SEMESTER LEARNING ACTIVITY PLANS (SLAP)

SEMESTER ODD 2022/2023

Physics Undergraduate Study Program

Physics Department

Physics of Complex and Nonlinear Systems

MFF 3053/ 2 Credits

Lecturer Coordinator:

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Dr.Eng. Fahrudin Nugroho, S.Si., M.Si.

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 ODD 2022/2023	**Document Number :** ……

SEMESTER LEARNING ACTIVITY PLANS (SLAP)

Code	Course Name	Credits (Credits)		Semester	Status	Prerequisite
MFF 3053	*Physics of Complex and Nonlinear Systems*	*T: 2*	*P: …*	*ODD*	*Elective*	*Numerical Method (MFF 1024), Atomic and Molecular Physics (MFF 2310)*

Short Description	Physics of Complex and Nonlinear Systems courses are electives for the Bachelor of Physics at Gadjah Mada University. This course is offered to third-year students in odd semesters. In most other courses, students are introduced to linear phenomena and models. This course is intended to provide students with basic knowledge about non-linear phenomena. The systematics of the content of this lecture is that students are introduced to a system that makes it possible to observe complex phenomena and then know at least two types of complex phenomena, namely turbulence, and chaos. They were further introduced to the dynamics analysis method on complex systems.	
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	Provide examples of systems that can demonstrate complex phenomena
	CO2	Explain the physical mechanism of the occurrence of complex phenomena in several systems. Included in this is how to direct by setting a specific physical parameter so that the system goes to a complex state
	CO3	Explain what is meant by turbulence and chaos with a physical definition.
	CO4	Conduct qualitative and quantitative analysis of the dynamics of a system (time evolution). With this analysis, students can distinguish whether a dynamic is categorized as a chaotic dynamic or not. Furthermore, students can determine how high the level of nonlinearity is.

The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO 1	Explanation and agreement of lectures, Brief review of the primary keys in linear systems	TCL-SCL mixed	***2X50 minutes***
	CO 1	Rayleigh-Bernard Convection	TCL-SCL mixed	***2X50 minutes***
	CO 2	Electrohydrodynamic System: Nematic liquid crystal	TCL-SCL mixed	***2X50 minutes***
	CO 3	Turbulence	TCL-SCL mixed	***2X50 minutes***
	CO 3	Review of Phase Spaces and Paths in phase space; Definition of Chaos	TCL-SCL mixed	***2X50 minutes***

	CO 3	Attractors and Strange attractors	TCL-SCL mixed	***2X50 minutes***
	CO 3	Logistics Map	TCL-SCL mixed	***2X50 minutes***
	Midterm exam/Project Task Results/Case Analysis Results			
	CO 3	Random dynamics (data plotting)	TCL-SCL mixed	***2X50 minutes***
	CO 4	Leap Unov Exponent and Spectral Analysis	TCL-SCL mixed	***2X50 minutes***
	CO 4	Gizburg Landau equation type: Korteweg-DeVries	TCL-SCL mixed	***2X50 minutes***
	CO 4	Gizburg Landau equation type: Swift Hohenberg	TCL-SCL mixed	***2X50 minutes***
	CO 4	The Ginzburg-Landau equation type: Nikolaevskiy	TCL-SCL mixed	***2X50 minutes***
	CO 4	Ginzburg-Landau equation type: Nikolaevskiy damped and Linear stability analysis	TCL-SCL mixed	***2X50 minutes***
	CO 4		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	**Listen, ask, answer questions and discuss**
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	CO3	CO4
Participatory Activity*						
Project Results/ Case Study Results/ PBL Results*						
Cognitive						
Assignment	**20**		√	√	√	√
Midterm Exam	**40**		√	√	√	
Final Exam	**40**				√	√
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. Mori, H., Kuramoto, Y., 1998, Dissipative Structure and chaos, Springer, Berlin..
2. Zwanzig, R, 2001, Nonequilibrium statistical mechanics, Oxford Univ Press, UK..</td></tr>
<tr><td>Lecturers (Team Teaching)</td><td colspan="4">1. Dr. Eng. Rinto Anugraha NQZ, S.Si., M.Si.
2. Dr.Eng. Fahrudin Nugroho, S.Si., M.Si.</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. Eng. Rinto Anugraha NQZ, S.Si., M.Si.</td><td></td><td>Dr. Eng. Ahmad Kusumaatmaja, S.Si., M.Sc.</td></tr>
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