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

Atomic and Molecular Spectroscopy

MFF5321 / 2 Credits

Lecturer Coordinator:

Dr. Mitrayana, S.Si., M.Si.

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
MFF5321	*Atomic and Molecular Spectroscopy*	*2*	*Odd*	*Elective*	*None*

Short Description	Atomic and Molecular 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: Summary of the quantum theory of atoms and molecules, the interaction between radiation and matter, and the selection rules. Atomic and molecular spectra, fine structure, hyperfine, outer field atomic interaction. Spectroscopic methods: inner electron spectroscopy, visible/optical spectroscopy, radio frequency spectroscopy, microwave, and infrared spectroscopy. Supporting equipment/components atomic and molecular spectroscopy. 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 concepts and solve cases related to Atomic and Molecular Structure.		
	CO2	Explain concepts and solve cases related to Multiple Spectroscopic Methods.		
	CO3	Work in groups to study the development of the Theory and Application of Atomic and Molecular Spectroscopy.		
	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 Contract, Spectroscopy Atom Dynamics	Lecture, discussion	2 x 50 minutes
	CO1	Electron Interaction with GEM and Particles: Electron transition, Case events.	Lecture, discussion	2 x 50 minutes
	CO1	Selection Rule: For electrons, For nucleons.	Lecture, discussion	2 x 50 minutes
	CO2	Atomic Structure: Electron configuration, Nucleon dynamics.	Lecture, discussion	2 x 50 minutes
	CO2	Molecular Structure: Chemical bonding, A number of cases related to molecules.	Lecture, discussion	2 x 50 minutes
	CO2	Radiation and Scattering Processes: X-ray scattering, Radiation of atomic nuclei.	Lecture, discussion	2 x 50 minutes
	CO2	Deep Electron Spectroscopy: An introduction to spectroscopy, Cases of the spectrum.	Lecture, discussion	2 x 50 minutes
	CO3	Deep Electron Spectroscopy: An introduction to spectroscopy, Cases of the spectrum.	Lecture, discussion	2 x 50 minutes
	CO3	Radiofrequency Spectroscopy: Transition by radiofrequency interaction, Case in point.	Lecture, discussion	2 x 50 minutes
	CO3	Microwave and Infrared Spectroscopy: Electron energy, Atomic energy, Molecular energy.	Lecture, discussion	2 x 50 minutes
	CO4	Fundamentals of ESR Spectroscopy: Zeeman's Solution, Fine Spectrum of ESR.	Lecture, discussion	2 x 50 minutes
	CO4	ESR Spectrometer: Instrumentation System, Paramagnetic Interaction with Microwaves.	Lecture, discussion	2 x 50 minutes
	CO4	Cavity Resonator ESR Spectrometer: Clyster and Waveguide, Brace wall Nomogram.	Lecture, discussion	2 x 50 minutes

	CO4	ESR Spectrum Analysis: Pascal's Triangle, Anthracin and DPPH, Cases of ESR fine spectrum.	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: Lecture Contract, Spectroscopy Atom Dynamics, Electron Interaction with GEM and Particles: Electron transition, Case events., Selection Rule: For electrons, For nucleons., Atomic Structure: Electron configuration, Nucleon dynamics., Molecular Structure: Chemical bonding, A number of cases related to molecules., Radiation and Scattering Processes: X-ray scattering, Radiation of atomic nuclei., Deep Electron Spectroscopy: An introduction to spectroscopy, Cases of the spectrum., Deep Electron Spectroscopy: An introduction to spectroscopy, Cases of the spectrum., Radiofrequency Spectroscopy: Transition by radiofrequency interaction, Case in point., Microwave and Infrared Spectroscopy: Electron energy, Atomic energy, Molecular energy., Fundamentals of ESR Spectroscopy: Zeeman's Solution, Fine Spectrum of ESR., ESR Spectrometer: Instrumentation System, Paramagnetic Interaction with Microwaves., Cavity Resonator ESR Spectrometer: Clyster and Waveguide, Brace wall Nomogram., ESR Spectrum Analysis: Pascal's Triangle, Anthracin and DPPH, Cases of ESR fine spectrum..			
Access to Learning Media/ LMS and Offline and Online Percentage	In-focus and whiteboard, video synchronous and asynchronous			
Assessment Methods and Synchronization with CO	(see table below)			

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. Sindu, P.S., 1985, Molecular Spectroscopy, Tata McGraw-Hill, India.
3. Demtroder, W., 1981, Laser Spectroscopy, Basic Concepts and Istrumentations, Springer-Verlag.

<table>
<tr><td>Lecturers (Team Teaching)</td><td colspan="4">1. Dr. Mitrayana, S.Si., M.Si.
2. Dr. Bambang Murdaka Eka Jati, M.S.
3.
4.</td></tr>
<tr><td rowspan="2">Authorization</td><td>Date of Drafting</td><td>Lecturer Coordinator</td><td>Head of Curriculum Committee</td><td>Head of Study Program</td></tr>
<tr><td></td><td>Dr. Mitrayana, S.Si., M.Si.</td><td>Dr.Ing. Ari Setiawan</td><td>Mirza Satriawan, M.Si., Ph.D</td></tr>
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