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

Methods of Experimental Physics

MFF5061 / 3 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
MFF5061	*Methods of Experimental Physics*	*3*	*Odd*	*Elective*	*None*

Short Description

Methods of Experimental 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:
Experimental Strategy, Multiple Experimental Design Applications, Simple Comparison Experiments, Experiments with Single Factors, Development of experimental theories and methods, instrumentation, and data analysis in various fields of Classical and Modern Physics, with an emphasis on fostering and developing research skills and students' skills of critical attitude towards experimentation physics methodology; Postgraduate research design.

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 1	Have a commendable attitude and ethics as 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 5	Able to plan, manage and carry out experiments and conclude the results, or be able to create and use modeling and simulations based on the basic principles of physics to study and solve a problem in a scientific field of Physics or applied Physics that produces models, methods, or theories tested and innovative.
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	Handles errors in measurements.
	CO2	Use basic statistics to analyze experimental data.
	CO3	Designing experiments to solve problems in measuring a physical quantity, as well as developing measurement methods.
	CO4	
	CO5	
	CO6	
	CO7	
	CO8	

The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO1	Sources of error, propagation of error, best value and dispersion.	Lecture, discussion	3 x 50 minutes
	CO1	Probability, mean of probability, permutation and combination	Lecture, discussion	3 x 50 minutes
	CO1	Probability distribution, binomial distribution, Poisson distribution, Gaussian distribution.	Lecture, discussion	3 x 50 minutes
	CO2	Data Rejection, Goodness of fit.	Lecture, discussion	3 x 50 minutes
	CO2	Standard deviation of the mean value, general formula for propagation of error.	Lecture, discussion	3 x 50 minutes
	CO2	Least square method	Lecture, discussion	3 x 50 minutes
	CO2	Least squares method with some unknown variables, correlation.	Lecture, discussion	3 x 50 minutes
	CO3	Experimental strategy; best guess approach; one-factor-at-a-time; factorial experiment.	Lecture, discussion	3 x 50 minutes
	CO3	Multiple Experimental Design Applications.	Lecture, discussion	3 x 50 minutes
	CO3	Examples of experimental designs; process characterization; process optimization; product design.	Lecture, discussion	3 x 50 minutes
	CO4	Basic principles and guidelines in experimental design.	Lecture, discussion	3 x 50 minutes
	CO4	Simple comparison experiment; Testing hypothesis	Lecture, discussion	3 x 50 minutes
	CO4	Basic concepts of statistics; central limit theorem.	Lecture, discussion	3 x 50 minutes

	CO4	Experiment with single factor, Analysis of variance.	Lecture, discussion	3 x 50 minutes
	Final Exam/ Project Task Results/ Case Analysis Results			
Learning Methods	Lecture, discussion			
Student Learning Experience	Learn to analyze and review: Sources of error, propagation of error, best value and dispersion., Probability, mean of probability, permutation and combination, Probability distribution, binomial distribution, Poisson distribution, Gaussian distribution., Data Rejection, Goodness of fit., Standard deviation of the mean value, general formula for propagation of error., Least square method, Least squares method with some unknown variables, correlation., Experimental strategy; best guess approach; one-factor-at-a-time; factorial experiment., Multiple Experimental Design Applications., Examples of experimental designs; process characterization; process optimization; product design., Basic principles and guidelines in experimental design., Simple comparison experiment; Testing hypothesis, Basic concepts of statistics; central limit theorem., Experiment with single factor, Analysis of variance..			
Access to Learning Media/ LMS and Offline and Online Percentage	Powerpoint slide, whiteboard, pdf view of reference file, elisa			
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. Douglas C. Montgomery, 2001, Design and Analysis of Experiment, JohnWiley and Son. 2. Frederick James, 2006, Statistical Methods in Experimental Physics, World Scientific. 3. Hugh D. Young, 2009, Statistical Treatmnent of Wxperimental Data, McGraw Hill Book Company Inc.
Lecturers (*Team Teaching*)	1. Dr. Eko Sulistya, M.Si. 2. 3. 4.

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