	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
Mechanics	4520104127	Compulsory Study Program Subjects	T=4 P=0 ECTS=6.36	3	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model: Project Based Learning

Program Learning Outcomes (PLO)

PLO study program that is charged to the course

PLO-7	Communicate their ideas and/or research results in academic writing and speaking effectively.
PLO-11	Design and conduct experiments in physics learning by applying scientific methods

Program Objectives (PO)

PO - 1	Identify, apply, and analyze basic concepts of mechanics and vectors in mechanics problems
PO - 2	Representing phenomena of object motion systems in the form of simple mathematical physical models to solve object motion system problems
PO - 3	Demonstrate personal and interpersonal skills in solving problems with object motion systems
PO - 4	Demonstrate critical thinking skills in analyzing and solving object movement problems

PLO-PO Matrix

P.O	PLO-7	PLO-11
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: Study of basic concepts (space, time, mass, quantities, units and vectors), Newtonian mechanics (kinematics and particle dynamics), harmonic vibrations, central force field and gravitational field, transformation of reference frames, dynamics of particle systems and rigid body mechanics , Lagrangian mechanics and Hamiltonian equations by applying discussion methods, guided discovery, problem solving, and laboratory experimental activities to discover, understand, and apply mechanical concepts.

References

Main :

1. Greiner, W., 2004.Classical Mechanics-Point Particles and Relativity. Springer.
2. Fowles, G.R., 1999. Analytical Mechanics. New York: Saunders College Publishing
3. Arya, P. Atam, 1990. Introduction to Classical Mechanics. Prentice Hall.
4. Spiegel, M.R., 1982. Theory and Problems of Theoretical Mechanics. McGraw-Hill

Supporters:

1. Spiegel, M.R., 1982, Theory and Problems of Theoretical Mechanics, McGraw-Hill.

Supporting lecturer: Prof. Dr. Munasir, S.Si., M.Si.
Arie Realita, M.Si.
Dr. Fitriana, S.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	Analyze basic concepts of mechanics and vectors and apply them to physics problems	1.Identify vector quantities 2.Calculates the size of the product of two/more vectors 3.Determine the coordinate system transformation matrix 4.Apply vector derivatives to obtain derivative quantities from position vectors in various coordinate systems	**Criteria:** Get full marks if you can solve all the questions given **Form of Assessment** : Participatory Activities	Problem Solving Presentation Discussion 3 X 50 style table experiment		**Material:** Introduction to Classical Physics **Bibliography:** *Fowles, GR, 1999. Analytical Mechanics. New York: Saunders College Publishing*	3%
2	Analyze basic concepts of mechanics and vectors and apply them to physics problems	1.Identify vector quantities 2.Calculates the size of the product of two/more vectors 3.Determine the coordinate system transformation matrix 4.Apply vector derivatives to obtain derivative quantities from position vectors in various coordinate systems	**Criteria:** Get full marks if you can solve all the questions given **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Problem Solving Presentation Discussion 3 X 50 style table experiment		**Material:** Particle Kinematics (in 3-D Space) **References:** *Fowles, GR, 1999. Analytical Mechanics. New York: Saunders College Publishing*	3%
3	Analyzing Newton's laws as basic concepts of dynamics and dynamics problems	1.Determine the relationship between momentum and force experienced by particles 2.Determine the identity of particle motion (position, velocity, acceleration) under the influence of various forms of force 3.Solving dynamic problems in a coherent and correct manner	**Criteria:** Presentation: 40 % Q&A: 30 % Paper: 30 % **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	DiscussionDirect Learning (DI)Problem solvingIndividual assignment Newton's law 3 X 50 experiment		**Material:** Newtonian Particle Dynamics (1) **References:** *Fowles, GR, 1999. Analytical Mechanics. New York: Saunders College Publishing*	4%

