

Universitas Negeri Surabaya Faculty of Mathematics and Natural Sciences Undergraduate Physics Study Program

Document Code

SEMESTER LEARNING PLAN

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PL PL PL PL PC PO PO	LO-8 LO-10 LO-12 LO-14 LO-15 Program Object O - 1 O - 2	Able to make of their duties. Analyze physic Have the ability Formulate physic Solve problems tives (PO) Realizing an in Geophysical M Mastering the about enjoyed	lecisions al syster / to impro sical syst s in physi ndependo easurem	based on s by a pove their ems as ical systems, cree	on da pplyin ir knov s phys tems	ng ma wledg sical m comp	d info them ge and nodel	rmatio atics a 1 be a 5 usin	on in o and co able to	order t omput	o fulfil	I and ev	aluate	responsi	Able to make decisions based on data and information in order to fulfill and evaluate responsibilities according to												
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PL Pri PO PO	LO-15 Program Object O - 1 O - 2	Solve problems tives (PO) Realizing an in Geophysical M Mastering the about cubourfo	s in physion	ical system	tems	comp	roha	Formulate physical systems as physical models using mathematics																			
Pri PO PO	rogram Object O - 1 O - 2	tives (PO) Realizing an in Geophysical M Mastering the	ndepende easurem	ent, cre		Solve problems in physical systems comprehensively using mathematics and computational tools.																					
PC PO PO	0 - 1	Realizing an in Geophysical M Mastering the	ndepende easurem	ent, cre	Program Objectives (PO)																						
PO	0 - 2	Mastering the		Realizing an independent, creative and honest character in carrying out lecture assignments, UTS and UAS Geophysical Measurement Methods.																							
PO		Mastering the structured study of various methods commonly used in geophysical surveys to reveal information about subsurface and near-surface structures at survey locations which includes measuring local physical quantity anomalies.																									
	0 - 3	Apply one of the geophysical methods in the decision-making process regarding accurate identification and characterization of subsurface and near-surface structures at geophysical survey locations.																									
PO	0 - 4	Understand the differences in field data collection and processing techniques between one geophysical method and another in the context that one method is complementary to another.																									
PL	LO-PO Matrix	atrix																									
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		P.0	PLO	-4	PLC	D-5		PLO-8	3	PLO	-10	PLO	-12	PLO-1	L4	PLO-1	.5										
		PO-1	1		1	•										1											
		PO-2						1		~		1		1													
		PO-3			1	,		1		~	•	1		1													
		PO-4						•		1	,	1	,	1													
PC	O Matrix at the	e end of each	learning	g stage	e (Sul	b-PO)																				
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			1	2	3	4	5	6	7	8	9	10 1	11 12	2 13	14	15	16										
		PO-1								1				1	1	•	•										
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Short Course Descript	tion	Geophysical Measurement Methods study the Earth as a physical system with a layered and complex structure with differences physical characteristics between layers of crustal rock that form the structure of the Earth which can be determined through fie surveys, survey data collection and processing techniques that involve the application of geophysical methods, both single method and combination methods. Although data collection (both single and combined methods) relies on field surveys, the role of modelin (both 2D and 3D) of subsurface and near-surface structures is crucial in the process of identifying and characterizing the physic system being studied. The geophysical methods studied in lectures are gravity methods, seismic methods (reflection, refractio tomography), magnetic methods, geoelectric methods, and electromagnetic methods.						differences in d through field ingle methods le of modeling g the physical on, refraction,
Referen	ces	Main :			leonomagneno			
 Telford, Universit Blakely, pp.1-512 Hinze, V applicati Reynold pp.1-711 Glatzma Natural H Stein, S. Publishin Everett, 		M. W., Geldart, L. F y Press, US. pp.1-7 R. J. 1995. Potent J. J., von Frese, F ons. University Print s, J. M. 1997. An In er, G. A. 2001. Co distory Book. The N and Wysession, M g, US. pp.1-498. M. E. 2013. Near-su	P., Sheriff, R. E. and Key 44. ial Theory in Gravity an R. R. B. and Saad, A. H ting House: Cambridge U troduction to Applied and nvection in the core and ew Press, New York: US I. 2003. An Introduction f urface Applied Geophysic	rs, D. A. 1990. d Magnetic Ap H. 2013. Gravi Iniversity Press I Environmenta I the generatio 5. pp.62-67. to Seismology, cs. 2nd Edition.	Applied Geophysics. 2nd plications. Cambridge: C ty and Magnetic Explor , UK. pp.1-512. I Geophysics. Chicheste n of the Earth's magneti Earthquake, and Earth S New York: Cambridge U	d Edition. New York Cambridge Univers ations: principles, r: John Wiley and S c field. An America Structure. Malden, niversity Press, US	c: Cambridge ity Press, UK. practices, and Sons Ltd., UK. an Museum of MA: Blackwell . pp.1-422.	
		Supporters:						
		1. Semua s	umber yang releva	n yaitu power point, hand	lbook, modul, d	an internet		
Support lecturer	ing	Prof. Tjipto Prasto Arie Realita, M.Si	owo, Ph.D. . Leahmissi M.S.					
Week-	Fine	al abilities of h learning	Ev	aluation	He Lear Stude	elp Learning, ning methods, nt Assignments, stimated time]	Learning materials	Assessment
	(Su	b-PO)	Indicator	Criteria & Form	Offline(offline)	Online (online)	- [References]	Weight (70)
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Ab tha ge sc ge me us	ble to understand e importance of ophysics, motion ales and time ales relevant to ophysics and easurement ethods commonly ed in geophysics	Students are able to explain the importance of geophysics, motion scales and time scales that are relevant to geophysics and measurement methods commonly used in geophysics	Criteria: Non-test Form of Assessment Participatory Activities	Lectures, Discussions, Questions and Answers 2 X 50		Material: Understanding geophysics, motion scale and geophysical time scale Geophysical Metasurement Methods Library: Telford, MW, Geldart, LP, Sheriff, RE and Keys, DA 1990. Applied Geophysics. 2nd Edition. New York: Cambridge University Press, US. pp. 1-744.	3%
2	Ab gri hee Ea wi va de roo lay me loo an inn ch su su	ole to understand avity methods, terogeneity of arth's rock and neral layers, riations in insity of Earth's ck and mineral vers, easurement of cal gravitational omalies as an dication of the aracteristics of bsurface or near- rface structures	Students are able to explain the gravity method, heterogeneity of Earth's rock and mineral layers, variations in density of Earth's rock and mineral layers, measurement of local gravitational anomalies as an indication of the characteristics of subsurface or near-surface structures.	Criteria: Assignment of short articles and scientific posters (in groups) related to lectures on Geophysical Methods and video clips of poster presentations (individually) Form of Assessment : Project Results Assessment / Product Assessment	Lectures, Discussions, Questions and Answers 2 X 50		Material: Gravitational methods Earth's rock and mineral layers Density variations as a measure of vertical stratification Gravitational anomalies Measurement of gravitational anomalies References: Blakely, RJ 1995. Potential Theory in Gravity and Magnetic Applications. Cambridge: Cambridge University Press, UK. pp. 1-512.	3%

