SEMESTER LEARNING ACTIVITY PLANS (SLAP)

SEMESTER ODD 2022/2023

Physics Undergraduate Study Program

Physics Department

Electromagnetics I

MFF 2415/ 2 Credits

Lecturer Coordinator:

Drs. Wagini R., M.S.
Idham Syah Alam, S.Si., M.Sc.

UNIVERSITAS GADJAH MADA
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
2022

	Universitas Gadjah Mada Faculty of Mathematics and Natural Science Physics Department / Physics Undergraduate Study Program Semester ODD 2022/2023	**Document Number :** …………

SEMESTER LEARNING ACTIVITY PLANS (SLAP)

Code	Course Name	Credits (Credits)		Semester	Status	Prerequisite
MFF 2415	*Electromagnetics I*	*T: 2*	*P: …*	*ODD*	*Compulsory*	*Basic Physics II (MFF1012), Mathematical Physics I (MFF1020)*

Short Description	Physics is a human effort to understand all physical phenomena or phenomena and apply them for engineering and technological purposes. To understand physical phenomena or phenomena, physicists then build theories that describe the relationship between fundamental physics concepts about the physical attributes of physical system objects, such as mass and electric charge, and the accompanying fields and interactions. Among the physical symptoms familiar with daily experience are the symptoms of electricity and the symptoms of magnetism. Learning about the phenomena of electricity and magnetism for the dimensions of physical systems where classical physics applies begins through the Basic Physics Two course and the Electricity and Magnetism course, which provides fundamental theories of electricity and magnetism, such as ideas and models about electric charge, then the properties of charge and magnetism. Generated fields such as electric and magnetic fields and the forces generated by electric and magnetic fields. This Basic Physics Two course is designed so that students can conceptualize electrical and magnetic phenomena based on basic models and theories about electricity and magnetism, for example, through ideas and definitions of electric charge and field, moving electric charge and magnetic field, as well as magnetic flux density, to electric potential, electrical energy, electric current, electric circuits, and magnetic fields as well as applying basic models and theories of electricity to understand electrical and magnetic phenomena in more macro and ideal physical systems in terms of geometry and characteristics of physical systems that are reviewed such as polarization and permittivity phenomena, phenomena magnetization and permeability, electric power sources, electrical resistance, capacitors, etc. Meanwhile, the Electricity and Magnetism course is designed as a continuation of the Two Basic Physics course with an emphasis on the ability to elaborate vector concepts, vector algebra, nabla operators, divergence, curl, and laplacian in representing quantities and phenomena of electricity and magnetism in cases in the system. Ideal electrostatics and magnetostatics apply the basic concepts of electricity and magnetism in understanding the characteristics of properties and components in direct current electric circuits, symptoms of induced emf, and alternating current electric circuits. The Electromagnetic Lecture is a compulsory course that is a continuation of the Second Basic Physics course and the Electricity and Magnetism Lecture. This course is designed so that students have more profound and broader mathematical analysis tools in presenting the fundamental laws of electrostatics and magnetostatics in integral and differential forms through Stoke's theorem and Gauss's theorem (Maxwell's equations for the stationary case), vector algebra in spherical and cylindrical coordinates, and reviewing electrostatic and magnetostatic phenomena in materials through the concepts of polarization and magnetization. In the Electromagnetics course, the physical system reviewed is based on the classical atomic concept, which accommodates the concepts of orbital and spin momentum, and chemical bonds, which accommodate the concepts of free and bound charges. In this way, students are expected to be able to apply the theories of electricity and magnetism in understanding the phenomena of electricity and magnetism in more complex materials, such as the concepts of dielectric, diamagnetic, paramagnetic, and ferromagnetic.

