SEMESTER LEARNING ACTIVITY PLANS (SLAP)

SEMESTER EVEN 2022/2023

Physics Undergraduate Study Program

Physics Department

Mechanics I

MFF 1401/ 2 Credits

Lecturer Coordinator:

Dr. Mitrayana
Drs. Imam Suyanto, M. Si.
Dr. Yosef Robertus Utomo, S. U.
Ibnu Jihad, S. Si., M. Sc.

UNIVERSITAS GADJAH MADA
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
2022

	Universitas Gadjah Mada Faculty of Mathematics and Natural Science Physics Department / Physics Undergraduate Study Program Semester EVEN 2022/2023	**Document Number :** ……

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Code	Course Name	Credits (Credits)		Semester	Status	Prerequisite
MFF 1401	*Mechanics I*	*T: 2*	*P: …*	*EVEN*	*Compulsory*	*Basic Physics I (MFF1011), Calculus I (MMM1101)*

Short Description	Mechanics 1 course is compulsory for the Physics Study Program and the Geophysics Study Program, the Department of Physics, FMIPA UGM. Courses are given in each semester 2 (Even) with a weight of 2 credits of theory. This RPKPS was prepared based on the syllabus determined by the Physics Study Program and the Geophysics Study Program, the Physics Department, FMIPA UGM. Because more than 120 students attend this course each semester, the lectures are divided into two classes for the physics study program, separating even and odd student numbers. With such a large number of students, this will slightly limit the variations in learning methods. The learning methods for the Mechanics course used are the Lecture method (Quantum learning), class discussion (Cooperative learning), and giving examples of problem-solving (problem-based learning) based on the student center learning (SCL) paradigm. Learning is carried out on a face-to-face schedule in class for 14 weeks, each consisting of one 100-minute meeting. Four weeks during the lecture period are used for the Mid-Semester Examination and the Final Semester Examination, each of which is scheduled for two weeks by the Academic Section of FMIPA UGM. Evaluation for students for course assessment is carried out summatively and formatively. This is manifested in the form of written exams, both the Mid-Semester Examination and the Final Semester Examination, which take a maximum of 120 minutes. The formative evaluation is realized through independent assignments for each student. The form of independent activity is completing an assignment given to students to be discussed in groups and then completed independently at home in the form of a written report for each assignment. The monitoring process is carried out by looking at student activities during the lecture process, such as attendance at lectures, questions and answers and discussions on the material being presented, and student performance in carrying out independent assignments in the form of homework given.

Program Learning Outcomes (PLO) Imposed on the Course	***PLO 2***	Knowledge. Able to explain theoretical concepts and principles of classical and modern physics and able to apply basic concepts of physics and related mathematical methods in finding solutions to physical problems.
	PLO 5	Long Life Learning. Able to analyze various alternative solutions to physical problems and conclude them for appropriate decision-making, both in familiar and new problems.
Course Outcomes (CO)	**After completing this course, students are expected to be able to:**	
	CO1	Explain and solve cases of dynamics of single-body motion
	CO2	Explain and solve cases of dynamics of motion of many bodies and rigid bodies

		Learning Materials	Learning Methods	Time Allocation
The Correlation of CO to Learning Materials and Methods, and Time Allocation	***CO 1***	Basic Concepts and Vectors: measures of space and time: units and dimensions, vectors, multiplication of scalars, multiplication of vectors, Examples of Multiplication of vectors: Moment	TCL-SCL mixed	***2X50 minutes***

		of Force, Multiplication of Three vector quantities,		
	CO 1	Changes in Coordinate Systems: Transformation Matrices, Vector Derivatives, Particle Position Vectors: Velocity and Acceleration in Perpendicular Coordinates, Velocity, and Acceleration in Plane Polar Coordinates, Velocity and Acceleration in Cylindrical and Spherical Coordinates.	TCL-SCL mixed	***2X50 minutes***
	CO 1	Newton's Mechanics and Reciprocal Motion of Particles: Newton's Laws of Motion: An Introduction to History, Straight Motion: Uniform Acceleration Under Constant Force,	TCL-SCL mixed	***2X50 minutes***
	CO 1	Position-dependent force is kinetic and potential energy; velocity-dependent force is fluid resistance and terminal velocity.	TCL-SCL mixed	***2X50 minutes***
	CO 1	Oscillation: Linear Reverse Force: Harmonic Motion, Overview of Energy in Harmonic Motion, Damped Harmonic Motion, Forced Harmonic Motion: Resonance.	TCL-SCL mixed	***2X50 minutes***
	CO 1	The general motion of particles in three dimensions: Introduction: General Principles, Potential Energy Functions in Three Dimensional Motion: Del operator, Force of Separable Types: Projectile Motion, Harmonic Oscillators in Two and Three Dimensions, Motion of Charged Particles in Electric and Magnetic Fields, Constrained Particle Motion	TCL-SCL mixed	***2X50 minutes***
	CO 1	Noninertial Reference Systems: Accelerated Coordinate Systems and Inertial Forces, Rotating Coordinate Systems, Particle Dynamics in Rotating Coordinate Systems, Effects of Earth's Rotation, Foucault's Pendulum.	TCL-SCL mixed	***2X50 minutes***
	Midterm exam/Project Task Results/Case Analysis Results			
	CO 2	Gravity and Central Force: Gravity Force between Uniform Spheres and Particles, Kepler's Laws of Planetary Motion, Kepler's Second Law: Equal Areas, Kepler's First Law: Ellipses, Kepler's Third Law:	TCL-SCL mixed	***2X50 minutes***

