	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
Wave	4520103084		T=3	P=0	ECTS=4.77	4	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	.....	.....	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**	
	Program Objectives (PO)	
	PO - 1	Solving learning problems through learning approaches that are appropriate to the conditions of students, characteristics of learning materials, and the learning environment.
	PO - 2	Students are able to formulate vibration systems and implement high-level thinking processes (critical, creative, logical and problem solving
	PO - 3	Applying the knowledge and skills acquired during postgraduate studies through various activities, including: teaching practice, providing workshop mentoring training, internships at certain institutions (educational/non-educational), or participating in activities abroad, for example site in, short course, credit earning or as an international seminar presenter abroad
	PLO-PO Matrix	

P.O
PO-1
PO-2
PO-3

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																

Short Course Description	The Waves course studies the physical concepts of wave motion and relevant mathematical equations, a set of Maxwell's equations, generation and propagation of electromagnetic waves, Poynting vectors and intensity of electromagnetic waves, electromagnetic pressure and momentum, geometric aspects of light propagation, phenomena of transmission, reflection and refraction of electromagnetic waves, Snellius and Fresnel laws, conservation of energy in the propagation of electromagnetic waves meeting a surface, superposition of waves with the same and different frequencies, Fourier transform, pulses and wave packets, bandwidth and coherence length, physical optical phenomena of electromagnetic wave propagation including polarization, interference and diffraction .	
References	**Main :**	

1. Prastowo, T. 2017. Lecture Notes on Waves. unpublished work.
2. Pain, H. J. 2005. Introduction to Modern Optics. West Sussex, UK: John Wiley and Sons.
3. Hecht, E. 2002. Optics. San Fransisco, US: Addison Wesley.
4. Tippler, P. A. 1999. Physics for Scientists and Engineers. New York, US: W. H. Freemann.

Supporters:

Supporting lecturer	Dr. Titin Sunarti, M.Si. Abu Zainuddin, S.Pd., M.Pd. Lydia Rohmawati, S.Si., M.Si. Dr. Rohim Aminullah Firdaus, S.Pd, M.Si Dr. Fitriana, S.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	Able to understand the concept of wave motion as the propagation of energy in space and time and understand the mathematical functions that represent waves	Students are able to explain the concept of wave motion as the propagation of energy in space and time and understand the mathematical functions that represent waves	**Form of Assessment** : Participatory Activities	• Lecture• Discussion• Question and answer 3 X 50		**Material:** Akira Hirose, Introduction to Wave Phenomena, John Willey & Sons. Inc. 1985 **References:**	0%
2	Able to understand Maxwell's equations, understand the theory of EM wave propagation in air and the nature of EM gel transversality, understand the Poynting vector to describe the propagation of EM energy, and understand the propagation of EM waves in materials	Students are able to explain Maxwell's equations, explain the theory of EM wave propagation in air and the nature of EM gel transversality, explain the Poynting vector to describe the propagation of EM energy, and explain the propagation of EM waves in materials; able to express one's own opinion and accept the opinions of others and apply new understanding in the learning process	**Criteria:** A mark of 100 if the question is answered well and correctly	• Lecture• Discussion• Question and answer 3 X 50			0%
3	Able to understand Maxwell's equations, understand the theory of EM wave propagation in air and the nature of EM gel transversality, understand the Poynting vector to describe the propagation of EM energy, and understand the propagation of EM waves in materials	Students are able to explain Maxwell's equations, explain the theory of EM wave propagation in air and the nature of EM gel transversality, explain the Poynting vector to describe the propagation of EM energy, and explain the propagation of EM waves in materials; able to express one's own opinion and accept the opinions of others and apply new understanding in the learning process	**Criteria:** A mark of 100 if the question is answered well and correctly	• Lecture• Discussion• Question and answer 3 X 50			0%

4	Able to understand Maxwell's equations, understand the theory of EM wave propagation in air and the nature of EM gel transversality, understand the Poynting vector to describe the propagation of EM energy, and understand the propagation of EM waves in materials	Students are able to explain Maxwell's equations, explain the theory of EM wave propagation in air and the nature of EM gel transversality, explain the Poynting vector to describe the propagation of EM energy, and explain the propagation of EM waves in materials; able to express one's own opinion and accept the opinions of others and apply new understanding in the learning process	**Criteria:** A mark of 100 if the question is answered well and correctly	• Lecture• Discussion• Question and answer 3 X 50			0%
5	Able to understand the propagation of light through the boundary between two media, understand the laws of reflection and refraction, Snellius' law and Fresnel's equation, the law of conservation of energy in the propagation of light waves	Students are able to explain the propagation of light through the boundary plane between two media, explain the laws of reflection and refraction, Snellius' law and Fresnel's equation, the law of conservation of energy in the propagation of light waves; able to express one's own opinion and accept the opinions of others and apply new understanding in the learning process	**Criteria:** A mark of 100 if the question is answered well and correctly	• Lecture• Discussion• Question and answer• Assignment 3 X 50			0%
6	Able to understand the propagation of light through the boundary between two media, understand the laws of reflection and refraction, Snellius' law and Fresnel's equation, the law of conservation of energy in the propagation of light waves	Students are able to explain the propagation of light through the boundary plane between two media, explain the laws of reflection and refraction, Snellius' law and Fresnel's equation, the law of conservation of energy in the propagation of light waves; able to express one's own opinion and accept the opinions of others and apply new understanding in the learning process	**Criteria:** A mark of 100 if the question is answered well and correctly	• Lecture• Discussion• Question and answer• Assignment 3 X 50			0%

