	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
Mathematical Physics II	4520104069	Compulsory Study Program Subjects	T=4	P=0	ECTS=6.36	3	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Nugrahani Primary Putri, M.Si.	Nugrahani Primary Putri, M.Si.	Prof. Dr. Munasir, S.Si., M.Si.

Learning model: **Case Studies**

Program Learning Outcomes (PLO)

PLO study program which is charged to the course

PLO-9	Able to work as an individual or team effectively, have entrepreneurial skills, and care about environmental issues.
PLO-10	Analyze physical systems by applying mathematics and computing/ICT tools.

Program Objectives (PO)

PO - 1	Students are able to formulate simple physical systems related to classical physics into mathematical models using relevant symbolic/numerical language.
PO - 2	Students are able to solve problems in simple physical systems related to classical physics using mathematical physics and computational approaches.
PO - 3	Students are able to analyze a simple physical system related to classical physics using mathematical physics and computational approaches.

PLO-PO Matrix

P.O	PLO-9	PLO-10
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

This course examines: Complex numbers, Fourier series, special functions, solutions to differential equations, and partial differential equations through active learning with a combination of discussion methods, questions and answers and IT-assisted assignments.

References

Main :

1. Boas, M.L., , 2006, Mathematical Methods in the Physical Science, edisi 3, John Wiley & Sons, New York.
2. Arfken, G., 1995, Mathematical Methods for Physicists, Academic Press.
3. Trigs, G.L., 2000, Mathematical tools for Physicist, Wiley-Velt Verlag.
4. Riley, K.F., Hobson, M.P., Bence, S.J. 2006. Mathematical Methods for Physics and Engineering, edisi 3, Cambridge Univ. Press.
5. Hassani, Sadri. 2009. Mathematical methods for students of physics and related fields, 2nd ed. Springer, Illinois.

Supporters:

	1. software phyton
Supporting lecturer	Dr. Zainul Arifin Imam Supardi, M.Si. Nugrahani Primary Putri, S.Si., 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	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical systems related to classical physics into mathematical models, using complex numbers and computational tools.	1. Students are able to perform complex algebraic operations 2. Students are able to solve problems related to complex series, exponential functions, logarithms, trigonometry, and hyperbolic complexes. 3. 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 on the topic of complex numbers 4 X 50	Lectures, discussions and assignments on the topic of complex numbers 4 x 50	**Material:** Ch 2 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.*	2%
2	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical systems related to classical physics into mathematical models, using complex numbers and computational tools.	1. Students are able to perform complex algebraic operations 2. Students are able to solve problems related to complex series, exponential functions, logarithms, trigonometry, and hyperbolic complexes. 3. Students are able to apply complex numbers to solve physics problems	**Criteria:** Students get full marks if they can solve all complex number problems **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments on the topic of complex numbers 4 X 50	Lectures, discussions and assignments on the topic of complex numbers 4 x 50	**Material:** Ch 3 **References:** *Trigs, GL, 2000, Mathematical tools for Physicists, Wiley-Velt Verlag.*	3%

3	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical systems related to classical physics into mathematical models, using complex numbers and computational tools.	1. Students are able to perform complex algebraic operations 2. Students are able to solve problems related to complex series, exponential functions, logarithms, trigonometry, and hyperbolic complexes. 3. Students are able to apply complex numbers to solve physics problems	**Form of Assessment** : Portfolio Assessment	Lectures, discussions and assignments on the topic of complex numbers 4 X 50	Lectures, discussions and assignments on the topic of complex numbers 4 x 50	**Material:** Ch. 20 **References:** *Riley, KF, Hobson, MP, Bence, SJ 2006. Mathematical Methods for Physics and Engineering, 3rd edition, Cambridge Univ. Press.*	4%
4	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical system problems related to classical physics into mathematical models using Fourier series and computational tools	1. Students are able to determine the average value of a function 2. Students are able to identify the periodic function and the periodicity of a function 3. Students are able to determine the value of the coefficient of the Fourier. series 4. Students are able to identify odd and even functions 5. Students can change the form of Fourier series to complex form 6. Students can solve Fourier series with different intervals	**Criteria:** Students get full marks if they can solve all Fourier series problems **Form of Assessment** : Portfolio Assessment	Lectures, discussions and assignments 4 X 50	Lectures, discussions and assignments 4 X 50	**Material:** Ch. 7 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.* **Material:** Ch 3 **References:** *Arfken, G., 1995, Mathematical Methods for Physicists, Academic Press.* **Material:** Ch 12 **References:** *Trigs, GL, 2000, Mathematical tools for Physicists, Wiley-Velt Verlag.*	4%