3	Able to understand seismology as a science that studies the propagation of seismic waves (under and near the surface), various seismic methods (reflection, refraction, tomography), mechanisms for releasing seismic activity, differences between tectonic earthquakes, and volcanic earthquakes, seismic survey and measurement methods	Students are able to explain seismology as a science that studies the propagation of seismic waves (below and near the surface), various seismic methods (reflection, refraction, tomography), mechanisms for releasing seismic energy via seismic activity, differences between tectonic earthquakes and volcanic earthquakes, methods of surveying and seismic measurements	Criteria: Doing tasks on time Form of Assessment Participatory Activities	Lectures, Discussions, Questions and Answers 2 X 50	Material: Seismic methods Variations in rock elasticity, Seismic reflection, Seismic refraction, Seismic tomography, Seismic activity, and seismic energy Tectonic and volcanic earthquakes Seismic surveys and measurements References: Stein, S. and Wysession, M. 2003. An Introduction to Seismology, Earthquakes, and Earth Structure. Malden, MA: Blackwell Publishing, US. pp. 1-498.	3%
4	Able to understand seismology as a science that studies the propagation of seismic waves (under and near the surface), various seismic methods (reflection, refraction, tomography), mechanisms for releasing seismic energy via seismic activity, differences between tectonic earthquakes and volcanic earthquakes, seismic survey and measurement methods	Students are able to explain seismology as a science that studies the propagation of seismic waves (below and near the surface), various seismic methods (reflection, refraction, tomography), mechanisms for releasing seismic energy via seismic activity, differences between tectonic earthquakes and volcanic earthquakes, methods of surveying and seismic measurements	Criteria: Doing tasks on time Form of Assessment : Participatory Activities	Lectures, Discussions, Questions and Answers 2 X 50	Material: Seismic methods, Variations in rock elasticity, Seismic reflection, Seismic refraction, Seismic tomography, Seismic activity and seismic energy Tectonic and volcanic earthquakes Seismic surveys and measurements References: Stein, S. and Wysession, M. 2003. An Introduction to Seismology, Earthquakes, and Earth Structure. Malden, MA: Blackwell Publishing, US. pp. 1-498.	3%

