	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
Tsunami Physics	4520102246	Study Program Elective Courses	T=2	P=0	ECTS=3.18	6	July 29, 2021

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

Learning model	**Project Based Learning**	
Program Learning Outcomes (PLO)	**PLO study program which is charged to the course**	
	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	Demonstrating independent, creative and honest characters in doing student assignments, mid and final exams.
	PO - 2	Understanding the concepts and zones of generation, propagation, and mitigation of a tsunami wave.
	PO - 3	Understanding possible tsunami sources of seismotectonic and non-seismotectonic origin.
	PO - 4	Understanding the concepts of non-dispersive tsunamis and the corresponding wave speed in the open ocean.
	PO - 5	Understanding the concepts of dispersive tsunamis and the corresponding wave speed in the open ocean.
	PO - 6	Understanding the effects of ocean floor deformation, ocean water compressibility on the long wave speed.
	PO - 7	Understanding the concepts of tsunami onset time, travel time, arrival time, and time delay.
	PO - 8	Understanding the concepts of tsunami wave height, tsunami run-up, and horizontal inundation.
	PLO-PO Matrix	

P.O	PLO-12	PLO-13
PO-1		
PO-2		
PO-3		
PO-4		
PO-5		
PO-6		
PO-7		
PO-8		

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						✔	✔									
PO-6									✔	✔						
PO-7											✔					
PO-8												✔	✔			

Short Course Description	The Physics of Tsunamis examines tsunamis as a series of long surface waves in the ocean generated by an impulsive geophysical disturbance that abruptly, vertically displaces the ocean water column. This course discusses earthquakes, submarine landslides, and volcanic eruptions that are considered as the most possible sources of tsunami excitation in the ocean. During its propagation from the source to coastal regions far away, the wave speed may or may not be influenced by ocean topography or ocean water characteristics. In this context, class discussions include shallow-water and deep-water approximation, non-dispersive and dispersive tsunamis, and time and spatial analysis of a tsunami wave arrival at shorelines. Tsunami hazard analysis is also discussed, emphasizing on important aspects of tsunami mitigation.
References	**Main :**

1. Ward, S. N. 2011. Encyclopedia of Solid Earth Geophysics: Tsunami. Edited by Harsh K. Gupta. National Geophysical Research Institute (NGRI). Council 52 of Scientific and Industrial Research (CSIR). Dordrecht, Netherlands: Springer, pp. 1-1539. e-ISBN: 978-90-481-8702-7.
2. Kundu, P. K. and Cohen, I. M. 2002. Fluid Mechanics. 2nd Edition. San Diego, US: Academic Press, pp. 1-730. ISBN-13: 978-0121782511.
3. Pain, H. J. 2005. The Physics of Vibrations and Waves. 6th Edition. West Sussex, UK: John Wiley & Sons, pp. 1-557. ISBN: 978-0-470-01295-6.
4. Sorensen, R. M. 2006. Basic Coastal Engineering. 3rd Edition. New Delhi, India: Springer US, pp. 1-324. e-ISBN: 978-0-387-23333-8.
5. Levin, B. W. and Nosov, M. A. 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.

Supporters:

1. Some power point files and/or course materials relevant to tsunami hazard study from the internet.

Supporting lecturer	Prof. Tjipto Prastowo, Ph.D. 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	Become able to understand the concepts and zones of generation, propagation, and mitigation of a tsunami wave	Students can explain the concepts and zones of generation, propagation, and mitigation of a tsunami wave	**Form of Assessment** : Participatory Activities	Contextual Learning, Discussion, Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Three zones of a tsunami wave: generation, propagation, and mitigation **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.* **Material:** Tsunami as a gravity surface wave in the ocean **Reference:** *Ward, SN 2011. Encyclopedia of Solid Earth Geophysics: Tsunami. Edited by Harsh K. Gupta. National Geophysical Research Institute (NGRI). Council 52 of Scientific and Industrial Research (CSIR). Dordrecht, Netherlands: Springer, pp. 1-1539. e-ISBN: 978-90-481-8702-7.*	2%

2	Being able to understand possible tsunami sources of earthquake, submarine landslide, and volcanic eruption origin	Students can explain possible tsunami sources of earthquake, submarine landslide, and volcanic eruption origin	**Criteria:** Description on student assignments: 1. Some useful mathematical derivations (by a group) 2. Thematic poster (by a group) 3. Individual presentation on the relevant poster **Form of Assessment** : Participatory Activities	Contextual Learning, Discussion, Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Different major tsunami sources: earthquakes, submarine landslides, and volcanic eruptions **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.* **Material:** Examples of a combined source of tsunami excitation **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	3%
3	Being able to understand possible tsunami sources of earthquake, submarine landslide, and volcanic eruption origin	Students can explain possible tsunami sources of earthquake, submarine landslide, and volcanic eruption origin	**Criteria:** Description on student assignments: 1. Some useful mathematical derivations (by a group) 2. Thematic poster (by a group) 3. Individual presentation on the relevant poster **Form of Assessment** : Participatory Activities	Contextual Learning, Discussion, Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Different major tsunami sources: earthquakes, submarine landslides, and volcanic eruptions **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.* **Material:** Examples of a combined source of tsunami excitation **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	3%

