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

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Seismological Physics	4520102077	Study Program Elective Courses	T=2	P=0	ECTS=3.18	5	July 18, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Prof. Dr. Madlazim, M.Si.	Prof. Tjipto Pratowo, Ph.D.	Prof. Dr. Munasir, S.Si., M.Si.

Learning model	**Project Based Learning**

Program Learning Outcomes (PLO)

PLO study program that is charged to the course	
PLO-7	Communicate their ideas and/or research results in academic writing and speaking effectively.
PLO-12	Have the ability to improve their knowledge and be able to continue their studies to a higher level.
PLO-13	Demonstrate knowledge of Classical Physics and Modern Physics

Program Objectives (PO)	
PO - 1	Develop an independent, creative and honest character in carrying out lecture assignments, UTS and UAS in Seismology Physics.
PO - 2	Able to work together effectively in solving Seismological Physics problems
PO - 3	Able to process information effectively in solving Seismology Physics problems
PO - 4	Able to think at a high level (complex) effectively in solving Seismological Physics problems.
PO - 5	Implement an environmentally conscious and responsive attitude and be prepared for earth disasters.

PLO-PO Matrix

P.O	PLO-7	PLO-12	PLO-13
PO-1			
PO-2			
PO-3			
PO-4			
PO-5			

PO Matrix at the end of each learning stage (Sub-PO)

P.O	Week															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PO-1																
PO-2																
PO-3																
PO-4																
PO-5																

Short Course Description	This lecture discusses: elasticity theory, seismic wave propagation, velocity structure, earthquake parameters, earthquake parameter estimation, travel time curves, travel time tomography, earthquakes, CMT, focal mechanisms, identification of fault planes. This lecture can be taken by students who have taken the Earth Physics course. Lectures are carried out using an expository approach in the form of lectures, discussions, presentations, and observations, practicums, workshops equipped with the use of LCDs, computer simulations, as well as an inquiry approach in the context of observation tasks and the use of tools or software related to Seismological Physics.
References	**Main :**
	1. Aki and Richards, Quantitative Seismology, Academic, Press, 2002. 2. Shearer, Introduction to Seismology, Cambridge, University Press, 1990. 3. Madlazim. 2017. Buku Fisika Bumi Seri Seismologi. Unpublished work.
	Supporters:
Supporting lecturer	Prof. Dr. Madlazim, M.Si. Arie Realita, M.Si. Muhammad Nurul Fahmi, S.Si., M.Si.

Week-	**Final abilities of each learning stage (Sub-PO)**	**Evaluation**		**Help Learning, Learning methods, Student Assignments, [Estimated time]**		**Learning materials [References]**	**Assessment Weight (%)**
		Indicator	**Criteria & Form**	**Offline (*offline*)**	**Online (*online*)**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
1	Students know the lecture contract and understand the meaning, objectives and results to be achieved in learning seismology	Students are able to understand the basic concepts of seismology that will be studied	**Criteria:** quantitative **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Question and answer 2 x 50 minutes		**Material:** Introduction to Seismology **Literature:** *Madlazim. 2017. Earth Physics Book, Seismology Series. Unpublished work.*	3%
2	Students are able to explain the concept of elasticity, seismic wave propagation and are able to analyze velocity structures.	Students are able to explain the theory of elasticity	**Criteria:** quantitative **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Question and answer 2 x 50 minutes		**Material:** Elasticity Theory **Bibliography:** *Shearer, Introduction to Seismology, Cambridge, University Press, 1990.*	3%
3	Students are able to explain the concept of elasticity, seismic wave propagation and are able to analyze velocity structures.	Students are able to explain concepts. seismic wave propagation.	**Criteria:** The assignment is to summarize the physics of seismology **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Question and answer individual assignments 2 x 50 minutes		**Material:** Elasticity Theory **Bibliography:** *Shearer, Introduction to Seismology, Cambridge, University Press, 1990.*	3%
4	Students are able to explain the concept of elasticity, seismic wave propagation and are able to analyze velocity structures.	Students are able to analyze velocity structures	**Criteria:** quantitative **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Question and answer 2 x 50 minutes		**Material:** Velocity structure **References:** *Aki and Richards, Quantitative Seismology, Academic, Press, 2002.*	3%
5	Students are able to analyze and present the concept of estimating earthquake parameters.	Students are able to present earthquake parameters.	**Criteria:** quantitative **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Question and answer 2 x 50 minutes		**Material:** Earthquake parameters **Reference:** *Aki and Richards, Quantitative Seismology, Academic, Press, 2002.*	3%

