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 I	8420303235	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	Have the ability to formulate physical systems using appropriate mathematical methods and modeling to qualitatively analyze physical problems.
PO - 2	Have the ability to use physics concepts, mathematical methods and appropriate mathematical modeling to obtain quantitative solutions to physics problems.
PO - 3	Have the ability to analyze physical systems by applying appropriate mathematical and modeling methods.
PO - 4	Able to think critically in solving physics problems using appropriate mathematical methods

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: linear functions and transcendent functions and their graphs, function limits, ordinary and partial differentials, function integrals and line integrals, vector analysis, and curvilinear coordinates through active learning using the case study method.

References

Main :

1. Varberg, Purcell, and Rigdon. 2021. Calculus, 9th ed.
2. Boas, M.L. 2006. Mathematical Methods in the Physical Science, edisi 3, John Wiley & Sons, New York.

Supporters:

1. Ayres and Mendelson. 2013. Calculus, Schaum outlines, 6th ed.
2. Larson and Edwards. 2010. Calculus of single variable, 9th ed.
3. Software geogebra

Supporting lecturer	Dr. Zainul Arifin Imam Supardi, M.Si. Prof. Dr. Munasir, S.Si., M.Si. Nugrahani Primary Putri, S.Si., M.Si. Setyo Admoko, S.Pd., M.Pd. Dr. Rohim Aminullah Firdaus, S.Pd, M.Si Dr. Eng. Evi Suaebah, M.Si., M.Sc. 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	1. Students are able to understand the concept of function graphs and their application to qualitatively analyze physics problems 2. Students are able to use the function graph method to obtain solutions to quantitative problems in physics	1. Students are able to identify linear, quadratic, cubic, trigonometric, logarithmic and exponential functions.	**Criteria:** . Accuracy in solving problems related to linear, polynomial, trigonometric, logarithmic and exponential functions. **Form of Assessment** : Portfolio Assessment	Lectures and discussions 3 x 50 minutes	Lectures and discussions 3 x 50	**Material:** 1. Linear functions, quadratic functions, cubic functions and their graphs **References:** *Varberg, Purcell, and Rigdon. 2021. Calculus, 9th ed.*	2%
2	1. Students are able to use the function graph method to analyze physics problems both qualitatively and quantitatively 2. Students are able to think critically in using the function graph method and apply it appropriately to solve physics problems	1. 2. Students are able to sketch and analyze graphs of linear, polynomial, trigonometric, logarithmic and exponential functions. 2. 3. Students are able to create appropriate mathematical models of physics problems/cases.	**Criteria:** Accuracy in solving physics problems using mathematical function modeling. **Form of Assessment** : Portfolio Assessment	Case study discussion 3 x 50 minutes	Case study discussion 3 x 50 minutes	**Material:** 2. Trigonometric, logarithmic, exponential functions and their graphs. **Bibliography:** *Ayres and Mendelson. 2013. Calculus, Schaum outlines, 6th ed.* **Material:** Graphs of quadratic, cubic, trigonometric, exponential and logarithmic functions. **Library:** *Geogebra software*	3%
3	1. Students are able to understand the concept of limits and its application to qualitatively analyze physics problems 2. Students are able to use the limit method to get solutions to quantitative problems in physics	1. Students are able to solve problems related to the limits of a function.	**Criteria:** Accuracy in solving problems related to limits **Form of Assessment** : Portfolio Assessment	Lectures and discussions 3 x 50 minutes	Lectures and discussions 3 x 50 minutes	**Material:** Limit Theorem **References:** *Varberg, Purcell, and Rigdon. 2021. Calculus, 9th ed.* **Material:** Limits of trigonometric functions **Reader:** *Ayres and Mendelson. 2013. Calculus, Schaum outlines, 6th ed.*	4%

