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

SEMESTER LEARNING PLAN

Courses	**CODE**	**Course Family**	**Credit Weight**			**SEMESTER**	**Compilation Date**
Mathematical Physics II	8420303238	Compulsory Study Program Subjects	**T=3**	**P=0**	**ECTS=4.77**	2	July 17, 2024

AUTHORIZATION	**SP Developer**	**Course Cluster Coordinator**	**Study Program Coordinator**
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Learning model	**Case Studies**

Program Learning Outcomes (PLO)

PLO study program which is charged to the course

Program Objectives (PO)

PO - 1	Students master the knowledge of classical and modern physics to identify the properties of a simple physical system using a mathematical physics approach.
PO - 2	Students are able to formulate a simple physical system into mathematical model using relevant symbolic/numeric language.
PO - 3	Students are able to use high order thinking processes to form solutions from the simple physical model.
PO - 4	Students are able to apply scientific manners, critical thinking, and innovation skills to examine physics learning problems using mathematics.

PLO-PO Matrix

P.O
PO-1
PO-2
PO-3
PO-4

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																

Short Course Description

This course examines infinite series, complex numbers, partial differentials, ordinary differential equations, and vector analysis through active learning by combining the methods of discussion, questions and answers, also assignments using IT (Python).

References

Main :

1. Mary L. Boas. 2006. Mathematical Methods in the Physical Science . 3th edition. New York: John Wiley & Sons.
2. Arfken, G. 1995. Mathematical Methods for Physicists . Academic Press.
3. Trigs, G.L. 2000. Mathematical tools for Physicist . Wiley-Velt Verlag.

Supporters:

Supporting lecturer	Dr. Zainul Arifin Imam Supardi, M.Si. Dzulkiflih, S.Si., M.T. Nugrahani Primary Putri, S.Si., M.Si. Dr. Rohim Aminullah Firdaus, S.Pd, M.Si Dr. Eng. Evi Suaebah, M.Si., M.Sc. Arie Realita, M.Si. Dr. Muhimmatul Khoiro, 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	1. Students master knowledge of infinite series and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language in infinite series 3. Students are able to use high order thinking processes to form solutions from the simple physical models related to mechanics and thermodynamics. 4. Students are able to apply scientific manners, critical thinking, and innovation skills to examine mechanics and thermodynamics learning problems at high school using mathematics.	1. 1. Students are able to undertake convergence test of a series. 2. 2. Students are able to analyze a function into power series. 3. 3. Students are able to solve mechanics and thermodynamics problems using series concept.	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 1 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	2%

2	1. Students master knowledge of infinite series and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language in infinite series 3. Students are able to use high order thinking processes to form solutions from the simple physical models related to mechanics and thermodynamics. 4. Students are able to apply scientific manners, critical thinking, and innovation skills to examine mechanics and thermodynamics learning problems at high school using mathematics.	1. 1. Students are able to undertake convergence test of a series. 2. 2. Students are able to analyze a function into power series. 3. 3. Students are able to solve mechanics and thermodynamics problems using series concept.	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 1 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	3%
3	1. Students master knowledge of infinite series and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language in infinite series 3. Students are able to use high order thinking processes to form solutions from the simple physical models related to mechanics and thermodynamics. 4. Students are able to apply scientific manners, critical thinking, and innovation skills to examine mechanics and thermodynamics learning problems at high school using mathematics.	1. 1. Students are able to undertake convergence test of a series. 2. 2. Students are able to analyze a function into power series. 3. 3. Students are able to solve mechanics and thermodynamics problems using series concept.	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 1 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	5%

4	1. Students master the knowledge of complex numbers and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language on complex numbers 3. Students are able to use high order thinking processes to form solutions from the simple physical models related to mechanics and thermodynamics. 4. Students are able to apply scientific manners, critical thinking, and innovation skills to examine mechanics and thermodynamics learning problems at high school using mathematics.	1. Students are able to perform complex algebraic operations	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 2 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	2%
5	1. Students master the knowledge of complex numbers and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language on complex numbers 3. Students are able to use high order thinking processes to form solutions from the simple physical models related to mechanics and thermodynamics. 4. Students are able to apply scientific manners, critical thinking, and innovation skills to examine mechanics and thermodynamics learning problems at high school using mathematics.	2. Students are able to solve problems related to complex series, exponential functions.	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 2 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	3%

6	1. Students master the knowledge of complex numbers and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language on complex numbers 3. Students are able to use high order thinking processes to form solutions from the simple physical models related to mechanics and thermodynamics. 4. Students are able to apply scientific manners, critical thinking, and innovation skills to examine mechanics and thermodynamics learning problems at high school using mathematics.	3. Students are able to solve problems related to complex series, exponential functions, logarithms, trigonometry, and hyperbolic complexes.	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 2 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	5%
7	1. Students master the knowledge of complex numbers and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language on complex numbers 3. Students are able to use high order thinking processes to form solutions from the simple physical models related to mechanics and thermodynamics. 4. Students are able to apply scientific manners, critical thinking, and innovation skills to examine mechanics and thermodynamics learning problems at high school using mathematics.	4. Students are able to apply complex numbers to solve physics problems	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 2 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	5%