5	Able to understand seismology as a science that studies the propagation of seismic waves (under and near the surface), various seismic methods (reflection, refraction, tomography), mechanisms for releasing seismic energy via seismic activity, differences between tectonic earthquakes, seismic survey and measurement methods	Students are able to explain seismology as a science that studies the propagation of seismic waves (below and near the surface), various seismic methods (reflection, refraction, tomography), mechanisms for releasing seismic energy via seismic activity, differences between tectonic earthquakes and volcanic earthquakes and volcanic earthquakes methods of surveying and seismic measurements	Criteria: Doing tasks on time Form of Assessment Participatory Activities	Lectures, Discussions, Questions and Answers 2 X 50	Material: Seismic methods Variations in rock elasticity, Seismic reflection, Seismic tomography, Seismic waves, Seismic activity, and seismic energy Tectonic and volcanic earthquakes Seismic surveys and measurements References: Stein, S. and Wysession, M. 2003. An Introduction to Seismology, Earthquakes, and Earth Structure. Malden, MA: Blackwell Publishing, US. pp. 1-498.	3%
6	Able to understand the geodynamo process of the Earth's outer core as a source of the Earth's magnetism (main magnetic field), the magnetism of the Earth's rock and mineral layers as an external magnetic field, variations in the susceptibility of the Earth's rock and mineral layers, local magnetic anomalies, methods of surveying and measuring local magnetic anomalies	Students are able to explain the geodynamo process of the Earth's outer core as the source of the Earth's magnetism (main magnetic field), the magnetism of the Earth's rock and mineral layers as an external magnetic field, variations in the susceptibility of the Earth's rock and mineral layers, local magnetic anomalies, methods of surveying and measuring local magnetic anomalies	Criteria: 1.Collection of short articles related to lectures on Geophysical Measurement Methods 2.Group article assessment rubric 3.Group marks are given when articles are collected Form of Assessment Project Results Assessment / Product Assessment	Lectures, Discussions, Questions and Answers 2 X 50	Material: Magnetic methods, Earth Magnetism, Geodynamo processes, Magnetic fields, Main Magnetism of rock layers and Earth minerals Variations in susceptibility of rock layers, External magnetic fields Magnetic anomalies Survey and measurement of magnetic anomalies References: <i>Glatzmaier, GA</i> 2001. <i>Convection in the core and the generation of the Earth's magnetic field.</i> <i>An American</i> <i>Museum of</i> <i>Natural History</i> <i>Book. The New</i> <i>York: US. pp.</i> 62-67.	3%

