	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
Atmospheric Physics	4520102248	Study Program Elective Courses	T=2	P=0	ECTS=3.18	6	October 10, 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-14	Formulate physical systems as physical models using mathematics
	Program Objectives (PO)	
	PO - 1	Understanding a systematic study of the atmosphere as a physical system and its role in human life and living organisms.
	PO - 2	Understanding the interdependence of humans and the atmosphere.
	PO - 3	Understanding stably stratified layers of the atmosphere and the corresponding characteristics of each layer.
	PO - 4	Understanding the dynamics of the atmosphere associated with overturning circulation and transformation of energy in the atmosphere.
	PO - 5	Understanding potential threats from hydrometeorological hazards associated with a coupled system of the ocean and atmosphere.
	PLO-PO Matrix	

P.O	PLO-12	PLO-14
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	Atmospheric Physics discusses problems in physics that are sourced from levels of knowledge and uses of atmospheric resources in Indonesia. Learning strategies in this course involve the introduction of atmospheric sciences through phenomenological approaches with emphasis placed on physical aspects. Class discussions include examination of a layered structure of the atmosphere and corresponding characteristics of each layer, atmospheric overturning circulation at low- and mid-latitudes (the Hadley Cell), planetary waves and associated transformation of energy, ionospheric currents, air-sea interactions (El-Nino and La-Nina cases), hydrometeorological hazards (extreme weather, excessive rainfall, floods, droughts, forest fires, atmospheric storms) related to a coupled physical system of the ocean and atmosphere, the crucial role of the atmosphere in weather and climate systems at local, regional and global scales, climate change and global warming.
References	**Main :**

	1. Vallis, G. K. 2006. Atmospheric and Oceanic Fluid Dynamics. Cambridge, UK: Cambridge University Press, pp.1-745. 2. Ahrens, C. D. 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526. 3. Lambeck, K. 2010. The Science of Climate Change: Questions and Answers. Canberra, Australia: Australian Academy of Science. pp.1-24. 4. Hare, S., Cresswell, L., Twigg, and Buchdahl, R. 2002. Air Pollution. Manchester, UK: Atmosphere, Climate and Environment (ACE) Information Programme, Manchester Metropolitan Uni. pp.1-153. 5. Cushman-Roisin, B. and Beckers, J-M. 2009. Introduction to Geophysical Fluid Dynamics. New Hampshire, US: Academic Press, pp.1-759.
	Supporters:
	1. Some power point files and/or course materials relevant to Atmospheric Physics 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	Being able to understand the atmosphere as a physical system with crucial roles in life	Students can explain the atmosphere as a physical system with crucial roles in life.	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Class discussion Q & A 2 X 50	Virtual face-to-face lectures with Google meet 2 x 50	**Material:** Atmospheric Physics is a counterpart of Physical Oceanography in weather and climate systems at all scales. **References:** *Ahrens, CD 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526.*	1%
2	Being able to understand the interdependence of humans on the dynamics of the atmosphere	Students can explain the interdependence of humans on the dynamics of the atmosphere.	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Class discussion Q & A 2 X 50	Virtual face-to-face lectures with Google meet 2 x 50	**Material:** Introduction to atmospheric sciences through phenomenological approaches **References:** *Ahrens, CD 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526.* **Material:** Use of atmospheric resources in Indonesia **Library:** *Some power point files and/or course materials relevant to Atmospheric Physics from the internet*	1%
3	Being able to understand basic features of the atmosphere, a layered structure of its own physical characteristics in each layer	Students can explain basic features of the atmosphere, a layered structure of its own physical characteristics in each layer.	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Class discussion Q & A 2 X 50	Virtual face-to-face lecture via Google meet 2 x 50	**Material:** The atmosphere is a physical system; A stably stratified structure with its own characteristics in each layer. **References:** *Ahrens, CD 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526.*	1%

4	Being able to understand basic features of the atmosphere, a layered structure of its own physical characteristics in each layer	Students can explain basic features of the atmosphere, a layered structure of its own physical characteristics in each layer.	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Class discussion Q & A 2 X 50	virtual face-to-face lectures with Google meet 2 x 50	**Material:** The atmosphere is a physical system; A stably stratified structure with its own characteristics in each layer. **References:** *Ahrens, CD 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526.*	1%
5	Being able to understand meridional circulation in the atmosphere, the corresponding Hadley Cell and atmospheric parameters	Students can explain meridional circulation in the atmosphere, the corresponding Hadley Cell and atmospheric parameters.	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Class discussion Q & A 2 X 50	Virtual face-to-face lectures with Google meet 2 x 50	**Material:** Atmospheric overturning circulation; Meridional circulation at low- and mid-latitudes; The Hadley Cell **Bibliography:** *Ahrens, CD 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526.*	2%
6	Being able to understand meridional circulation in the atmosphere, the corresponding Hadley Cell and atmospheric parameters	Students can explain meridional circulation in the atmosphere, the corresponding Hadley Cell and atmospheric parameters.	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Class discussion Q & A 2 X 50	Virtual face-to-face lectures with Google meet 2 x 50	**Material:** Atmospheric overturning circulation; Meridional circulation at low- and mid-latitudes; The Hadley Cell **Bibliography:** *Ahrens, CD 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526.*	2%
7	Being able to understand mid- and low-latitudes atmospheric circulation in terms of zonally-averaged atmospheric circulation	Students can explain mid- and low-latitudes atmospheric circulation in terms of zonally-averaged atmospheric circulation.	**Criteria:** Assessment criteria are available **Form of Assessment** : Participatory Activities	Contextual Learning Class discussion Q & A 2 X 50	Virtual face-to-face lectures with Google meet 2 x 50	**Material:** Atmospheric overturning circulation; Meridional circulation at low- and mid-latitudes; The Hadley Cell **Bibliography:** *Ahrens, CD 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526.*	2%
8	Mid Semester Exam	Mid Semester Exam	**Criteria:** 1. 2.Assessment criteria are available **Form of Assessment** : Project Results Assessment / Product Assessment	Mid Semester Exam 2 X 50	Mid Semester Exam 2 x 50	**Material:** Meeting material 1-7 **References:**	20%

