SEMESTER LEARNING ACTIVITY PLANS (SLAP)

SEMESTER EVEN 2022/2023

Physics Undergraduate Study Program

Physics Department

Atomic and Molecular Physics Experiments

MFF 2313/ 1 Credits

Lecturer Coordinator:

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UNIVERSITAS GADJAH MADA
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
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	Universitas Gadjah Mada Faculty of Mathematics and Natural Science Physics Department / Physics Undergraduate Study Program Semester EVEN 2022/2023	**Document Number :** ……

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Code	Course Name	Credits (Credits)		Semester	Status	Prerequisite
MFF 2313	*Atomic and Molecular Physics Experiments*	*T: 1*	*P: …*	*EVEN*	*Compulsory*	*Atomic and Molecular Physics (MFF2310)*

Short Description	The Atomic and Molecular Physics Experiments course is a mandatory subject in the 2021 Curriculum of the Physics Undergraduate Study Program, Faculty of Mathematics and Natural Sciences UGM. The general objective of holding this Constitutional Court is to provide mastery of the basic concepts of modern physics and the skills to conduct experiments verifying natural phenomena at the atomic and molecular levels. So that this Constitutional Court is related to competence in the aspects of Knowledge and Understanding, aspects of Intellectual Thinking Skills, and Practical Skills. Learning is carried out based on an experimental schedule for five weeks, with each week consisting of a 30-minute pretest which is intended to determine the initial understanding of physics concepts and experimental techniques to be carried out and related experiments for 120 minutes in groups (one group consists of two students) in the laboratory Nuclear Atomic Physics Department of Physics UGM. In the sixth week, a response will be to evaluate students' understanding of physics concepts and related experiments. Evaluation for students for course assessment is carried out summatively and formatively. Summatively manifested as a pretest before the students conduct experiments for 30 minutes and the Response Test after completing all the experimental titles. This response test time is carried out for 3 hours containing questions from the five experimental topics and examples of experimental data that must be analyzed. The formative evaluation is realized in the form of a Practicum Report for each student for each experimental title that has been carried out. This practicum report was completed independently at home and collected before students took part in the practicum for the title of the following experiment.
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 3	General Skills. Able to communicate the results of problem studies and physical behavior both in writing and verbally, as well as being able to lead and collaborate at various levels of roles in a team.
	PLO 4	Special Skills. Able to design and carry out experiments/theoretical reviews, able to identify a physical problem based on the results of observations and experiments, and able to operate related technologies.
	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	Students can carry out experiments on the e/m ratio using an electro-magnet setup, analyze data, and provide conclusions from this experiment.

	CO2	Students can conduct experiments with Franck-Hertz to show the discrete nature of charge e and can analyze data and provide conclusions from this experiment.		
	CO3	Students can conduct experiments on Atomic Spectroscopy using the Hilger spectrometer and can analyze data and provide conclusions from this experiment.		
	CO4	Students can carry out electron spin resonance (ESR) experiments using electromagnetic setups and are also able to determine the value of the gyromagnetic factor of organic materials. Students are also able to analyze data and provide conclusions from this experiment.		
	CO5	Students can carry out the Zeeman Effect experiment to show the influence of magnetic fields on atomic emission spectra. They can analyze data and provide conclusions from this experiment based on the coupling of angular, angular momentum, and spin of an atom.		
The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO 1, CO 2, CO 3, CO 4, CO 5	(1). An e/m experiment determines an electron's charge-to-mass ratio using electric and magnetic fields. (2). The Franck-Hertz experiment demonstrated the discrete nature of electrons using high voltages. (3). Atomic Spectroscopy Experiment, showing the emission and absorption of an atomic gas using a Hilger spectrometer. (4). Electron spin resonance (ESR) experiments using an electromagnet setup are also capable		***4X50 minutes***
	CO 1, CO 2, CO 3, CO 4, CO 5	Intrinsic angular momentum, magnetic moment, core states, core states		***3X50 minutes***
	Midterm exam/Project Task Results/Case Analysis Results			
	CO 1, CO 2, CO 3, CO 4, CO 5	(1). Experiment e/m, determine the ratio of charge and mass of electrons using electric and magnetic fields. (2). The Franck-Hertz experiment demonstrated the discrete nature of electrons using high voltages. (3). Atomic Spectroscopy Experiment, showing the emission and absorption of an atomic gas using a Hilger spectrometer. (4). Electron spin resonance (ESR) experiments using an electromagnet setup are also able to		***1X50 minutes***
	CO 1, CO 2, CO 3, CO 4, CO 5	(1). An e/m experiment determines an electron's charge-to-mass ratio using electric and magnetic fields. (2). The Franck-Hertz experiment demonstrated the discrete nature of electrons using high voltages. (3). Atomic Spectroscopy Experiment,		***1X50 minutes***

		showing the emission and absorption of an atomic gas using a Hilger spectrometer. (4). Electron spin resonance (ESR) experiments using an electromagnet setup are also capable		
	CO 1, CO 2, CO 3, CO 4, CO 5	Final Test		***5X50 minutes***
	Final exams/ Project Task Results/Case Analysis Results			

Learning Methods	**CBL (Case Based Learning): Pretest, Presentation of material and some display material, Hands-on experiments using available set-ups, Making reports**
Student Learning Experience	**Learn to study and study experimental methods**
Access to Learning Media/ LMS and Offline and Online Percentage	Offline (Experimental tool) and Online (Zoom Meeting, Google Meet, Google Classroom)

Assessment Methods and Synchronization with CO

Assessment Methods	Assessment Percentage	Criteria/ Indicators	CO1	CO2	CO3	CO4	CO5
Participatory Activity*	**20**		√	√	√	√	√
Project Results/ Case Study Results/ PBL Results*							
Cognitive							
Practicum Report	**40**		√	√	√	√	√
Pretest	**10**		√	√	√	√	√
Final Test	**30**		√	√	√	√	√
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%.

References

Main References;

1. Melissinos, A. C., 2003: Experiments in Modern Physics, Academic Press..
2. Tim Pengampu, 2016, Petunjuk Praktikum Fisika Atom dan Molekul, Lab. Fisika Atom-Inti..
3. Sayer, M dan A Mansingh, 2000. Measurement Instrumentation and Experiment Design in Physics and Engineering, Prentice Hall, New Delhi..

Lecturers (*Team Teaching*)

1. Dr. Iman Santoso
2. Dr.Eng. Fahrudin Nugroho

	3. Ikhsan Setiawan, M. Si 4. Elida Istiqomah, M. Sc.			
Authorization	**Date of Drafting**	**Lecturer Coordinator**	**Head of Curriculum Committee**	**Head of Study Program**
		Dr. Iman Santoso		*Dr. Eng. Ahmad Kusumaatmaja, S.Si., M.Sc.*