7	Able to understand the propagation of light through the boundary between two media, understand the laws of reflection and refraction, Snellius' law and Fresnel's equation, the law of conservation of energy in the propagation of light waves	Students are able to explain the propagation of light through the boundary plane between two media, explain the laws of reflection and refraction, Snellius' law and Fresnel's equation, the law of conservation of energy in the propagation of light waves; able to express one's own opinion and accept the opinions of others and apply new understanding in the learning process	**Criteria:** A mark of 100 if the question is answered well and correctly	• Lecture• Discussion• Question and answer• Assignment 3 X 50			0%
8	Able to understand USS questions well	Students are able to solve USS questions well	**Criteria:** Score 100 if the USS question is answered correctly	• Written test, open book • Discussion on USS 3 X 50 questions			0%
9	Able to understand the superposition of waves with the same and different frequencies, understand periodic and non-periodic waves, understand the Fourier transform in digital communication systems, pulses and packet waves	Students are able to explain the superposition of waves with the same and different frequencies, explain periodic and non-periodic waves, explain the Fourier transform in digital communication systems, pulses and packet waves; able to express one's own opinion and accept the opinions of others and apply new understanding in the learning process	**Criteria:** A mark of 100 if the question is answered well and correctly	• Lecture• Discussion• Question and answer• Assignment 3 X 50			0%
10	Able to understand the superposition of waves with the same and different frequencies, understand periodic and non-periodic waves, understand the Fourier transform in digital communication systems, pulses and packet waves	Students are able to explain the superposition of waves with the same and different frequencies, explain periodic and non-periodic waves, explain the Fourier transform in digital communication systems, pulses and packet waves; able to express one's own opinion and accept the opinions of others and apply new understanding in the learning process	**Criteria:** A mark of 100 if the question is answered well and correctly	• Lecture• Discussion• Question and answer• Assignment 3 X 50			0%

11	Able to understand the superposition of waves with the same and different frequencies, understand periodic and non-periodic waves, understand the Fourier transform in digital communication systems, pulses and packet waves	Students are able to explain the superposition of waves with the same and different frequencies, explain periodic and non-periodic waves, explain the Fourier transform in digital communication systems, pulses and packet waves; able to express one‘s own opinion and accept the opinions of others and apply new understanding in the learning process	**Criteria:** A mark of 100 if the question is answered well and correctly	• Lecture• Discussion• Question and answer• Assignment 3 X 50			0%
12	Able to understand the symptoms of light polarization, types of polarization, mathematical tools to describe types of light polarization (vectors and Jones matrices)	Students are able to explain the symptoms of light polarization, types of polarization, explain mathematical tools to describe types of light polarization (vectors and Jones matrices); able to express one‘s own opinion and accept the opinions of others in groups and classes as well as apply new understanding in the learning process	**Criteria:** A mark of 100 if the question is answered well and correctly	• Lecture• Discussion• Question and answer• Assignment 3 X 50			0%
13	Able to understand the symptoms of light polarization, types of polarization, mathematical tools to describe types of light polarization (vectors and Jones matrices)	Students are able to explain the symptoms of light polarization, types of polarization, explain mathematical tools to describe types of light polarization (vectors and Jones matrices); able to express one‘s own opinion and accept the opinions of others in groups and classes as well as apply new understanding in the learning process	**Criteria:** A mark of 100 if the question is answered well and correctly	• Lecture• Discussion• Question and answer• Assignment 3 X 50			0%

14	Able to understand the symptoms of light interference, maximum and minimum interference requirements, discuss Young's experiments	Students are able to explain the symptoms of light interference, maximum and minimum interference requirements, discuss Young's experiments; able to express one's own opinion and accept the opinions of others in groups and classes as well as apply new understanding in the learning process		• Lecture• Discussion• Question and answer 3 X 50			0%
15	Able to understand the phenomena of light diffraction, maximum and minimum diffraction requirements, discuss Fraunhoffer diffraction experiments	Students are able to explain the phenomena of light diffraction, maximum and minimum diffraction requirements, discuss Fraunhoffer diffraction experiments; able to express one's own opinion and accept the opinions of others in groups and classes as well as apply new understanding in the learning process		• Lecture• Discussion• Question and answer 3 X 50			0%
16							0%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
		0%

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.