9	Become able to understand planetary waves in the atmosphere, propagation and interaction of Rossby and Kelvin waves	Students can explain planetary waves in the atmosphere, propagation and interaction of Rossby and Kelvin waves.	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Class discussion Q & A 2 X 50	virtual face-to-face lectures with Google meet 2 x 50	**Material:** Propagation and interaction of Rossby and Kelvin waves; Ionospheric currents **Bibliography:** *Ahrens, CD 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526.*	2%
10	Being able to understand the effects of air-sea interactions with respect to wind-forcing patterns on atmospheric conditions at local, regional and global scales	Students can explain the effects of air-sea interactions with respect to wind-forcing patterns on atmospheric conditions at local, regional and global scales.	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Class discussion Q & A 2 X 50	virtual face-to-face lectures with Google meet 2 x 50	**Material:** A coupled system of the ocean and atmosphere; Air-sea interaction; Wind-forced pattern; Weather and climate systems; El-Nino and La-Nina **Bibliography:** *Ahrens, CD 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526.*	2%
11	Being able to understand the effects of air-sea interactions with respect to wind-forcing patterns on atmospheric conditions at local, regional and global scales	Students can explain the effects of air-sea interactions with respect to wind-forcing patterns on atmospheric conditions at local, regional and global scales.	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Class discussion Q & A 2 X 50	Virtual face-to-face lectures with Google Meet	**Material:** A coupled system of the ocean and atmosphere; Air-sea interaction; Wind-forced pattern; Weather and climate systems; El-Nino and La-Nina **Bibliography:** *Ahrens, CD 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526.*	2%
12	Being able to understand potential threats from atmospheric hazards associated with a coupled system of ocean hydrological cycle and atmospheric dynamics	Students can explain potential threats from atmospheric hazards associated with a coupled system of ocean hydrological cycle and atmospheric dynamics.	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Class discussion Q & A 2 X 50	Virtual face-to-face lectures with Google meet 2 x 50	**Material:** Hydrometeorological hazards; Extreme weather, excessive rainfall; Floods and droughts; Forest fires; Atmospheric storms **Bibliography:** *Ahrens, CD 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526.*	2%
13	Being able to understand potential threats from atmospheric hazards associated with a coupled system of ocean hydrological cycle and atmospheric dynamics	Students can explain potential threats from atmospheric hazards associated with a coupled system of ocean hydrological cycle and atmospheric dynamics.	**Criteria:** Complete tasks on time **Form of Assessment** : Participatory Activities	Contextual Learning Class discussion Q & A 2 X 50	virtual face-to-face lectures with Google meet 2 x 50	**Material:** Hydrometeorological hazards; Extreme weather, excessive rainfall; Floods and droughts; Forest fires; Atmospheric storms **Bibliography:** *Ahrens, CD 2011. Essentials of Meteorology: An Invitation to the Atmosphere. Melbourne, Australia: Cengage Learning, pp.1-526.*	2%

14	Being able to understand posters relevant to atmospheric physics with emphasis upon the crucial role of the atmosphere in weather and climate systems at local, regional and global scales	Students can explain posters relevant to atmospheric physics with emphasis upon the crucial role of the atmosphere in weather and climate systems at local, regional and global scales.	**Criteria:** Complete tasks on time **Form of Assessment** : Project Results Assessment / Product Assessment	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 **References:**	30%
15	Being able to understand posters relevant to atmospheric physics with emphasis upon the crucial role of the atmosphere in weather and climate systems at local, regional and global scales	Students can explain posters relevant to atmospheric physics with emphasis upon the crucial role of the atmosphere in weather and climate systems at local, regional and global scales.	**Criteria:** Complete tasks on time **Form of Assessment** : Project Results Assessment / Product Assessment	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 **References:**	30%
16	Final Exam	Final Exam	**Criteria:** Complete tasks on time	Final Exam 2 x 50	Final Exam 2 x 50	**Material:** Poster presentation **References:**	30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	20%
2.	Project Results Assessment / Product Assessment	80%
		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.