	CO 2	Harmonic Law, Potential Energy in a Gravitational Field: Gravitational Potential, Potential Energy in the Central General Field, Orbital Energy Equation in the Central Field, Orbital Energy in the Inverse-Square Field, Limits of Radial Movement: Effective Potential, Near-Circular Orbit in the Central Field: Stability.	TCL-SCL mixed	***2X50 minutes***
	CO 2	Particle system dynamics: Introduction: Center of Mass and Linear Momentum of the System, Angular Momentum and Kinetic Energy of the System, Motion of Two Interacting Objects: Reduced Mass, Collision, Oblique Collision, and Scattering: Comparison of Laboratory Coordinates and Center of Mass.	TCL-SCL mixed	***2X50 minutes***
	CO 2	Rigid Body Mechanics: Planar Motion: Center of Mass of Rigid Bodies, Rotation of Rigid Bodies on Fixed Axis: Moment of Inertia, Calculation of Moment of Inertia, Physical Pendulum, Angular Momentum of Rigid Bodies in Laminar Motion, Examples of Laminar Motion of Rigid Bodies, Impulses and Collisions Involving Rigid Bodies	TCL-SCL mixed	***2X50 minutes***
	CO 2	Calculation of Moment of Inertia, Physical Pendulum, Angular Momentum of Rigid Bodies in Laminar Motion, Examples of Laminar Motion of Rigid Bodies, Impulses, and Collisions Involving Rigid Bodies	TCL-SCL mixed	***2X50 minutes***
	CO 2	The motion of Rigid Bodies in Three Dimensions: Rotation of Rigid Bodies about Any Axes: Moments and Products of Inertia—Angular Momentum and Kinetic Energy, Principal Axis of Rigids, Euler's Equations of Motion of Rigid Bodies, Free Rotations of Rigid Bodies: Geometric Description of Motion, Free Rotation of Rigid Bodies with Axis of Symmetry: Analytical Treatment, Description of Rigid Bodies Rotation Relative to a Fixed	TCL-SCL mixed	***2X50 minutes***

		Coordinate System: Euler Angles, Movement from Above, Energy and Nutation Equations, Gyrocompass		
	CO 2	Principal Axes of Rigid Bodies, Euler's Equation of Motion of Rigid Bodies, Free Rotation of Rigid Bodies: Geometric Description of Motion, Free Rotation of Rigid Bodies with Axis of Symmetry: Analytical Treatment, Description of Rotation of Rigid Bodies Relative to a Fixed Coordinate System: Euler's Angles.	TCL-SCL mixed	***2X50 minutes***
	Final exams/ Project Task Results/Case Analysis Results			
Learning Methods	**SCL (Student Centered Learning): Project-based learning (Team-based Project)/Case-based learning/PBL/other SCL methods**			
Student Learning Experience	**Learn to examine and study the differences in the concepts of classical mechanics and modern mechanics (Quantum)**			
Access to Learning Media/ LMS and Offline and Online Percentage	Offline (LCD, PPT Slide, Whiteboard, Laptop) and Online (Zoom Meeting, Google Meet, Google Classroom)			

Assessment Methods and Synchronization with CO

Assessment Methods	Assessment Percentage	Criteria/ Indicators	CO1	CO2
Participatory Activity*				
Project Results/ Case Study Results/ PBL Results*				
Cognitive				
Midterm Exam	**35**		√	
Final Exam	**35**			√
Total	**100**			

*) can also be obtained from the Midterm or Final Exam as the result of participatory activities or project/ case study results. According to IKU 7, the percentage of project results/ case study/ PBL results is at least 50%.

<table>
<tr><td>References</td><td colspan="4">Main References;
1. Fowles & Cassiday (1993), Edisi 7; Analytical Mechanics..
2. David Morin (2004); Introductory Classical Mechanics, with Problems and Solutions..
3. Qiang Yuan-qi dkk. (!994); Problems and Solutions on Mechanics; Major American University Ph. D. Qualifying Questions and Solution.</td></tr>
<tr><td>Lecturers (Team Teaching)</td><td colspan="4">1. Dr. Mitrayana
2. Drs. Imam Suyanto, M. Si.
3. Dr. Yosef Robertus Utomo, S. U.
4. Ibnu Jihad, S. Si., M. Sc.</td></tr>
<tr><td rowspan="2">Authorization</td><td>Date of Drafting</td><td>Lecturer Coordinator</td><td>Head of Curriculum Committee</td><td>Head of Study Program</td></tr>
<tr><td></td><td>Dr. Mitrayana</td><td></td><td>Dr. Eng. Ahmad Kusumaatmaja, S.Si., M.Sc.</td></tr>
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