5	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical system problems related to classical physics into mathematical models using Fourier series and computational tools	1. Students are able to determine the average value of a function 2. Students are able to identify the periodic function and the periodicity of a function 3. Students are able to determine the value of the coefficient of the Fourier. series 4. Students are able to identify odd and even functions 5. Students can change the form of Fourier series to complex form 6. Students can solve Fourier series with different intervals	**Criteria:** Students get full marks if they can solve all Fourier series problems **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments 4 X 50	Lectures, discussions and assignments 4 X 50	**Material:** Ch. 7 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.* **Material:** Ch 3 **References:** *Arfken, G., 1995, Mathematical Methods for Physicists, Academic Press.* **Material:** Ch 12 **References:** *Trigs, GL, 2000, Mathematical tools for Physicists, Wiley-Velt Verlag.*	3%
6	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical system problems related to classical physics into mathematical models using Fourier series and computational tools	1. Students are able to determine the average value of a function 2. Students are able to identify the periodic function and the periodicity of a function 3. Students are able to determine the value of the coefficient of the Fourier. series 4. Students are able to identify odd and even functions 5. Students can change the form of Fourier series to complex form 6. Students can solve Fourier series with different intervals	**Criteria:** Students get full marks if they can solve all Fourier series problems **Form of Assessment** : Portfolio Assessment	Lectures, discussions and assignments 4 X 50	Lectures, discussions and assignments 4 X 50	**Material:** Ch. 7 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.* **Material:** Ch 3 **References:** *Arfken, G., 1995, Mathematical Methods for Physicists, Academic Press.* **Material:** Ch 12 **References:** *Trigs, GL, 2000, Mathematical tools for Physicists, Wiley-Velt Verlag.*	3%

7	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical systems related to classical physics into mathematical models using special functions and computational tools.	Students are able to perform integral solutions using the gamma and beta functions	**Criteria:** Students get full marks if they can solve Gamma and Beta functions problems **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions and assignments on the topic Special Functions 4 x 50	Lectures, discussions and assignments on the topic Special Functions 4 x 50	**Material:** Ch 11 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.*	4%
8	Students can understand complex numbers and Fourier series material, and can apply it when solving physics problems	Students can solve physics problems related to complex numbers and Fourier series	**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:** Ch 2 &7 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.*	20%
9	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical systems related to classical physics into mathematical models using special functions and computational tools.	1. Students are able to perform integral solutions using elliptic functions 2. Students are able to apply the concepts of gamma, beta, error functions and elliptic functions to solve physics problems	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Discussion and assignment 4 x 50	Discussion and assignment 4 x 50	**Material:** Ch 11 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.* **Material:** Ch 18 **Bibliography:** *Trigs, GL, 2000, Mathematical tools for Physicists, Wiley-Velt Verlag.*	3%
10	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical systems related to classical physics into mathematical models using partial differential equations and computational tools.	1. Students are able to solve differential equations related to physics concepts using Legendre polynomials 2. Students are able to solve differential equations related to physics concepts using Bessel polynomials 3. Students are able to solve differential equations related to physics concepts using the Hermite and Laguerre functions	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Discussion and assignment 4 x 50	Discussion and assignment 4 x 50	**Material:** Ch 12 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.*	3%

11	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical systems related to classical physics into mathematical models using partial differential equations and computational tools.	1. Students are able to solve differential equations related to physics concepts using Legendre polynomials 2. Students are able to solve differential equations related to physics concepts using Bessel polynomials 3. Students are able to solve differential equations related to physics concepts using the Hermite and Laguerre functions	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Discussion and assignment 4 x 50	Discussion and assignment 4 x 50	**Material:** Ch 12 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.*	4%
12	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical systems related to classical physics into mathematical models using partial differential equations and computational tools.	1. Students are able to solve differential equations related to physics concepts using Legendre polynomials 2. Students are able to solve differential equations related to physics concepts using Bessel polynomials 3. Students are able to solve differential equations related to physics concepts using the Hermite and Laguerre functions	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Discussion and assignment 4 x 50	Discussion and assignment 4 x 50	**Material:** Ch 12 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.*	5%

13	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical systems related to classical physics into mathematical models using partial differential equations and computational tools.	1. 1. Students are able to explain the types of partial differential equations 2. 2. Students are able to solve 2-dimensional (2D) Laplace equations 3. 3. Students are able to solve 1-dimensional (1D) wave equations 4. 4. Students are able to solve steady-state temperature distribution in cylindrical rods	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Discussion and assignment 4 x 50	Discussion and assignment 4 x 50	**Material:** Ch 13 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.*	5%
14	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical systems related to classical physics into mathematical models using partial differential equations and computational tools.	1. 1. Students are able to explain the types of partial differential equations 2. 2. Students are able to solve 2-dimensional (2D) Laplace equations 3. 3. Students are able to solve 1-dimensional (1D) wave equations 4. 4. Students are able to solve steady-state temperature distribution in cylindrical rods	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Discussion and assignment 4 x 50	Discussion and assignment 4 x 50	**Material:** Ch 13 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.*	3%
15	Students are able to formulate, able to solve problems, and able to analyze problems of simple physical systems related to classical physics into mathematical models using partial differential equations and computational tools.	1. 1. Students are able to explain the types of partial differential equations 2. 2. Students are able to solve 2-dimensional (2D) Laplace equations 3. 3. Students are able to solve 1-dimensional (1D) wave equations 4. 4. Students are able to solve steady-state temperature distribution in cylindrical rods	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Participatory Activities, Portfolio Assessment	Discussion and assignment 4 x 50	Discussion and assignment 4 x 50	**Material:** Ch 13 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.*	4%

16		Students can solve physics problems related to special functions, solutions to differential equations and partial differential equations	**Criteria:** Students will get full marks if they meet the assessment indicators **Form of Assessment** : Test	UAS 2 x 50	UAS 2 x 50	**Material:** Ch 11, 12, 13 **References:** *Boas, ML, , 2006, Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.*	30%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	19.5%
2.	Portfolio Assessment	30.5%
3.	Test	50%
		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.