7	Able to understand the electrical properties of rocks in the Earth's crust, natural and artificial sources using the geoelectric method, resistivity and conductivity as two electrical parameters, Wenner configuration, Schlumberger configuration	Students are able to explain the electrical properties of rocks in the Earth's crust, natural and artificial sources using the geoelectric method, resistivity and conductivity as two electrical parameters which are a measure of the stratification of rock layers, Wenner configuration, Schlumberger configuration, Wenner- Schlumberger	Criteria: Doing tasks on time Form of Assessment : Participatory Activities	Lectures, Discussions, Questions and Answers 2 X 50	Material: Geoelectric methods, Earth Electricity Variations in resistivity and conductivity of subsurface rock layers, Geoelectric surveys Resistivity anomalies, Conductivity anomalies, Geoelectric Anomaly Measurements Bibliography: Telford, MW, Geldart, LP, Sheriff, RE and Keys, DA 1990. Applied Geophysics. 2nd Edition. New York: Cambridge University Press, US. pp. 1-744.	3%
8	Able to understand USS questions well	Students are able to solve USS questions well	Criteria: 100 marks if the USS questions are answered well and correctly Forms of Assessment : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Written test, discussion of USS 2 X 50 questions	Material: UTS Library: All relevant sources, namely power points, handbooks, modules and the internet	20%
9	Able to understand the differences between geophysical measurement techniques from natural and artificial sources, a combination of integrated methods of magnetism and electricity in the form of electromagnetic induction methods, VLF and GPR methods for identifying near- surface structures	Students are able to explain the differences between geophysical measurement techniques from natural and artificial sources, a combination of integrated methods of magnetism and electricity in the form of electromagnetic induction methods, VLF and GPR methods for identifying near- surface structures	Criteria: Doing tasks on time Form of Assessment Participatory Activities	Lectures, Discussions, Questions and Answers 2 X 50	Material: Concept of natural and artificial sources of geophysical measurements, Concept of identification and characterization of near-surface structures, Variations in permittivity of near-surface soil layers, Electromagnetic Induction Method VLF Method, GPR Method References: Hinze, WJ, von Frese, RRB and Saad, AH 2013. Gravity and Magnetic Explorations: principles, practices, and applications. University Printing House: Cambridge University Press, UK. pp. 1-512.	4%

10	Able to understand various survey and measurement methods in applied geophysics for the purposes of natural resource exploration and other relevant needs	Students are able to explain various surveys and measurement methods in applied geophysics for the purposes of natural resource exploration and other relevant needs	Criteria: Doing tasks on time Form of Assessment : Project Results Assessment / Product Assessment	Contextual Learning Discussion Questions and answers 2 X 50	Material: Concept of natural and artificial sources of geophysical measurements, Concept of identification and characterization of near-surface structures, Variations in permittivity of near-surface soil layers, Electromagnetic Induction Method VLF Method, GPR Method References: Hinze, WJ, von Frese, RRB and Saad, AH 2013. Gravity and Magnetic Explorations: principles, practices, and applications. University Priess, UK. pp. 1-512.	4%
11	Able to understand various survey and measurement methods in applied geophysics for the purposes of natural resource exploration and other relevant needs	Students are able to explain various surveys and measurement methods in applied geophysics for the purposes of natural resource exploration and other relevant needs	Criteria: Doing tasks on time Form of Assessment Participatory Activities	Contextual Learning Discussion Questions and answers 2 X 50	Material: Concept of natural and artificial sources of geophysical measurements, Concept of identification and characterization of near-surface structures, Variations in permittivity of near-surface soil layers, Electromagnetic Induction Method VLF Method, GPR Method References: Hinze, WJ, von Frese, RRB and Saad, AH 2013. Gravity and Magnetic Explorations: principles, practices, and applications. University Printing House: Cambridge University, press, UK, pp. 1-512.	4%

