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

Stochastics Process for Physicist

MFF5003 / 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 Odd 2022/2023

SEMESTER LEARNING ACTIVITY PLANS (SLAP)

Code	Course Name	Credits (credits)	Semester	Status	Prerequisite
MFF5003	*Stochastics Process for Physicist*	*2*	*Odd*	*Elective*	*None*

Short Description	Stochastics Process for Physicist 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: Introduction: Simple limitations of stochastic processes, stochastic phenomena in nature, stochastic processes in physics, epistemological and ontological views regarding stochastic processes. Probability theory and Lebesgue integrals: probability limitation, sample spaces, sigma algebra, sigma algebraic properties, event spaces, measured spaces, sizes, sized spaces, size properties, types of measures, probability measures, and Kolmogorov limitation for probability, probability spaces, mapping of measured variables, random variables, and its properties, distribution of random variables, simple functions, simple function sequence construction for measurable functions, Lebesgue integrals for simple functions, Lebesgue integrals for any measurable function, Lebesgue integrals and their mean, variance, covariance, properties of Lebesgue integrals. Stochastic Processes: technical mathematical limitations of stochastic processes, filter concept, filters built by stochastic processes, distribution of stochastic processes, Brownian motion, martingale and semimartingale, Ito and Stratonovich integrals, stochastic differential equations, Fokker-Planck equations. Applied in physics: stochastic mechanics, stochastic quantum mechanics, econophysics. 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 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	Explaining the properties of stochastic processes, forming stochastic differential equations and stochastic integrals for a physical system that follows a stochastic process.
	CO2	Explain the use of physical stochastic processes.
	CO3	State and explain the simple limitations of stochastic processes.
	CO4	Explaining the basics of probability theory then mentioning examples of its application in physics and being able to explain the nature of the Lebesque integral then being able to solve the Lebesque integral for any measurable function.
	CO5	
	CO6	
	CO7	
	CO8	

The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO1	Introduction: simple limitations of stochastic processes, stochastic phenomena in nature.	Lecture, discussion	2 x 50 minutes
	CO1	Stochastic processes in physics, epistemological and ontological views regarding stochastic processes.	Lecture, discussion	2 x 50 minutes
	CO1	Opportunity constraints, sample space, sigma algebra, sigma algebraic properties, event space, measured space, size, sized space, size properties, types of measures, probability measure and Kolmogorov constraint for probability, probability space, mapping measurable and random variables and their properties.	Lecture, discussion	2 x 50 minutes
	CO2	Distribution of random variables, simple functions, constructing a sequence of simple functions for a measurable function.	Lecture, discussion	2 x 50 minutes
	CO2	Lebesgue integral for simple functions, Lebesgue integral for any measurable function.	Lecture, discussion	2 x 50 minutes
	CO2	Lebesgue integral and mean and variance, covariance, properties of Lebesgue integral.	Lecture, discussion	2 x 50 minutes

	CO2	Mathematical technical limitation of stochastic process, filter concept, filter constructed by stochastic process, distribution of a stochastic process.	Lecture, discussion	2 x 50 minutes
	CO3	Mathematical technical limitation of stochastic process, filter concept, filter constructed by stochastic process, distribution of a stochastic process.	Lecture, discussion	2 x 50 minutes
	CO3	Brownian motion, martinis and semi-martinels.	Lecture, discussion	2 x 50 minutes
	CO3	The Ito integral and the Stratonovic integral.	Lecture, discussion	2 x 50 minutes
	CO4	The Ito integral and the Stratonovic integral.	Lecture, discussion	2 x 50 minutes
	CO4	Stochastic differential equations, Fokker-Planck equations.	Lecture, discussion	2 x 50 minutes
	CO4	Applied stochastic processes in physics.	Lecture, discussion	2 x 50 minutes
	CO4	Applied stochastic processes in physics.	Lecture, discussion	2 x 50 minutes
	Final Exam/ Project Task Results/ Case Analysis Results			
Learning Methods	Lecture, discussion			
Student Learning Experience	Learn to analyze and review: Introduction: simple limitations of stochastic processes, stochastic phenomena in nature. , Stochastic processes in physics, epistemological and ontological views regarding stochastic processes., Opportunity constraints, sample space, sigma algebra, sigma algebraic properties, event space, measured space, size, sized space, size properties, types of measures, probability measure and Kolmogorov constraint for probability, probability space, mapping measurable and random variables and their properties., Distribution of random variables, simple functions, constructing a sequence of simple functions for a measurable function., Lebesgue integral for simple functions, Lebesgue integral for any measurable function., Lebesgue integral and mean and variance, covariance, properties of Lebesgue integral., Mathematical technical limitation of stochastic process, filter concept, filter constructed by stochastic process, distribution of a stochastic process., Mathematical technical limitation of stochastic process, filter concept, filter constructed by stochastic process, distribution of a stochastic process., Brownian motion, martinis and semi-martinels., The Ito integral and the Stratonovic integral., The Ito integral and the Stratonovic integral., Stochastic differential equations, Fokker-Planck equations., Applied stochastic processes in physics., Applied stochastic processes in physics..			
Access to Learning Media/ LMS and Offline and Online Percentage	Powerpoint, whiteboard			
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. Erhan Cinlar, 2011, Probability and Stochastics, Graduate Text in Mathematics 261, Springer Verlag, Berlin. 2. Bernt Øksendal, 2000, Stochastic Differential Equation; An Introduction with Application, Springer-Verlag.
Lecturers (*Team Teaching*)	1. Dr. Dwi Satya Palupi, 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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