SEMESTER LEARNING ACTIVITY PLANS (SLAP) SEMESTER ODD 2022/2023

Special Topics in Computational Physics

MFF5039 / 3 Credits

Lecturer Coordinator:

Sholihun, S.Si., M.Sc., Ph.D.Sc.

UNIVERSITAS GADJAH MADA
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
2022

	Universitas Gadjah Mada Faculty of Mathematics and Natural Science Physics Department / Study Program Master Physics Semester Odd 2022/2023

SEMESTER LEARNING ACTIVITY PLANS (SLAP)

Code	Course Name	Credits (credits)	Semester	Status	Prerequisite
MFF5039	*Special Topics in Computational Physics*	*3*	*Odd*	*Elective*	*None*

Short Description	Special Topics in Computational Physics course is Elective course 3 credits (Theory) in the 2022 Curriculum Master Physics Study Program, Faculty of Mathematics and Natural Science UGM. The syllabus of this course is as follows: The material includes the Finite difference method, Finite Element method, High-order partial differential equation solution method (Elliptic, parabolic and hyperbolic equations), and Monte Carlo method. The courses are held in class for 14 weeks, each week's session last for 3 x 50 minutes. Four weeks of course period is used for Midterm Exam and Final Exam, each held for two weeks as scheduled. Student evaluation for course assessments is performed summative and formative. The summative evaluation is implemented as written exams, both Midterm and Final Exam, which take a maximum of 120 minutes. The formative evaluation is implemented as individual assignments for each student in the form of completing an assignment individually. Monitoring is carried out by observing student activities during the course, such as attendance, Q&A and discussion about the material presented, and student performance in completing individual assignments.

Program Learning Outcomes (PLO) Imposed on the Course

PLO 3	Mastering further knowledge of classical and modern physics theory, and its relationship with other disciplines, and has mastered an advanced field of physics specialization that allows him to keep up with the latest international research developments.
PLO 4	Mastering various mathematical disciplines related to an advanced field of physics, and able to develop physical models using various mathematical and computational tools with an inter or multidisciplinary approach to solving problems related to an advanced field of physics.
PLO 6	Able to apply knowledge to analyze, synthesize, formulate problems and solve problems comprehensively in one of advanced field of physics, through experimental or theoretical research, then be able to classify and draw conclusions about their findings for the development of science and technology.

Course Outcomes (CO)

Upon completion of this course, students should be able to:	
CO1	Develop algorithms to translate physical problems into computer language and understand the concept of discretization.

	CO2	Understand finite difference computing methods.		
	CO3	Understand different element computation methods.		
	CO4	Apply presented computational methods to solve complex physical problems numerically.		
	CO5			
	CO6			
	CO7			
	CO8			
The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO1	Programming and Algorithm	Lecture	3 x 50 minutes
	CO1	Discretization concept in computing	Lecture	3 x 50 minutes
	CO1	Finite difference and Euler Method	Lecture	3 x 50 minutes
	CO2	Forward Difference (FD) and Backward Difference (BD)	Lecture	3 x 50 minutes
	CO2	Central Difference (CD)	Lecture	3 x 50 minutes
	CO2	Runge-Kutta Method (RK)	Lecture	3 x 50 minutes
	CO2	Application of FD, BD, CD, and RK methods for physical systems and accuracy comparisons.	Lecture	3 x 50 minutes
	CO3	The n-order Runge-Kutta method and its application to complex systems.	Lecture	3 x 50 minutes
	CO3	Finite Element 1 discretization concept	Lecture	3 x 50 minutes
	CO3	Finite Element 2 discretization concept	Lecture	3 x 50 minutes
	CO4	Solving Elliptical equations and examples for physical systems.	Lecture	3 x 50 minutes
	CO4	Solving Parabolic equations and examples for physical systems.	Lecture	3 x 50 minutes
	CO4	Solution of hyperbolic equations and examples for physical systems.	Lecture	3 x 50 minutes
	CO4	Comparison of the accuracy of the Runge-Kutta and Finite Element methods.	Lecture	3 x 50 minutes
	Final Exam/ Project Task Results/ Case Analysis Results			
Learning Methods	Lecture			
Student Learning Experience	Learn to analyze and review: Programming and Algorithm, Discretization concept in computing, Finite difference and Euler Method, Forward Difference (FD) and Backward Difference (BD), Central Difference (CD), Runge-Kutta Method (RK), Application of FD, BD, CD, and RK methods for physical systems and accuracy comparisons., The n-order Runge-Kutta method and its application to complex			

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<tr><td></td><td>systems., Finite Element 1 discretization concept, Finite Element 2 discretization concept, Solving Elliptical equations and examples for physical systems., Solving Parabolic equations and examples for physical systems., Solution of hyperbolic equations and examples for physical systems., Comparison of the accuracy of the Runge-Kutta and Finite Element methods..</td></tr>
<tr><td>Access to Learning Media/ LMS and Offline and Online Percentage</td><td>Powerpoint, whiteboard</td></tr>
<tr><td>Assessment Methods and Synchronization with CO</td><td>
<table>
<tr><th>Assessment Methods</th><th>Assessment Percentage</th><th>Criteria/Indicators</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th></tr>
<tr><td>Participatory Activity*</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project Results/ Case Study Results/ PBL Results*</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="7">Cognitive</td></tr>
<tr><td>Assignment</td><td>30%</td><td></td><td>7,5%</td><td>7,5%</td><td>7,5%</td><td>7,5%</td></tr>
<tr><td>Quiz</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Midterm Exam</td><td>35%</td><td></td><td>17,5%</td><td>17,5%</td><td></td><td></td></tr>
<tr><td>Final Exam</td><td>35%</td><td></td><td></td><td></td><td>17,5%</td><td>17,5%</td></tr>
<tr><td colspan="7">*) 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%.</td></tr>
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<tr><td>References</td><td>Main references:
1. Numerical Methods, 3rd eds, 2002, Doug Faires and Dick Burden.
2. Numerical Methods for Engineers 6 Ed. Chapra SC dan Canale S.
3. Pang, T, 2006, An introduction to computational physics, Cambridge University Press.
4. J.M., Thijssen, 1999, Computational Physics, Cambridge University Press.</td></tr>
<tr><td>Lecturers (Team Teaching)</td><td>1. Sholihun, S.Si., M.Sc., Ph.D.Sc.
2.
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4.</td></tr>
<tr><td>Authorization</td><td>
<table>
<tr><th>Date of Drafting</th><th>Lecturer Coordinator</th><th>Head of Curriculum Committee</th><th>Head of Study Program</th></tr>
<tr><td></td><td>Sholihun, S.Si., M.Sc., Ph.D.Sc.</td><td>Dr.Ing. Ari Setiawan</td><td>Mirza Satriawan, M.Si., Ph.D</td></tr>
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