6	Students are able to analyze and present the concept of estimating earthquake parameters.	Students are able to analyze the concept of estimating earthquake parameters.	**Criteria:** Assignment to make presentation material on the physics of seismology **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Question and answer 2 x 50 minutes		**Material:** Estimation of earthquake parameters. **References:** *Aki and Richards, Quantitative Seismology, Academic, Press, 2002.*	3%
7	Students are able to analyze the concept of travel time curves and write papers about problems with the concept of travel time tomography	Students are able to analyze the concept of travel time curves.	**Criteria:** quantitative **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Question and answer 2 x 50 minutes		**Material:** Travel time curve **Reference:** *Madlazim. 2017. Earth Physics Book, Seismology Series. Unpublished work.*	3%
8		Students are able to do UTS questions well and correctly	**Criteria:** Full marks if the UTS questions are answered well and correctly **Form of Assessment** : Participatory Activities	Midterm Exam 100 minutes		**Material:** Midterm Exam **Literature:**	20%
9	Able to carry out experiments independently and in groups	Students are able to record data in tables, analyze and conclude correctly regarding seismic waves and seismogram analysis	**Criteria:** Assignment Create a practical report **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Project base Learning with virtual laboratory Assignment to make 2 x 50 minute reports		**Material:** Seismic Waves and Seismogram Analysis **Library:** *Madlazim. 2017. Earth Physics Book, Seismology Series. Unpublished work.*	5%
10	Students are able to explain the concepts of earthquakes, CMT and focal mechanisms and fault planes	Students are able to analyze earthquake data picking	**Criteria:** quantitative **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Question and answer 2 x 50 minutes		**Material:** Seismogram analysis **References:** *Aki and Richards, Quantitative Seismology, Academic, Press, 2002.*	3%
11	Able to carry out experiments independently and in groups	Students are able to record data in tables, analyze and conclude correctly	**Criteria:** Assignment Create a practical report **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Project base Learning with virtual laboratory Assignment to make 2 x 50 minute reports		**Material:** Picking seismic data **Reader:** *Madlazim. 2017. Earth Physics Book, Seismology Series. Unpublished work.*	5%
12	Students are able to explain the concepts of earthquakes, CMT and focal mechanisms and fault planes	Students are able to carry out analysis of the epicenter and hypocenter of earthquakes	**Criteria:** quantitative **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Question and answer 2 x 50 minutes		**Material:** Earthquake Epicenter and Hypocenter **Reference:** *Madlazim. 2017. Earth Physics Book, Seismology Series. Unpublished work.*	3%

13	Able to carry out experiments independently and in groups	Students are able to record data in tables, analyze and conclude correctly.	**Criteria:** Assignment Create a practical report **Form of Assessment** : Participatory Activities	Project base Learning with virtual laboratory Assignment to make 2 x 50 minute reports		**Material:** Epicenter and Hypocenter of earthquakes **Reference:** *Madlazim. 2017. Earth Physics Book, Seismology Series. Unpublished work.*	5%
14	Students are able to explain the concepts of earthquakes, CMT and focal mechanisms and fault planes	Students are able to analyze B-Value and create maps of earthquake locations	**Criteria:** quantitative **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Question and answer 2 x 50 minutes		**Material:** B value analysis and making earthquake location maps. **Reference:** *Madlazim. 2017. Earth Physics Book, Seismology Series. Unpublished work.*	3%
15	Able to carry out experiments independently and in groups	Students are able to record data in tables, analyze and conclude correctly.	**Criteria:** Assignment Create a practical report **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Project base Learning with virtual laboratory Assignment to make 2 x 50 minute reports		**Material:** B value analysis and making earthquake location maps. **Reference:** *Madlazim. 2017. Earth Physics Book, Seismology Series. Unpublished work.*	5%
16	Students are able to analyze and present the concept of estimating earthquake parameters.	Students are able to present the results of the projects they have carried out	**Criteria:** Presentation 40%, Q&A 30%, media 30% **Form of Assessment** : Participatory Activities	final semester exam project presentation 2 x 50 minutes		**Material:** Final Semester Exam **Literature:**	30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	92.5%
2.	Project Results Assessment / Product Assessment	7.5%
		100%

Notes

1. **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.
2. **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.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
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.