SEMESTER LEARNING ACTIVITY PLANS (SLAP)

SEMESTER ODD 2022/2023

Physics Undergraduate Study Program

Physics Department

Computational Physics

MFF 2027/ 2 Credits

Lecturer Coordinator:

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UNIVERSITAS GADJAH MADA
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
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	Universitas Gadjah Mada Faculty of Mathematics and Natural Science Physics Department / Physics Undergraduate Study Program Semester ODD 2022/2023	**Document Number :** …………

SEMESTER LEARNING ACTIVITY PLANS (SLAP)						
Code	**Course Name**	**Credits (Credits)**		**Semester**	**Status**	**Prerequisite**
MFF 2027	*Computational Physics*	*T: 2*	*P: …*	*ODD*	*Compulsory*	*Numerical Method (MFF1024), Calculus I (MMM1101)*
Short Description	The Computational Physics course is compulsory for the Bachelor of Physics study program at Gadjah Mada University. This course can be taken by students in the odd semester of the second year of study with the approval of the supervisor/academic. Before taking this course, students must have taken the MFF 1024 Numerical Method and MMM 1101 Calculus courses. This is because in the Computational Physics course (and MFF 1024 Numerical Methods and MFF 3023 Kapita Selecta in Computational Physics), Calculus is used as a basis to understand Computational Physics as a whole better so that the Computational Physics method can be used as a method to solve the symptoms of Physics. Moreover, it will make it easier to understand Physics and Advanced Physics. With the overall Computational Physics course as an instrument, students are expected to understand better various Physics and Advanced Physics phenomena from the computational/numerical aspect. Learning is carried out based on a face-to-face schedule in class for 14 weeks, with two meetings for 50 and 100 minutes each week. Four weeks during the lecture period are used for the Mid-Semester Examination and the Final Semester Examination , each of which is carried out on a scheduled basis for two weeks by the Academic Section of FMIPA UGM. Evaluation for students for course assessment is carried out summatively and formatively. Summatively manifested in the form of written exams, Mid-Semester Examination and the Final Semester Examination, which takes a maximum of 120 minutes. The formative evaluation is manifested as independent assignments for each student. The form of independent activity is the completion of a task given to students to be discussed in groups and then completed independently at home in the form of a written report for each task. The monitoring process is carried out by looking at student activities during the lecture process, such as attendance at lectures, questions and answers and discussion of the material being presented, and student performance in carrying out independent assignments in the form of homework given. Evaluation for students for course assessment is carried out summatively and formative. Summatively manifested in the form of written exams, both Mid-Semester Examination and the Final Semester Examination, which takes a maximum of 120 minutes. The formative evaluation is manifested in the form of independent assignments for each student. The form of independent activity is the completion of a task given to students to be discussed in groups and then completed independently at home in the form of a written report for each task. The monitoring process is carried out by looking at student activities during the lecture process, such as attendance at lectures, questions and answers and discussion of the material being presented, and student performance in carrying out independent assignments in the form of homework given. Evaluation for students for course assessment is carried out summatively and formatively. Summatively manifested in the form of written exams, both Mid-Semester Examination and the Final Semester Examination, which takes a maximum of 120 minutes. The formative evaluation is manifested in the form of independent assignments for each student. The form of independent activity is the form of 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 of these taCredits. The monitoring process is carried out by looking at student activities during the lecture, such as attendance at lectures, questions and answers and discussion of 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 4	Special Skills. Able to design and carry out experiments/theoretical reviews, able to identify a physical problem based on the results of observations and experiments, and able to operate related technologies.		
	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	Students have the ability in Physics Skills, namely how to formulate and describe (to describe) the physical phenomena being studied and reveal important information in the physics problem through various tricks or specific mathematical procedures and utilizing various approaches (approximations).		
	CO2	Students have the ability in Analytical Skills, namely how to pay attention to physics problems in detail, analyze problems and build arguments logically and carefully.		
	CO3	Students have the ability in Investigative Skills, namely how to search for physics problems from various sources and references for research gain insight into an important piece of information.		
	CO4	Students have the ability in Problem-Solving Skills, namely how to solve a problem with a structured solution (well-defined solutions), formulate a problem carefully, and try other approaches (approaches) to improve solving a challenging problem (challenging problems).		
The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO 1	Explanation of some of the software and hardware that is potentially useful in carrying out the computing process,	TCL-SCL mixed	***2X50 minutes***
	CO 1	Applying the numerical integration method for the study of physical problems, which cannot be expressed in a feasible integral, and, therefore, in the form of an improper integral, uses several numerical quadrature methods.	TCL-SCL mixed	***2X50 minutes***
	CO 1	Applying numerical integration methods for the study of physical problems, which can be expressed in proper integral form using the Trapezoidal method, Simpson's method, or similar numerical integration methods.	TCL-SCL mixed	***2X50 minutes***
	CO 4	Computation for evaluating functions in the form of series, recurrence relations, and asymptotic forms, which are	TCL-SCL mixed	***2X50 minutes***

