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

Electrodynamics

MFF5411 / 3 Credits

Lecturer Coordinator:

Dr. Dwi Satya Palupi, 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/Even 2022/2023

SEMESTER LEARNING ACTIVITY PLANS (SLAP)

Code	Course Name	Credits (credits)	Semester	Status	Prerequisite
MFF5411	*Electrodynamics*	*3*	*Odd/Even*	*Compulsory*	*None*

Short Description

Electrodynamics course is Compulsory 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:
Coulomb's law, electric field and potential caused by electric charge. Gauss's law for electricity and the density of electrical energy in a vacuum, Green's Theorem. Electrostatic potential energy, configuration energy, energy density. Boundary condition problems include solving boundary condition problems using the shadow method if there is a source. Solve Laplace's equations and Poisson's equations with specific boundary conditions. Multipole moment, electric field, and electric potential are generated by a multipole moment in a vacuum and a medium. The induced magnetic field is generated by current density distribution, Biot-Savart's Law, and Ampere's Law. Faraday's law and induced EMF, vector potential, differential equations in vector potential form, and how to solve them. Magnetic moments and magnetic induced fields are generated by magnetic moments in a vacuum and a linear isotropic medium. The magnetic field at the boundary plane. Maxwell's equations in differential, integral, scalar potentials and vector potentials form, tera transformations. A simple application of Maxwell's equations: electromagnetic waves.

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	Explain, calculate and analyze the magnetic field generated by the current distribution and changes in the electric field flux.
	CO2	Explain and formulate the magnetic field generated by the following electric multipole distribution.
	CO3	Formulate, explain the use of Maxwell's equations, and express Maxwell's equations in the form of electric potential and vector potential, as well as the propagation of electromagnetic waves.
	CO4	Explain and solve static electricity problems and their boundary conditions.
	CO5	Explain and calculate electric fields and electric potentials caused by electric multipole distributions.
	CO6	
	CO7	
	CO8	

The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO1	Coulomb's law, electric field and potential caused by electric charges.	Lecture, discussion	3 x 50 minutes
	CO1	Gauss's law for electricity and the density of electrical energy in a vacuum, Green's Theorem.	Lecture, discussion	3 x 50 minutes
	CO1	Electrostatic potential energy, configuration energy, energy density.	Lecture, discussion	3 x 50 minutes
	CO2	Boundary conditions problems include: solving boundary conditions problems using the shadow method if there is a source.	Lecture, discussion	3 x 50 minutes
	CO2	Hamiltonian formulation, phase space, Legendre transformation, Hamiltonian mechanical relations with symmetry and the law of sustainability.	Lecture, discussion	3 x 50 minutes
	CO2	Multipole moment, electric field, potential generated by multipole moment in vacuum.	Lecture, discussion	3 x 50 minutes
	CO2	Multipole moments, electric fields, potentials generated by multipole moments in the medium.	Lecture, discussion	3 x 50 minutes
	CO3	Magnetic induction field generated by a current density distribution, Bio-Savart's Law, Ampere's Law.	Lecture, discussion	3 x 50 minutes

	CO3	Faraday's law and induced emf, as well as vector potential, vector potential, differential equations in vector potential form and how to solve them.	Lecture, discussion	3 x 50 minutes
	CO3	Magnetic Moment and Magnetic Induction Fields created by magnetic moments in a vacuum.	Lecture, discussion	3 x 50 minutes
	CO4	Magnetic moment and magnetic induction field generated by a magnetic moment in a linear isotropic medium.	Lecture, discussion	3 x 50 minutes
	CO4	Magnetic field in the boundary plane	Lecture, discussion	3 x 50 minutes
	CO4	Maxwell's equations are in differential, integral form, as well as in the form of scalar potentials and vector potentials, tera transformations.	Lecture, discussion	3 x 50 minutes
	CO4	Simple application of Maxwell's equations: electromagnetic waves.	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: Coulomb's law, electric field and potential caused by electric charges., Gauss's law for electricity and the density of electrical energy in a vacuum, Green's Theorem., Electrostatic potential energy, configuration energy, energy density., Boundary conditions problems include: solving boundary conditions problems using the shadow method if there is a source., Hamiltonian formulation, phase space, Legendre transformation, Hamiltonian mechanical relations with symmetry and the law of sustainability., Multipole moment, electric field, potential generated by multipole moment in vacuum., Multipole moments, electric fields, potentials generated by multipole moments in the medium., Magnetic induction field generated by a current density distribution, Bio-Savart's Law, Ampere's Law., Faraday's law and induced emf, as well as vector potential, vector potential, differential equations in vector potential form and how to solve them., Magnetic Moment and Magnetic Induction Fields created by magnetic moments in a vacuum., Magnetic moment and magnetic induction field generated by a magnetic moment in a linear isotropic medium., Magnetic field in the boundary plane, Maxwell's equations are in differential, integral form, as well as in the form of scalar potentials and vector potentials, tera transformations., Simple application of Maxwell's equations: electromagnetic waves..			
Access to Learning Media/ LMS and Offline and Online Percentage	Powerpoint			
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:** Jackson, J. D, 1999, Classical Electrodynamics, edisi3, John Wiley & Sons.
Lecturers (*Team Teaching*)	1. Dr. Dwi Satya Palupi, S.Si., M.Si. 2. 3. 4.

Authorization	**Date of Drafting**	**Lecturer Coordinator**	**Head of Curriculum Committee**	**Head of Study Program**
		Dr. Dwi Satya Palupi, S.Si., M.Si.	Dr.Ing. Ari Setiawan	Mirza Satriawan, M.Si., Ph.D