8	Students are able to understand and apply material on infinite series and complex numbers in solving problems related to classical and modern physics	Students are able to apply material on infinite series and complex numbers in solving problems related to classical and modern physics	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Test	UTS 2 x 50	UTS 2 x 50	**Material:** Ch1 and 2 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	20%
9	1. Students master partial differential knowledge and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language in partial differentials 3. Students are able to use high order thinking processes to form solutions from the simple physical models related to mechanics and thermodynamics. 4. Students are able to apply scientific manners, critical thinking, and innovation skills to examine mechanics and thermodynamics learning problems at high school using mathematics.	1. 1. Students are able to execute partial differential using chain rules. 2. 2. Students are able to execute implicit differentiation, change variables and limit requirements	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 4 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	2%

10	1. Students master partial differential knowledge and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language in partial differentials 3. Students are able to use high order thinking processes to form solutions from the simple physical models related to mechanics and thermodynamics. 4. Students are able to apply scientific manners, critical thinking, and innovation skills to examine mechanics and thermodynamics learning problems at high school using mathematics.	1. 3. Students are able to look for minimum and maximum value of a function 2. 4. Students are able to solve mechanics and thermodynamics problems using partial differential concepts	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 4 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	5%
11	1. Students master the knowledge of ordinary differential equations and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language in partial differential equations 3. Students are able to use high order thinking processes to form solutions from the simple physical models related to mechanics and thermodynamics. 4. Students are able to apply scientific manners, critical thinking, and innovation skills to examine mechanics and thermodynamics learning problems at high school using mathematics.	1. 1. Students are able to identify first and second order differential equations related to physics concepts particularly mechanics and thermodynamics. 2. 2. Students are able to solve first order differential equations. 3. 3. Students are able to find solutions for first order differential equations in physics problems.	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 8 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	2%

12	1. Students master the knowledge of ordinary differential equations and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language in partial differential equations 3. Students are able to use high order thinking processes to form solutions from the simple physical models related to mechanics and thermodynamics. 4. Students are able to apply scientific manners, critical thinking, and innovation skills to examine mechanics and thermodynamics learning problems at high school using mathematics.	1. 1. Students are able to solve second order differential equations. 2. 2. Students are able to find solutions for second order differential equations in physics problems. 3. 3. Students are able to apply ordinary differential equations to solve physics problems in accordance with the concepts of mechanics and thermodynamics.	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 8 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	3%
13	1. Students master the knowledge of ordinary differential equations and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language in partial differential equations 3. Students are able to use high order thinking processes to form solutions from the simple physical models related to mechanics and thermodynamics. 4. Students are able to apply scientific manners, critical thinking, and innovation skills to examine mechanics and thermodynamics learning problems at high school using mathematics.	1. 1. Students are able to solve second order differential equations. 2. 2. Students are able to find solutions for second order differential equations in physics problems. 3. 3. Students are able to apply ordinary differential equations to solve physics problems in accordance with the concepts of mechanics and thermodynamics.	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 8 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	5%

14	1. Students master PDP knowledge and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language on the PDP 3. Students are able to work both individually and in groups to find solutions to simple physical models related to modern and classical physics using PDP material 4. Students are able to use a scientific attitude, critical thinking and innovation skills to study the problems of learning magnetic electricity, modern physics and waves in secondary schools with the help of mathematics	1. 1. Students are able to explain the types of partial differential equations 2. 2. Students are able to solve the 2-dimensional (2D) Laplace equation 3. 3. Students are able to solve the 1-dimensional (1D) wave equation 4. 7. Students are able to describe 2-dimensional (2D) temperature distributions using the Python program	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 13 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	5%
15	1. Students master PDP knowledge and can apply it to solving classical and modern physics problems 2. Students are able to formulate simple physical system problems related to classical physics and modern physics into mathematical models using symbolic/numerical language on the PDP 3. Students are able to work both individually and in groups to find solutions to simple physical models related to modern and classical physics using PDP material 4. Students are able to use a scientific attitude, critical thinking and innovation skills to study the problems of learning magnetic electricity, modern physics and waves in secondary schools with the help of mathematics	1. 1. Students are able to explain the types of partial differential equations 2. 2. Students are able to solve the 2-dimensional (2D) Laplace equation 3. 3. Students are able to solve the 1-dimensional (1D) wave equation 4. 7. Students are able to describe 2-dimensional (2D) temperature distributions using the Python program	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities	Lectures, discussions and assignments 3 x 50	Lectures, discussions and assignments 3 x 50	**Material:** Ch 13 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*	5%

16		Students are able to apply PDB and PDP solution material in solving problems related to classical and modern physics	**Criteria:** Students will get full marks if they meet the assessment indicators	UAS 2 x 50	UAS 2 x 50	**Material:** Ch 12 & 13 **Bibliography:** *Mary L. Boas. 2006. Mathematical Methods in the Physical Science. 3rd edition. New York: John Wiley & Sons.*		20%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	31%
2.	Portfolio Assessment	21%
3.	Test	20%
		72%

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** abilities in the process and student learning outcomes are specific and measurable statements that identify the abilities 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.