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

Fractal and Chaos in Physics

MFF5056 / 2 Credits

Lecturer Coordinator:

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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 Even 2022/2023

SEMESTER LEARNING ACTIVITY PLANS (SLAP)

Code	Course Name	Credits (credits)	Semester	Status	Prerequisite
MFF5056	*Fractal and Chaos in Physics*	*2*	*Even*	*Elective*	*None*

Short Description

Fractal and Chaos in Physics course is Elective course 2 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:
1. The concepts of turbulence, fractals, chaos, spatiotemporal chaos and phenomena in their physical systems (Brown motion, fluid systems, and liquid crystals).
2. Non-linear data analysis: spatiotemporal plot, phase space-based analysis, spectral analysis, autocorrelation, and Lyapunov exponential analysis.
3. Introduction to models and computation of nonequilibrium/non-linear (differential) equations: Langevin, Logistic Map, Korteweg-de Vries.
4. Amplitude Equations: Ginzburg-Landau, Swift-Hohenberg, Newell-Whitehead, Nikolaevsky.

The courses are held in class for 14 weeks, each week's session last for 2 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 2	Having the professional ability of a scientist.
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	Knowing several types of nonlinear phenomena generating systems, both physical systems and mathematical models.		
	CO2	Obtain and visualize non-linear data series.		
	CO3	Perform qualitative and quantitative analysis of nonlinear data using computer programs.		
	CO4	Solve nonlinear differential equation models and apply quantitative analysis to the results obtained.		
	CO5			
	CO6			
	CO7			
	CO8			
The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO1			2 x 50 minutes
	CO1			2 x 50 minutes
	CO1			2 x 50 minutes
	CO2			2 x 50 minutes
	CO2			2 x 50 minutes
	CO2			2 x 50 minutes
	CO2			2 x 50 minutes
	CO3			2 x 50 minutes
	CO3			2 x 50 minutes
	CO3			2 x 50 minutes
	CO4			2 x 50 minutes
	CO4			2 x 50 minutes
	CO4			2 x 50 minutes
	CO4			2 x 50 minutes

	Final Exam/ Project Task Results/ Case Analysis Results
Learning Methods	
Student Learning Experience	Learn to analyze and review: , , , , , , , , , , , , , .
Access to Learning Media/ LMS and Offline and Online Percentage	

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	30%		7,5%	7,5%	7,5%	7,5%
Quiz						
Midterm Exam	35%		17,5%	17,5%		
Final Exam	35%				17,5%	17,5%

*) 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. Deterministic Chaos. An Introduction. Fourth, Revised and Enlarged Edition. Heinz Georg Schuster, Wolfram Just, 2005 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.
2. Nonequilibrium Statistical Mechanics, Robert Zwanzig, Oxford Univ Press.
3. Addison, P., 1997, Fractals and Chaos, Philadelphia, IOP Pub.
4. Thomsou, J.M.T. dan Stewart, H.B., 1986, Nonlinear dinamics and chaos : geometrial methods for engineers and scientists, John-Wiley & Sons.

Lecturers (*Team Teaching*)

1. Dr.Eng. Fahrudin Nugroho, S.Si., M.Si.
2.
3.
4.

Authorization

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