4	Being able to derive the long wave speed of a nondispersive tsunami in the homogeneous open ocean with no bottom deformation on the basis of shallow-water approximation	Students can derive the long wave speed of a non-dispersive tsunami in the homogeneous open ocean with no bottom deformation on the basis of shallow-water approximation	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Non-dispersive tsunamis, Shallow-water approximation, Long wave speed **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	3%
5	Being able to derive the long wave speed of a nondispersive tsunami in the homogeneous open ocean with no bottom deformation on the basis of shallow-water approximation	Students can derive the long wave speed of a non-dispersive tsunami in the homogeneous open ocean with no bottom deformation on the basis of shallow-water approximation	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Non-dispersive tsunamis, Shallow-water approximation, Long wave speed **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	3%
6	Being able to derive the wave speed of a dispersive tsunami during propagation on the basis of deep-water approximation	Students can derive the wave speed of a dispersive tsunami during propagation on the basis of deep-water approximation	**Form of Assessment** : Participatory Activities	Contextual Learning Discussion Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Dispersive tsunamis, Deep-water approximation, Corresponding wave speed **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	3%
7	Being able to derive the wave speed of a dispersive tsunami during propagation on the basis of deep-water approximation	Students can derive the wave speed of a dispersive tsunami during propagation on the basis of deep-water approximation	**Criteria:** Assignment 1: handed in Criteria for assessment are available **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Dispersive tsunamis, Deep-water approximation, Corresponding wave speed **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	4%

8	Mid Semester Exam	mid-semester assessment	**Criteria:** Complete tasks on time **Form of Assessment** : Project Results Assessment / Product Assessment	Mid Semester Exam 100 minutes	Mid Semester Exam 100 minutes	**Material:** UTS **Bibliography:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	20%
9	Being able to derive the wave speeds of a tsunami during propagation due to the separate effects of ocean floor deformation and ocean water compressibility	Students can derive the wave speeds of a tsunami during propagation due to the separate effects of ocean floor deformation and ocean water compressibility	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning, Discussion, Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Varying tsunami speed with internal and external factors, Effect of ocean bottom topography, Effect of ocean water compressibility **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	4%
10	Being able to derive the wave speeds of a tsunami during propagation due to the separate effects of ocean floor deformation and ocean water compressibility	Students can derive the wave speeds of a tsunami during propagation due to the separate effects of ocean floor deformation and ocean water compressibility	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning, Discussion, Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Varying tsunami speed with internal and external factors, Effect of ocean bottom topography, Effect of ocean water compressibility **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	4%
11	Become able to understand the concepts of tsunami onset time, travel time, arrival time, and time delay	Students can understand the concepts of tsunami onset time, travel time, arrival time, and time delay	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Tsunami onset time, Tsunami travel time, Tsunami arrival time, Tsunami time delay **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	4%

12	Become able to understand the concepts of tsunami wave height, tsunami run-up, Green's law, and horizontal inundation	Students can understand the concepts of tsunami wave height, tsunami run-up, Green's law, and horizontal inundation	**Criteria:** Assignment 2 (thematic poster): handed in Criteria for assessment are available **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Estimates of tsunami wave height, Tsunami run-up Green's law, Horizontal inundation **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	4%
13	Become able to understand the concepts of tsunami wave height, tsunami run-up, Green's law, and horizontal inundation	Students can understand the concepts of tsunami wave height, tsunami run-up, Green's law, and horizontal inundation	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Discussion Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Estimates of tsunami wave height, Tsunami run-up Green's law, Horizontal inundation **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	4%
14	Being able to create a thematic poster relevant to tsunami hazard mitigation study and present it on the basis of video clip presentation	Students can create a thematic poster relevant to tsunami hazard mitigation study and present it on the basis of video clip presentation	**Criteria:** Assignment 3 (relevant clips): handed in Criteria for assessment are available **Form of Assessment** : Participatory Activities	Poster Presentation for Project-Based Learning Discussion Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Poster Presentation on Tsunami Hazard Mitigation Study (with students being active for class presentation) **Library:** *Some power point files and/or course materials relevant to tsunami hazard study from the internet.*	4%
15	Being able to create a thematic poster relevant to tsunami hazard mitigation study and present it on the basis of video clip presentation	Students can create a thematic poster relevant to tsunami hazard mitigation study and present it on the basis of video clip presentation	**Criteria:** Student assignment 3 (relevant clips): handed in Criteria for assessment are available **Form of Assessment** : Participatory Activities	Poster Presentation for Project-Based Learning Discussion Q & A 2 X 50	Virtual face-to-face lectures with Google Meet 2 x 50	**Material:** Poster Presentation on Tsunami Hazard Mitigation Study (with students being active for class presentation) **Library:** *Some power point files and/or course materials relevant to tsunami hazard study from the internet.*	4%

16	Final Exam	Final Exam	**Criteria:** Final Exam **Form of Assessment** : Project Results Assessment / Product Assessment	Final Exam 100 minutes	Final Exam 100 minutes	**Material:** Final Exam **References:** *Levin, BW and Nosov, MA 2016. Physics of Tsunamis. 2nd Edition. Heidelberg, Germany: Springer, pp. 1-388. eISBN: 978-3-319-24037-4.*	30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	49%
2.	Project Results Assessment / Product Assessment	50%
		99%

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.