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

Condensed Matter Magnetism

MFF5750 / 3 Credits

Lecturer Coordinator:

Dr. Eng. Edi Suharyadi, S.Si., M.Eng.

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 Even 2022/2023

SEMESTER LEARNING ACTIVITY PLANS (SLAP)

Code	Course Name	Credits (credits)	Semester	Status	Prerequisite
MFF5750	*Condensed Matter Magnetism*	*3*	*Even*	*Elective*	*None*

Short Description

Condensed Matter Magnetism 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:
Origin of Magnetism, Introduction and Classification of Magnetic Materials, Diamagnetic, Ferromagnetic, Paramagnetic, Antiferromagnetic, Magnetic Thermodynamics, Magnetic Interactions, Magnetocrine Anisotropy, Crystal Fields as well as Their Application in Magnetic Systems. Molecular Fields: Exchange Power and Molecular Fields, in Ferromagnetism, Antiferromagnetism and Ferrimagnetism, Cooperative Phenomena: Quantum Field and Spin Wave Theory, Summary of Experimental Aspects of Solids Magnetism, Methods of Measurement and Characterization of Magnetic Properties, such as Vibrating Sample Magnetometer (VSM), Torque Magnetometer, Magnetic Force Microscopy (MFM).

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 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	Understand the nature of magnetism in materials and the mechanism of their occurrence.		
	CO2	Understand the magnetic interactions in materials and the classification of materials from the aspect of magnetism.		
	CO3	Understand and conduct research in the field of magnetic materials, from the manufacturing process to characterization to determine the magnetic properties of materials.		
	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 to Magnetism in Incompressible Substances.	Lecture	3 x 50 minutes
	CO1	Fundamental theory and theory of quantum mechanics in Magnetism.	Lecture	3 x 50 minutes
	CO1	Introduction and classification of magnetic, diamagnetic, ferromagnetic, paramagnetic, antiferromagnetic materials.	Lecture	3 x 50 minutes
	CO2	Magnetic thermodynamics, exchange interactions, crystalline magnetic anisotropy.	Lecture	3 x 50 minutes
	CO2	Magnetism: aspect of the symmetry of solids. Crystal fields and their applications in magnetic systems.	Lecture	3 x 50 minutes
	CO2	Molecular fields: exchange forces and molecular fields, in ferromagnetism, antiferromagnetism and ferrimagnetism.	Lecture	3 x 50 minutes
	CO2	Cooperative phenomena: quantum field theory and spin waves. Summary of experimental aspects of solid magnetism.	Lecture	3 x 50 minutes
	CO3	Band structure on Magnetic Material (part 1).	Lecture	3 x 50 minutes
	CO3	Band structure on Magnetic Material (part 2).	Lecture	3 x 50 minutes

	CO3	Magnetic Interaction (part 1).	Lecture	3 x 50 minutes
	CO4	Magnetic Interaction (part 2).	Lecture	3 x 50 minutes
	CO4	Magnetic Semiconductors (part I).	Lecture	3 x 50 minutes
	CO4	Magnetic Semiconductors (part 2).	Lecture	3 x 50 minutes
	CO4	Spin Current & Spin Hall Effect.	Lecture	3 x 50 minutes
	Final Exam/ Project Task Results/ Case Analysis Results			
Learning Methods	Lecture			
Student Learning Experience	Learn to analyze and review: Introduction to Magnetism in Incompressible Substances., Fundamental theory and theory of quantum mechanics in Magnetism., Introduction and classification of magnetic, diamagnetic, ferromagnetic, paramagnetic, antiferromagnetic materials., Magnetic thermodynamics, exchange interactions, crystalline magnetic anisotropy., Magnetism: aspect of the symmetry of solids. Crystal fields and their applications in magnetic systems., Molecular fields: exchange forces and molecular fields, in ferromagnetism, antiferromagnetism and ferrimagnetism., Cooperative phenomena: quantum field theory and spin waves. Summary of experimental aspects of solid magnetism., Band structure on Magnetic Material (part 1)., Band structure on Magnetic Material (part 2)., Magnetic Interaction (part 1)., Magnetic Interaction (part 2)., Magnetic Semiconductors (part I)., Magnetic Semiconductors (part 2)., Spin Current & Spin Hall Effect..			
Access to Learning Media/ LMS and Offline and Online Percentage	Sync (google meet), Asynchronous (google classroom, video)			

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. Stephen Blundell, 2001, Magnetism in Condensed Matter, OUP Oxford, USA. 2. Craik, D., 1995, Magnetism: Principles and Applications, John Willey &Sons, Chischester, UK. 3. Chakravarty, A.S., 1980, Introduction to the Magnetic Properties of Solids,John Willey & Sons, New York, USA.			
Lecturers (*Team Teaching*)	1. Dr. Eng. Edi Suharyadi, S.Si., M.Eng. 2. 3. 4.			
Authorization	**Date of Drafting**	**Lecturer Coordinator**	**Head of Curriculum Committee**	**Head of Study Program**
		Dr. Eng. Edi Suharyadi, S.Si., M.Eng.	Dr.Ing. Ari Setiawan	Mirza Satriawan, M.Si., Ph.D