		often involved in solving various physics problems		
	CO 2	Computation for evaluating matrices and sets of simultaneous linear equations in linear algebra is often involved in solving various physics problems.	TCL-SCL mixed	***2X50 minutes***
	CO 4	Application of the problem of finding the roots (roots finding) of non-linear functions based on the Bisection or Newton-Raphson method to solve physics problems: solving the eigenvalue problem in quantum mechanics, namely the search for energy levels of finite potential wells	TCL-SCL mixed	***2X50 minutes***
	CO 3	Applying the finite difference discretization method to solve physical problems: solving the eigenvalue problem in quantum mechanics, namely the search for the energy levels of a bound system with an arbitrary potential.	TCL-SCL mixed	***2X50 minutes***
	Midterm exam/Project Task Results/Case Analysis Results			
	CO 2	The simple iteration or the Relaxation method for solving systems of simultaneous equations in several physical problems, such as electrical circuits.	TCL-SCL mixed	***2X50 minutes***
	CO 3	Continued use of the Gauss-Seidel iteration method for solving simultaneous systems of equations in several physics problems, such as in electric circuits.	TCL-SCL mixed	***2X50 minutes***
	CO 2	Applying a system of simultaneous linear equations with matrix representation in the initial conditions problem to solve some physics problems: solving the equations of motion of a pendulum or oscillation using the Euler method or the low-order Runge-Kutta method.	TCL-SCL mixed	***2X50 minutes***
	CO 4	Applying a simultaneous linear equation system with matrix representation in the initial conditions problem to solve some physics problems: solving the	TCL-SCL mixed	***2X50 minutes***

<table>
<tr><td rowspan="5"></td><td></td><td>equations of motion of a pendulum or oscillation using the high-order Runge-Kutta method.</td><td></td><td></td></tr>
<tr><td>CO 2</td><td>Simultaneous application of a system of linear equations with matrix representation on boundary condition problems to solve several physics problems: solving Poisson and Laplace equations in 1 Dimension (1D) magnetic, an electric system for computing force, field, and electric potential as well as heat or heat propagation.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 4</td><td>Simultaneous application of systems of linear equations with matrix representation on boundary condition problems to solve several physics problems: solving Poisson and Laplace equations in 2 Dimensions or 3 Dimensions (2D or 3D) magnetic electric systems for computing force, field, and electric potential as well as heat or heat propagation.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td>CO 3</td><td>Simultaneous application of systems of linear equations with matrix representation on boundary condition problems to solve several physics problems: solving Poisson and Laplace equations in 2 Dimensions or 3 Dimensions (2D or 3D) magnetic electric systems for computing force, field, and electric potential as well as heat or heat propagation.</td><td>TCL-SCL mixed</td><td>2X50 minutes</td></tr>
<tr><td colspan="4">Final exams/ Project Task Results/Case Analysis Results</td></tr>
<tr><td>Learning Methods</td><td colspan="4">SCL (Student Centered Learning): Project-based learning (Team-based Project)/Case-based learning/PBL/other SCL methods</td></tr>
<tr><td>Student Learning Experience</td><td colspan="4">Learn to analyze and study physical systems</td></tr>
<tr><td>Access to Learning Media/ LMS and Offline and Online Percentage</td><td colspan="4">Offline (LCD, PPT Slide, Whiteboard, Laptop) and Online (Zoom Meeting, Google Meet, Google Classroom)</td></tr>
</table>

Assessment Methods and Synchronization with CO	Assessment Methods	Assessment Percentage	Criteria/ Indicators	CO1	CO2	CO3	CO4
	Participatory Activity*						
	Project Results/ Case Study Results/ PBL Results*						
	Cognitive						
	Assignment	**20**		√		√	
	Midterm Exam	**30**			√		√
	Final Exam	**50**		√	√	√	√
	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%.						

References	**Main References;** 1. R. H. Landau, M. J. Páez, C. C. Bordeianu, 2008, A Survey of Computational Physics, Introductory Computational Science, Princeton University Press, ISBN: 978-0-691-13137-5. 2. DeVries, P. L., & Hasbun, J. E., 2011, A first Course in Computational Physics, Jones & Bartlett Learning, Sudbury, MA.. 3. Koonin, S. E., & Meredith, D. G., 1990, Computational Physics, second edition, Perseus Book.
Lecturers (*Team Teaching*)	1. Drs. Pekik Nurwantoro, M.S., Ph.D 2. Prof.,Agung Bambang Setio Utomo, S.U., Ph.D

Authorization	Date of Drafting	Lecturer Coordinator	Head of Curriculum Committee	Head of Study Program
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