12	Able to understand various survey and measurement methods in applied geophysics for the purposes of natural resource exploration and other relevant needs	Students are able to explain various surveys and measurement methods in applied geophysics for the purposes of natural resource exploration and other relevant needs	Criteria: Doing tasks on time Form of Assessment : Participatory Activities	Contextual Learning Discussion Questions and answers 2 X 50	Material: Concept of natural and artificial sources of geophysical measurements, Concept of identification and characterization of near-surface structures, Variations in permittivity of near-surface soil layers, Electromagnetic Induction Method VLF Method, GPR Method References: Telford, MW, Geldart, LP, Sheriff, RE and Keys, DA 1990. Applied Geophysics. 2nd Edition. New York: Cambridge University Press, US. pp. 1-744.	4%
13	Able to understand various posters on Geophysical Measurement Methods with the theme of the application of geophysical methods in the field of natural resource exploration	Students are able to explain various Geophysical Measurement Methods posters with the theme of the application of geophysical methods (both single and combination methods) in the field of natural resource exploration	Criteria: Full marks take into consideration the quality of the poster and poster presentation if the poster is presented at the end of the semester Form of Assessment : Project Results Assessment / Product Assessment	Poster Presentation Discussion Questions and answers 2 X 50	Material: Demo Poster on Geophysical Measurement Methods (active lecturer) Literature: All relevant sources, namely power points, handbooks, modules and the internet Material: Demo Poster on Geophysical Measurement Methods (active lecturer) Literature: All relevant sources, namely power points, handbooks, modules and the internet	4%
14	Able to understand various posters on Geophysical Measurement Methods with the theme of the application of geophysical methods in the field of natural resource exploration	Students are able to explain various Geophysical Measurement Methods posters with the theme of the application of geophysical methods (both single and combination methods) in the field of natural resource exploration	Criteria: Full marks take into consideration the quality of the poster and poster presentation if the poster is presented at the end of the semester Form of Assessment : Participatory Activities	Poster Presentation Discussion Questions and answers 2 X 50	Material: Poster on Geophysical Measurement Methods (active students) Literature: All relevant sources, namely power points, handbooks, modules and the internet	4%

15	Able to understand various posters on Geophysical Measurement Methods with the theme of the application of geophysical methods in the field of natural resource exploration	Students are able to explain various Geophysical Measurement Methods posters with the theme of the application of geophysical methods (both single and combination methods) in the field of natural resource exploration	Criteria: Full marks take into consideration the quality of the poster and poster presentation if the poster is presented at the end of the semester Form of Assessment : Project Results Assessment / Product Assessment	Poster Presentation Discussion Questions and answers 2 X 50	Material: Poster on Geophysical Measurement Methods (active students) Literature: All relevant sources, namely power points, handbooks, modules and the internet	4%
16	Able to complete UAS properly and correctly	Able to complete UAS properly and correctly	Criteria: Assess all student projects Form of Assessment : Project Results Assessment / Product Assessment	Projects and discussions	Material: UAS Literature: All relevant sources, namely power points, handbooks, modules and the internet	30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	37.67%
2.	Project Results Assessment / Product Assessment	54.67%
3.	Test	6.67%
		99.01%

Notes

- Learning Outcomes of Study Program Graduates (PLO Study Program) are the abilities possessed by each Study
 Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their
 study program obtained through the learning process.
- The PLO imposed on courses are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
 Program Objectives (PO) are abilities that are specifically described from the PLO assigned to a course, and are specific
- Frogram Objectives (FO) are ablines that are specifically described from the FEO assigned to a course, and are specific to the study material or learning materials for that course.
 Subject Sub-PO (Sub-PO) is a capability that is specifically described from the PO that can be measured or observed and
- 4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
- 5. Indicators for assessing ability in the process and student learning outcomes are specific and measurable statements that identify the ability or performance of student learning outcomes accompanied by evidence.
- 6. Assessment Criteria are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
- 7. Forms of assessment: test and non-test.
- 8. Forms of learning: Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.

9. Learning Methods: Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning,

- Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods. 10. Learning materials are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
- 11. The assessment weight is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
- 12. TM=Face to face, PT=Structured assignments, BM=Independent study.