<table>
<tr><td></td><td colspan="2">As a compulsory subject for the S1 Physics study program, the Electromagnetics course forms the essential competencies that physics graduates must possess. To achieve this target, the role of learning methods as a bridge between courses and the competencies possessed by students is essential. Many methods of spending can be an option for organizing lectures. All of these methods will, of course, be based on the characteristics of the course, student input, and the number of students. Observing the characteristics of physics, the lecture would be the most rational choice. Of course, lectures must invite students' interest and enthusiasm by linking the role of courses to the latest technological developments and understanding how close and strategic technological products in students' daily lives are made and work. Electromagnetic interactions that dominate physical aspects on a wide dimensional scale that are very close to daily human life make lectures a source of inspiration for students. Lectures must also integrate students in two-way discussions where lecturers must be able to encourage students to understand the course material as a series of previous courses based on the basic concepts obtained in the Two Basic Physics course and the Electricity and Magnetism course. Assessment which plays a role in measuring the extent to which students meet the targeted competency criteria also has an important position in the success of lectures. As prospective physicists, students are required to be able to think logically in applying basic concepts and theories in analyzing problems and making breakthroughs or discoveries both descriptively and analytically. Thus the exam questions, which are assessment tools, must be able to measure these two abilities. In addition to meeting the minimum standards to show that students understand lecture material, the questions must also be able to classify students' essential efforts and abilities in mastering lecture material.</td></tr>
<tr><td rowspan="2">Program Learning Outcomes (PLO) Imposed on the Course</td><td>PLO 2</td><td>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.</td></tr>
<tr><td>PLO 5</td><td>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.</td></tr>
<tr><td rowspan="10">Course Outcomes (CO)</td><td colspan="2">After completing this course, students are expected to be able to:</td></tr>
<tr><td>CO1</td><td>Able to represent vectors and vector algebra in various coordinate systems.</td></tr>
<tr><td>CO2</td><td>Able to display nabla, divergence, curl, and laplacian operators in various coordinate systems, and be able to identify and apply various coordinate systems to various geometries (shapes) of the physical system under review and be able to apply operations and physical meanings of nabla, divergence, curl and laplacian to electric and magnetic fields.</td></tr>
<tr><td>CO3</td><td>Able to understand the physical meaning of Stoke's theorem and Gaus's theorem and able to apply Gauss's theorem and Stoke's theorem to display Maxwell's equations in Differential form.</td></tr>
<tr><td>CO4</td><td>Be able to distinguish the properties of electric field lines and magnetic fields about the concept of electric and magnetic monopoles and see the relationship between fields and field sources in Coulomb's law and Ampère's law.</td></tr>
<tr><td>CO5</td><td>Identify the fundamental laws of electrostatics and magnetostatics and display Maxwell's equations about electric and magnetic monopoles.</td></tr>
<tr><td>CO6</td><td>Able to review electric and magnetic fields in materials through electric polarization and magnetization of materials.</td></tr>
<tr><td>CO7</td><td>Able to review the electrical aspects of materials made up of atoms and chemical bonds through the concepts of free and bound charges and magnetic moments.</td></tr>
<tr><td>CO8</td><td>Able to apply boundary conditions for electrostatic and magnetostatic fields.</td></tr>
<tr><td>CO9</td><td>Be able to distinguish the meaning of electric field, electric flux density, and magnetic field and magnetic flux density.</td></tr>
</table>