4	Analyzing Newton's laws as basic concepts of dynamics and dynamics problems	1. Determine the relationship between momentum and force experienced by particles 2. Determine the identity of particle motion (position, velocity, acceleration) under the influence of various forms of force 3. Solving dynamic problems in a coherent and correct manner	**Criteria:** 1. Presentation: 40 % Q&A: 30 % 2. Papers: 30 % **Form of Assessment** : Project Results Assessment / Product Assessment	Direct Learning Discussion (DI) Problem solving Individual assignment Newton's law experiment 3 X 50		**Material:** Newtonian Particle Dynamics (2) **References:** *Fowles, GR, 1999. Analytical Mechanics. New York: Saunders College Publishing*	4%
5	Using concepts/principles/theories in Mechanics in depth and critically, applying, analyzing, formulating and solving mechanical problems procedurally	Analyze harmonic oscillator problems critically and independently	**Criteria:** 1. Presentation: 40 % Q&A: 30 % 2. Papers: 30 % **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Direct Learning Discussion Problem solving Individual Task Experiment 3 X 50 harmonic oscillator		**Material:** harmonic oscillator **Reference:** *Arya, P. Atam, 1990. Introduction to Classical Mechanics. Prentice Hall.*	4%
6	Using concepts/principles/theories in Mechanics in depth and critically, applying, analyzing, formulating and solving mechanical problems procedurally	Analyzing damped harmonic oscillator problems collaboratively	**Criteria:** 1. Presentation: 40 % Q&A: 30 % 2. Papers: 30 % **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Direct Learning Discussion Problem solving Individual Task Experiment Harmonic oscillator with damping 3 X 50		**Material:** Damped Harmonic Oscillator **Reference:** *Arya, P. Atam, 1990. Introduction to Classical Mechanics. Prentice Hall.*	4%
7	1. Able to work independently or collaboratively in studying and solving mechanical problems 2. Using software/platform/technology applications such as PhET, Geogebra, Excel, and mathematical and computational approaches, to formulate and explain concepts/principles/theories of mechanics in solving physics problems	Analyze the dynamics problems of a system of N particles independently	**Criteria:** 1. Presentation: 40 % Q&A: 30 % 2. Papers: 30 % **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Direct Learning Discussion Problem solving Individual Task Experiment Harmonic oscillator with damping 3 X 50		**Material:** Dynamics of the N particle system. **Reference:** *Fowles, GR, 1999. Analytical Mechanics. New York: Saunders College Publishing*	4%
8	Able to understand UTS questions well	Students are able to do UTS questions well and correctly	**Criteria:** Get full marks if you can solve all the questions given **Form of Assessment** : Test	Midterm Exam 100 minutes		**Material:** Midterm Exam **Literature:**	20%
9	1. Implement high-level thinking processes (critical, creative, logical, and problem solving) in analyzing solutions to mechanical problems. 2. Able to work independently or collaboratively in studying and solving mechanical problems	Analyzing central force problems by simulation and collaboration	**Criteria:** Presentation: 40 % Q&A: 30 % **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Direct Learning Discussion Problem solving Individual Assignments 3 x 50		**Material:** Central Forces **References:** *Fowles, GR, 1999. Analytical Mechanics. New York: Saunders College Publishing*	3%
10	1. Implement high-level thinking processes (critical, creative, logical, and problem solving) in analyzing solutions to mechanical problems. 2. Able to work independently or collaboratively in studying and solving mechanical problems	Solve central force problems by simulation and collaboration	**Criteria:** Presentation: 40 % Q&A: 30 % **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Direct Learning Discussion Problem solving Individual Assignments 3 x 50		**Material:** Central Forces **References:** *Fowles, GR, 1999. Analytical Mechanics. New York: Saunders College Publishing*	3%

11	1. Implement high-level thinking processes (critical, creative, logical, and problem solving) in analyzing solutions to mechanical problems. 2. Able to work independently or collaboratively in studying and solving mechanical problems 3. Using concepts/principles/theories in Mechanics in depth and critically, applying, analyzing, formulating and solving mechanical problems procedurally	Applying the basic concepts of Lagrangian mechanics collaboratively	**Criteria:** Presentation: 40 % Q&A: 30 % **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Direct Learning Discussion Problem solving Individual Assignments 3 x 50		**Material:** Lagrangian Mechanics **Reference:** *Fowles, GR, 1999. Analytical Mechanics. New York: Saunders College Publishing*	3%
12	1. Implement high-level thinking processes (critical, creative, logical, and problem solving) in analyzing solutions to mechanical problems. 2. Able to work independently or collaboratively in studying and solving mechanical problems 3. Using concepts/principles/theories in Mechanics in depth and critically, applying, analyzing, formulating and solving mechanical problems procedurally	Applying the basic concepts of Hamiltonian mechanics collaboratively	**Criteria:** Presentation: 40 % Q&A: 30 % **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Direct Learning Discussion Problem solving Individual Assignments 3 x 50		**Material:** Hamiltonian Mechanics **Reference:** *Fowles, GR, 1999. Analytical Mechanics. New York: Saunders College Publishing*	4%
13	1. Implement high-level thinking processes (critical, creative, logical, and problem solving) in analyzing solutions to mechanical problems. 2. Able to work independently or collaboratively in studying and solving mechanical problems 3. Using concepts/principles/theories in Mechanics in depth and critically, applying, analyzing, formulating and solving mechanical problems procedurally	Apply basic concepts of rigid bodies independently	**Criteria:** Presentation: 40 % Q&A: 30 % **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Direct Learning Discussion Problem solving Individual Assignments 3 x 50		**Material:** Dynamics of rigid bodies **References:** *Spiegel, MR, 1982. Theory and Problems of Theoretical Mechanics. McGraw-Hill*	4%
14	1. Implement high-level thinking processes (critical, creative, logical, and problem solving) in analyzing solutions to mechanical problems. 2. Able to work independently or collaboratively in studying and solving mechanical problems 3. Using concepts/principles/theories in Mechanics in depth and critically, applying, analyzing, formulating and solving mechanical problems procedurally	Analyze collision and scattering problems independently	**Criteria:** Presentation: 40 % Q&A: 30 % **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Direct Learning Discussion Problem solving Individual Assignments 3 x 50		**Material:** Collisions and Scattering **Bibliography:** *Greiner, W., 2004. Classical Mechanics-Point Particles and Relativity. Springer.*	3%
15	1. Implement high-level thinking processes (critical, creative, logical, and problem solving) in analyzing solutions to mechanical problems. 2. Able to work independently or collaboratively in studying and solving mechanical problems 3. Using concepts/principles/theories in Mechanics in depth and critically, applying, analyzing, formulating and solving mechanical problems procedurally	Analyze special relativity problems independently	**Criteria:** Presentation: 40 % Q&A: 30 % **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Direct Learning Discussion Problem solving Individual Assignments 3 x 50		**Material:** Special Relativist Einstien **Bibliography:** *Greiner, W., 2004. Classical Mechanics-Point Particles and Relativity. Springer.*	4%

16	Able to understand UAS questions well	Students are able to do UAS questions well and correctly	**Criteria:** Get full marks if you can solve all the questions given **Form of Assessment** : Test	Final Semester Exam 100 minutes		**Material:** Final Semester Exam **Literature:**	30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	24.5%
2.	Project Results Assessment / Product Assessment	25.5%
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.