4	1. Students are able to use the limit method to analyze physics problems both qualitatively and quantitatively 2. Students are able to think critically in using the limit method and apply it appropriately to solve physics problems	Students are able to solve physics problems using the limit approach.	**Criteria:** Accuracy in solving physics problems using the concept of limits. **Form of Assessment** : Portfolio Assessment	Case study discussion 3 x 50 minutes	Case study discussion 3 x 50 minutes	**Material:** Infinite limits **Reference:** *Larson and Edwards. 2010. Calculus of single variables, 9th ed.*	4%
5	Students are able to understand the concept of differentials and their application to qualitatively analyze physics problems	Students are able to solve differential problems on polynomial, trigonometric, exponential and logarithmic functions.	**Criteria:** Accuracy in solving differential problems **Form of Assessment** : Portfolio Assessment	Lectures and discussions 3 x 50 minutes	Lectures and discussions 3 x 50 minutes	**Material:** Differential polynomial, trigonometric, exponential, logarithmic functions. **Library:** *Varberg, Purcell, and Rigdon. 2021. Calculus, 9th ed.*	3%
6	1. Students are able to use differential methods to obtain solutions to quantitative problems in physics 2. Students are able to use differential methods to analyze physics problems both qualitatively and quantitatively	1. Students are able to solve partial and implicit differentiation problems using the chain rule 2. Students can solve problems related to maximum and minimum scores	**Criteria:** 1. Accuracy in solving differential problems 2. Accuracy in solving maximum and minimum value questions. **Form of Assessment** : Portfolio Assessment	Lectures and discussions 3 x 50 minutes	Lectures and discussions 3 x 50 minutes	**Material:** Partial differential, chain rule, implicit differential, total differential, maximum & minimum values **References:** *Boas, ML 2006. Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.* **Material:** Partial differential, chain rule, implicit differential, total differential, maximum & minimum values **Library:** *Ayres and Mendelson. 2013. Calculus, Schaum outlines, 6th ed.*	3%
7	Students are able to think critically in using differential methods and apply them appropriately to solve physics problems	Students can solve physics cases using differential concepts	**Criteria:** Accuracy in solving physics cases using differential concepts **Form of Assessment** : Portfolio Assessment	Case study discussion 3 x 50 minutes	Case study discussion 3 x 50 minutes	**Material:** Differential function graphs **Library:** *Geogebra software*	4%
8	1. Students are able to understand the concept of function graphs and their application to qualitatively analyze physics problems. 2. Students are able to	1. Students are able to create appropriate mathematical models of physics problems/cases. 2. Students are able to solve physics problems using	**Criteria:** 1. Accuracy in solving physics problems using mathematical function modeling. 2. Accuracy in solving physics problems using the concept of limits.	2 x 50 minute midterm exams	2 x 50 minute midterm exams	**Material:** Ch 0, 1, 2, 3 **References:** *Varberg, Purcell, and Rigdon. 2021. Calculus, 9th ed.* **Material:** Ch 4 **References:** *Boas, ML*	20%

	understand the concept of limits and its application to qualitatively analyze physics problems 3. Students are able to understand the concept of differentials and their application to qualitatively analyze physics problems 4. Students are able to use the function graph method to obtain solutions to quantitative problems in physics 5. Students are able to use the limit method to get solutions to quantitative problems in physics 6. Students are able to use differential methods to obtain solutions to quantitative problems in physics 7. Students are able to use the function graph method to analyze physics problems both qualitatively and quantitatively 8. Students are able to use the limit method to analyze physics problems both qualitatively and quantitatively 9. Students are able to use differential methods to analyze physics problems both qualitatively and quantitatively 10. Students are able to think critically in using the function graph method and apply it appropriately to solve physics problems 11. Students are able to think critically in using the limit method and apply it appropriately to solve physics problems 12. Students are able to think critically in using differential methods and apply them appropriately to	the limit approach. 3. Students can solve physics cases using differential concepts	3. Accuracy in solving physics cases using differential concepts. **Form of Assessment** : Test			*2006. Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.* **Material:** Ch 7, 9, 10, 11, 14, 25, 26 **Bibliography:** *Ayres and Mendelson. 2013. Calculus, Schaum outlines, 6th ed.* **Material:** Ch 1, 2, 3, 5 **Bibliography:** *Larson and Edwards. 2010. Calculus of single variables, 9th ed.*	

	solve physics problems						
9	Students are able to understand integral concepts and their application to qualitatively analyze physics problems	Students are able to integrate functions	**Criteria:** Accuracy in solving function integration problems **Form of Assessment** : Portfolio Assessment	Lectures and discussions 3 x 50 minutes	Lectures and discussions 3 x 50 minutes	**Material:** Integral function theorem **References:** *Varberg, Purcell, and Rigdon. 2021. Calculus, 9th ed.*	3%
10	1. Students are able to use integral methods to obtain solutions to quantitative problems in physics 2. Students are able to use integral methods to analyze physics problems both qualitatively and quantitatively	Students are able to carry out fold integration	**Criteria:** Accuracy in solving fold integration problems **Form of Assessment** : Portfolio Assessment	Lectures and discussions 3 x 50 minutes	Lectures and discussions 3 x 50 minutes	**Material:** Integration techniques **References:** *Boas, ML 2006. Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.*	3%
11	Students are able to think critically in using the integral method and apply it appropriately to solve physics problems	Students are able to apply integration concepts to solve physics cases	**Criteria:** Accuracy in solving physics cases using integral concepts **Form of Assessment** : Portfolio Assessment	Case study discussion 3 x 50 minutes	Case study discussion 3 x 50 minutes	**Material:** ch 3, 7, 8 **References:** *Ayres and Mendelson. 2013. Calculus, Schaum outlines, 6th ed.*	4%
12	1. Students are able to understand the concept of vector analysis and its application to qualitatively analyze physics problems 2. Students are able to use vector analysis methods to obtain solutions to quantitative problems in physics	1. Students are able to do vector algebra and determine the application of vector algebra in the field of physics 2. Students are able to differentiate vectors	**Criteria:** 1. Accuracy in solving physics problems related to vector algebra 2. Accuracy in solving physics problems related to vector differentiation **Form of Assessment** : Portfolio Assessment	Lectures and discussions 3 x 50 minutes	Lectures and discussions 3 x 50 minutes	**Material:** Vector algebra and differentiation **References:** *Varberg, Purcell, and Rigdon. 2021. Calculus, 9th ed.* **Material:** Ch 6 **References:** *Boas, ML 2006. Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.*	5%
13	1. Students are able to use vector analysis methods to analyze physics problems both qualitatively and quantitatively 2. Students are able to think critically in using vector analysis methods and apply them appropriately to solve physics problems	1. Students are able to determine the del operator in Cartesian coordinates 2. Students are able to perform vector operations on physics problems using vector operators	**Criteria:** Accuracy in solving physics problems using vector operators **Form of Assessment** : Portfolio Assessment	Lectures and discussions 3 x 50 minutes	Lectures and discussions 3 x 50 minutes	**Material:** Vector operators and vector operations **Library:** *Ayres and Mendelson. 2013. Calculus, Schaum outlines, 6th ed.*	5%