	CO10	Be able to identify the properties of electric and magnetic forces as well as the Lorentz force law.		
	CO11	Be able to express the magnetic force acting on particles and conductors that conduct current and the interaction between two conductors that conduct current.		
	CO12	Able to understand the integration of electrical and magnetic phenomena through Maxwell's equations.		
	CO13	Be able to display Maxwell's equations for time-dependent fields.		
The Correlation of CO to Learning Materials and Methods, and Time Allocation		**Learning Materials**	**Learning Methods**	**Time Allocation**
	CO 1	Vector concepts, orthogonal curvilinear coordinates, and transformation rules between coordinate systems	TCL-SCL mixed	TCL-SCL mixed
	CO 2	Scale factor, general equation of nabla, divergence, curl in orthogonal curvilinear coordinate System, properties of electric and magnetic vector fields, and applying spherical and cylindrical coordinates in two cases.	TCL-SCL mixed	TCL-SCL mixed
	CO 3	Stokes' theorem and Gauss's theorem, Application of Gauss's theorem to Quolomb's law and the sum of magnetic flux on closed surfaces, and applying Stokes' theorem to Ampere's law and electric emf.	TCL-SCL mixed	TCL-SCL mixed
	CO 4	Properties of continuity of electric field lines and magnetic field lines, nature of divergence and curl of electric and magnetic fields from static sources, Coulomb's Law, and Ampère's Law	TCL-SCL mixed	TCL-SCL mixed
	CO 5	Maxwell's four equations for sources of static electric and magnetic fields.	TCL-SCL mixed	TCL-SCL mixed
	CO 6	Electric and magnetic fields in materials (polarization and magnetization).	TCL-SCL mixed	TCL-SCL mixed
	CO 7	Bonded and free charges, orbital magnetic moments, and spin intrinsic orbital moments.	TCL-SCL mixed	TCL-SCL mixed
	Midterm exam/Project Task Results/Case Analysis Results			
	CO 8	Ampere's and Gauss's laws for the interface between two mediums with different permittivity and permeability.	TCL-SCL mixed	***2X50 minutes***

	CO 9	Sources of electric and magnetic fields measured electric and magnetic fields.	TCL-SCL mixed	***2X50 minutes***
	CO 10	Electric force, magnetic force and their conservative and non-conservative properties, Lorents force and equations of motion (trajectory) of particles in electric and magnetic fields	TCL-SCL mixed	***2X50 minutes***
	CO 11	Charges and conductors that conduct electric current in a magnetic field, as well as interactions between two conductors	TCL-SCL mixed	***2X50 minutes***
	CO 12	The relationship between the electric field and the magnetic field	TCL-SCL mixed	***2X50 minutes***
	CO 13	Maxwell's equations with sources change with time.	TCL-SCL mixed	***2X50 minutes***
	CO 14	Electromagnetic waves, the properties of electromagnetic waves in a vacuum, and the properties of electromagnetic waves in materials are the boundary conditions of electric and magnetic fields for the interaction between electromagnetic waves and materials.	TCL-SCL mixed	***2X50 minutes***
	Final exams/ Project Task Results/Case Analysis Results			
Learning Methods	**SCL (Student Centered Learning): Project-based learning (Team-based Project)/Case-based learning/PBL/other SCL methods**			
Student Learning Experience	**Listening, Answering, Asking, Opinion, Answering Quiz**			
Access to Learning Media/ LMS and Offline and Online Percentage	Offline (LCD, PPT Slide, Whiteboard, Laptop) and Online (Zoom Meeting, Google Meet, Google Classroom)			

Assessment Methods and Synchronization with CO	**Assessment Methods**	**Assessment Percentage**	**Criteria/ Indicators**	**CO**												
				1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	Participatory Activity*															
	Project Results/ Case															

	Study Results/ PBL Results*															
	Cognitive															
	Homework	**20**		√	√	√	√	√	√	√	√	√	√	√	√	√
	Midterm Exam	**40**		√	√	√	√	√	√	√						
	Final Exam	**40**									√	√	√	√	√	√
	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. Griffiths, D. J., 1999, Introduction to Electrodynamics, Prentice Hall, Upper Saddle River, New Jersey..
2. Wangness, R. K. 1979, Electromagnetic Fields, John Wiley & Sons, USA..
3. Reitz, J. R., F. J. Milford, dan R. W. Christy, 1992 : Foundations of Electromagnetic Theory, edisi 3, Addison-Wesley..
4. Sadiku, M.N.O., 2018, Elements of Electromagnetics, Edisi ke-7, Oxford University Press.
5. Franklin, J., 2017, Classical Electromagnetism, Edisi ke-2, Dover Publications, Inc

Lecturers (*Team Teaching*)

1. Drs. Wagini R., M.S.
2. Idham Syah Alam, S.Si., M.Sc.

Authorization

Date of Drafting	Lecturer Coordinator	Head of Curriculum Committee	Head of Study Program
	Drs. Wagini R., M.S.		*Dr. Eng. Ahmad Kusumaatmaja, S.Si., M.Sc.*