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

Laser Spectroscopy

MFF5423 / 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
MFF5423	*Laser Spectroscopy*	*2*	*Odd*	*Elective*	*None*

Short Description

Laser Spectroscopy 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 to spectroscopic, emission, and absorption methods. Limited Doppler spectroscopy methods: optogalvanic, optoacoustic, Opto-thermal, laser-induced fluorescence (LIF), resonance induced spectroscopy (RIS), resonance induced mass spectroscopy (RIMS), double resonant method, laser-induced breakdown spectroscopy (LIBS). Doppler-free spectroscopy methods, saturation, polarization methods (POLINEX), intermodulation (IMOGS), and level crossing spectroscopy. Reasoning/supporting components of laser spectroscopy with their applications and analysis.

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	Explain the concepts of Spectroscopy using lasers and auxiliary equipment (mechanical, optical, electronic) as a legal basis for analyzing the results (spectrum, numeric, pulse) of the laser light interaction with atoms/molecules.		
	CO2	Explain the mechanism of interaction between laser light and atoms/molecules based on theoretical studies.		
	CO3	Explain the results obtained (numeric, spectrum) based on theoretical studies.		
	CO4			
	CO5			
	CO6			
	CO7			
	CO8			
The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO1	Introduction: Lecture rules, exams and assessments. Review properties, physical quantities and energy levels of atoms and molecules.	Lecture, discussion	2 x 50 minutes
	CO1	A further review of the atomic model, from Bohr, Sommerfeld's atomic model, is the presence of elliptical orbits of electrons in atoms.	Lecture, discussion	2 x 50 minutes
	CO1	An overview of the physical quantities of atoms/electrons is associated with the presence of quantized quantities.	Lecture, discussion	2 x 50 minutes
	CO2	The review of physical quantities is associated with the disturbance of atoms/electrons which are influenced by external magnetic and electric fields.	Lecture, discussion	2 x 50 minutes
	CO2	Solving the Laplace equation and the Poison equation with certain boundary conditions.	Lecture, discussion	2 x 50 minutes
	CO2	A review of the physical quantities of coupled l and s electrons as the basis for the existence of a fine structure (fine structure spectrum).	Lecture, discussion	2 x 50 minutes
	CO2	The review of physical quantities is associated with the involvement of the physical quantities of the atomic nucleus which are influenced by the atomic/electron system as the basis for the hyperfine structure (hyperfine spectrum).	Lecture, discussion	2 x 50 minutes

	CO3	Overview of molecular physical quantities and their structure/energy levels.	Lecture, discussion	2 x 50 minutes
	CO3	Overview of mechanical, optical and electronic equipment as a track record of the interaction of laser light with atoms/molecules for easy analysis.	Lecture, discussion	2 x 50 minutes
	CO3	Overview of low-resolution spectroscopic systems for (basic) spectrum observations using a discharge lamp energy source to distinguish the spectrum results when using a laser.	Lecture, discussion	2 x 50 minutes
	CO4	Overview of the medium resolution spectroscopy system (Doppler limited) using a laser light energy source that is able to observe the fine structure spectrum. (optogalvanic, opto-acoustic, opto-thermal, laser induced fluorescence (LIF), Resonance induced spectroscopy (RIS), resonance induced mass spectroscopy (RIMS), laser induced break down spectroscopy (LIBS).)	Lecture, discussion	2 x 50 minutes
	CO4	Overview of the medium resolution spectroscopy system (Doppler limited) using a laser light energy source that is able to observe the fine structure spectrum. (optogalvanic, opto-acoustic, opto-thermal, laser induced fluorescence (LIF), Resonance induced spectroscopy (RIS), resonance induced mass spectroscopy (RIMS), laser induced break down spectroscopy (LIBS).)	Lecture, discussion	2 x 50 minutes
	CO4	Overview of high resolution spectroscopy system (Doppler Free) using a laser light energy source that is able to observe the spectrum of hyperfine structures. (saturation method, polarization (POLINEX), inter modulation (IMOGS), level crossing spectroscopy).	Lecture, discussion	2 x 50 minutes
	CO4	Overview of high resolution spectroscopy system (Doppler Free) using a laser light energy source that is able to observe the	Lecture, discussion	2 x 50 minutes

		spectrum of hyperfine structures. (saturation method, polarization (POLINEX), inter modulation (IMOGS), level crossing spectroscopy).		
	Final Exam/ Project Task Results/ Case Analysis Results			
Learning Methods	Lecture, discussion			
Student Learning Experience	Learn to analyze and review: Introduction: Lecture rules, exams and assessments. Review properties, physical quantities and energy levels of atoms and molecules., A further review of the atomic model, from Bohr, Sommerfeld's atomic model, is the presence of elliptical orbits of electrons in atoms., An overview of the physical quantities of atoms/electrons is associated with the presence of quantized quantities., The review of physical quantities is associated with the disturbance of atoms/electrons which are influenced by external magnetic and electric fields., Solving the Laplace equation and the Poison equation with certain boundary conditions., A review of the physical quantities of coupled l and s electrons as the basis for the existence of a fine structure (fine structure spectrum)., The review of physical quantities is associated with the involvement of the physical quantities of the atomic nucleus which are influenced by the atomic/electron system as the basis for the hyperfine structure (hyperfine spectrum)., Overview of molecular physical quantities and their structure/energy levels., Overview of mechanical, optical and electronic equipment as a track record of the interaction of laser light with atoms/molecules for easy analysis., Overview of low-resolution spectroscopic systems for (basic) spectrum observations using a discharge lamp energy source to distinguish the spectrum results when using a laser., Overview of the medium resolution spectroscopy system (Doppler limited) using a laser light energy source that is able to observe the fine structure spectrum. (optogalvanic, opto-acoustic, opto-thermal, laser induced fluorescence (LIF), Resonance induced spectroscopy (RIS), resonance induced mass spectroscopy (RIMS), laser induced break down spectroscopy (LIBS).), Overview of the medium resolution spectroscopy system (Doppler limited) using a laser light energy source that is able to observe the fine structure spectrum. (optogalvanic, opto-acoustic, opto-thermal, laser induced fluorescence (LIF), Resonance induced spectroscopy (RIS), resonance induced mass spectroscopy (RIMS), laser induced break down spectroscopy (LIBS).), Overview of high resolution spectroscopy system (Doppler Free) using a laser light energy source that is able to observe the spectrum of hyperfine structures. (saturation method, polarization (POLINEX), inter modulation (IMOGS), level crossing spectroscopy)., Overview of high resolution spectroscopy system (Doppler Free) using a laser light energy source that is able to observe the spectrum of hyperfine structures. (saturation method, polarization (POLINEX), inter modulation (IMOGS), level crossing spectroscopy)..			
Access to Learning Media/ LMS and Offline and Online Percentage	Whiteboard, slide, slides copy			
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. Svanberg S., 1991, Atomic and Molecular Spectroscopy: Basic conceptsand practical applications, Springer-Verlag. 2. Demtroder, W., 1981, Laser Spectroscopy: Basic Cencept and Instrumentation, Springer-Verlag.			
Lecturers (*Team Teaching*)	1. Prof. Dr. Agung Bambang Setio Utomo, S.U. 2. 3. 4.			
Authorization	**Date of Drafting**	**Lecturer Coordinator**	**Head of Curriculum Committee**	**Head of Study Program**
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