14	1. Students are able to understand the concept of coordinate transformation and its application to qualitatively analyze physics problems 2. Students are able to use the coordinate transformation method to obtain solutions to quantitative problems in physics	Students are able to determine vector components in cylindrical and spherical coordinates	**Criteria:** Accuracy in making a summary of vector component transformations from Cartesian to cylindrical coordinates, and Cartesian to spherical coordinates **Form of Assessment** : Portfolio Assessment	Lectures and discussions 3 x 50 minutes	Lectures and discussions 3 x 50 minutes	**Material:** Ch 1 **Bibliography:** *Ayres and Mendelson. 2013. Calculus, Schaum outlines, 6th ed.* **Material:** Cartesian coordinates, cylindrical coordinates, spherical coordinates **Reference:** *Geogebra software*	3%
15	1. Students are able to use the coordinate transformation method to analyze physics problems both qualitatively and quantitatively 2. Students are able to think critically in using the coordinate transformation method and apply it appropriately to solve physics problems	1. Students are able to determine the unit vector transformation from Cartesian coordinates to cylindrical and spherical coordinates 2. Students are able to analyze kinematic quantities in Cartesian, cylindrical and spherical coordinates.	**Criteria:** Accuracy in solving problems related to coordinate transformation **Form of Assessment** : Portfolio Assessment	Discussion and case study 3 x 50 minutes	Discussion and case study 3 x 50 minutes	**Material:** Ch 6 **Bibliography:** *Ayres and Mendelson. 2013. Calculus, Schaum outlines, 6th ed.*	4%
16	1. Students are able to understand integral concepts and their application to qualitatively analyze physics problems 2. Students are able to understand the concept of vector analysis and its application to qualitatively analyze physics problems 3. Students are able to understand the concept of coordinate transformation and its application to qualitatively analyze physics problems 4. Students are able to use integral methods to obtain solutions to quantitative problems in physics 5. Students are able to use vector analysis methods to obtain solutions to quantitative problems in physics 6. Students are	1. Students are able to apply integration concepts to solve physics cases 2. Students are able to perform vector operations on physics problems using vector operators 3. Students are able to analyze kinematic quantities in Cartesian, cylindrical and spherical coordinates.	**Criteria:** 1. Accuracy in solving physics cases using integral concepts 2. Accuracy in solving physics problems using vector operators 3. Accuracy in solving problems related to coordinate transformation **Form of Assessment** : Test	Final Exam Semester 2 x 50 minutes	Final Exam Semester 2 x 50 minutes	**Material:** Ch 4, 5, 11 **References:** *Varberg, Purcell, and Rigdon. 2021. Calculus, 9th ed.* **Material:** Ch 5, 6 **References:** *Boas, ML 2006. Mathematical Methods in the Physical Science, 3rd edition, John Wiley & Sons, New York.* **Material:** Ch 1, 2, 6, 29, 34, 39 **References:** *Ayres and Mendelson. 2013. Calculus, Schaum outlines, 6th ed.* **Material:** Ch 4, 7, 8 **Bibliography:** *Larson and Edwards. 2010. Calculus of single variables, 9th ed.*	30%

	able to use the coordinate transformation method to obtain solutions to quantitative problems in physics 7. Students are able to use integral methods to analyze physics problems both qualitatively and quantitatively 8. Students are able to use vector analysis methods to analyze physics problems both qualitatively and quantitatively 9. Students are able to use the coordinate transformation method to analyze physics problems both qualitatively and quantitatively 10. Students are able to think critically in using the integral method and apply it appropriately to solve physics problems 11. Students are able to think critically in using vector analysis methods and apply them appropriately to solve physics problems 12. Students are able to think critically in using the coordinate transformation method and apply it appropriately to solve physics problems						

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Portfolio Assessment	50%
2.	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.