reference gravity.	Accuracy in explain the concept of reference gravity and able to calculate the value of reference gravity.	1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [2 x 50'] 2. Discussion [2 x 50'] 3. Responses, Exercises and Tasks [2 x 50']		1. Theory and Solution of Laplace's Equation 2. Reference surfaces of the Earth 3. Concept of Geoid and Ellipsoid 4. Normal gravity field 5. Potential gravity	10
6	Able to apply the concept of reference gravity in calculating the value of gravity anomalies from corrected gravity measurement data and can explain the concept of isostasy in the process of gravity reduction.	Accuracy in applying the concept of reference gravity in calculating the value of gravity anomalies from corrected gravity measurement data and can explain the concept of isostasy in the process of gravity reduction.	1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [1 x 50'] 2. Discussion [1 x 50'] 3. Responses, Exercises and Tasks [1 x 50']		1. Gravity anomalies 2. Correction and reduction of gravity (free-air, bouguer, terrain, atmospheric) 3. Free-air gravity anomalies; simple bouguer gravity anomaly, complete bouguer gravity anomaly, Helmert anomaly 4. The concept of isostasy	15
7	Able to explain the concept of height and coordinate systems and can show the	Accuracy in explaining the concept of	1. Completeness of the material	1. Lecture [1 x 50'] 2. Discussion [1 x 50'] 3. Response, Exercise [1 x 50']		1. Orthometric height system	10

	relationship between height systems and the concept of gravity.	height and coordinate systems and can show the relationship between height systems and the concept of gravity.	2. Depth of explanation and effectiveness of communication			2. Dynamic height system 3. Normal height system 4. Undulation 5. Geodetic and astronomical coordinate systems 6. Vertical deflection	
8	**Midterm Evaluation / Midterm Exam**						**50**
9 – 10	Able to master the basic concepts of gravity measurement and perform gravity measurements terestrically	Accuracy in mastering the basic concepts of gravity measurement and perform gravity measurements terestrically	1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [1 x 50'] 2. Group Discussion [1 x 50'] 3. Responses, Exercises and Tasks [1 x 50']		1. Absolute and relative gravity 2. Gravity survey on land 3. Gravity survey at sea 4. Airborne gravity survey 5. Satellite altimetry 6. Gravity satellites	10
11 - 12	Able to explain basic concepts and procedures for modeling the physical Earth	Accuracy in explain basic concepts and procedures for modeling the physical Earth	1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [2 x 50'] 2. Discussion [2 x 50'] 3. Response, Exercise [2 x 50']		1. Burns formula 2. Geodetic boundary value problems 3. Stokes Integral 4. Global geopotential model	10
13 – 14	Able to model geoids using the Stokes Integral method and Geoid Determination	Accuracy in modeling geoids using the Stokes Integral method and Geoid Determination	1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [2 x 50'] 2. Discussion [2 x 50'] 3. Responses, Exercises and Tasks [2 x 50']		1. Direct numerical integration 2. Fast fourier transform (FFT) 3. Least squares collocation 4. Geoid Determination	20

15	Able to analyze the relationship between the dynamics of the Earth with changes in the value of the distribution of Earth gravity.	Accuracy in analyzing the relationship between the dynamics of the Earth with changes in the value of the distribution of Earth gravity	1. Completeness of the material 2. Depth of explanation and effectiveness of communication	1. Lecture [1 x 50'] 2. Discussion [1 x 50'] 3. Response, Exercise [1 x 50']		1. Earth's rotation and orientation: precision, nutation, polar movement, changes in day length 2. Properties of earth dynamics: earth tides, plate tectonics, postglacial rebound	10
16	**Final Semester Evaluation / Final Semester Examination**						**100**