Electromagnetism 1

Basic Course Information			
Course Number	01005102	**Subject Category**	Compulsory (M)
Class Format	Lecture	**Credit Type and Number of Credits**	1
Department	Mechatronics	**Student Category**	Year 2
Period of Study	Semester 2	**Classes per Week**	2
Required Materials	KOSEN Textbook Series Physics volume 2, Heat, Electricity and Magnetism, and Atoms, H. Ushio et al., Morikita Publishing Co., Ltd. ISBN978-4-627-15521-4		
Instructor	Suwun Suwunnarat	Natsuda Klongyeesa	

Course Objective

Electromagnetism is a branch of physics involving the study of the electromagnetic force as well as the combination of electric and magnetic phenomena. There are various types of engineering problems that require a good knowledge and application of electromagnetism. Electromagnetism is important to understand the operation of electrical and mechatronics systems. This course provides the basic concepts of electromagnetism including the nature of electric charge, Coulomb's law, Gauss law, and static electric fields. The exercise, homework, and presentation are designed to help the students to develop knowledge, problem solving skills and understanding of the basis of the electromagnetism. Basic vector calculus, mathematical treatments in the electromagnetism, are also covered.

Evaluation (Rubric)	Ideal Level of Achievement (Very Good)	Standard Level of Achievement (Good)	Unacceptable Level of Achievement (Fail)
Understanding concepts of Electromagnetism and their relation	Demonstrates very good knowledge and understanding of concepts in Electromagnetism Good connections among these concepts and mathematical procedures to correctly solve problems or answer questions.	Demonstrates good knowledge and understanding of typical Electromagnetism concepts. Good connections among these concepts and mathematical procedures to solve problems, but occasionally may make minor errors.	Lacks the appropriate knowledge and understanding of concepts in Electromagnetism . Weak connections among these concepts.
Mathematical and graphical representation	Describe electromagnetism theorems and laws with equations. Able to apply a proper law to calculate electromagnetic quantities. Equations show good understanding and graphs are logical with sufficient details to describe electromagnetic phenomena.	Describe electromagnetism theorems and laws with equations. Able to apply a proper law to calculate electromagnetic quantities for simple cases. Equations show understanding and graphs are reasonable with information to understand electromagnetic phenomena, but not with details.	Describe electromagnetism theorems and laws inefficiently. Apply theorems or formulas improperly. Equations are limited or inaccurate. Graphs are incomplete or absent of information
Problem Solving	Provide a clear and logical progression from general concepts/equations to solve specific problems with different conditions. All final numerical answers are correct with appropriate units and calculations.	Provide a logical progression from general concepts/equations to solve specific problems with minor mistakes in calculation, algebraic, or units.	Provide an unclear logical progression or solution which is very difficult to follow. Major algebraic and/or other mathematical mistakes in solution.

Relationship with Learning Outcomes
G(5) As an engineer, attitude to act with awareness of social roles and responsibility to make a better society.
M(1) Ability to design, propose and develop robotic/ mechatronic systems to solve specific problems
M(2) Ability to design, propose and develop electrical and electronic systems for robotics/ mechatronic systems

Teaching Method	
Outline:	Students will study basic concepts and principles of Electromagnetism. Students are expected to develop an appreciation of the fundamental laws and principles and their applications to solve typical problems. Some topics will be demonstrated in class and/or in-class lab work will be conducted.
Class Format:	Lecture/exercise, and mini-Lab/demonstration
Please Note :	All materials will be posted on the Google classroom. The student is requested to keep photo copies or files of all submitted material to ensure further study by oneself. Assignment is requested to submit in Google classroom within a week after it is assigned. If not, there will be score deduction for late submission (full score - 100 points (submission within a week), 80 points (submission after one week) and 65 points (submission after the Electromagnetism 1's final exam date) and 0 points (2 weeks after the final exam date)).

Course Plan			Related MCC		
Semester 2	**Contents and Method of Course**	**Goals**			
1st week	Introduction to Electromagnetism, the Nature of Electric Charge, and Electrostatics: Coulomb's Law, 1	Appreciation of the relationship between electromagnetism and physics/engineering subjects. Appreciation of concepts of Coulomb's law for force between two point charges.	I-A I-A I-A V-C	1 1 1 2	68 69 70 26
2nd week	Electrostatics: Coulomb's Law 2 and Electroscope	Appreciation of concepts of Coulomb's law. Able to calculate electric forces for multiple point charges.	I-A I-A V-C	1 1 2	69 70 26
3rd week	Electric Field and Electric Line of Force	Appreciation of concepts electric field and electric line of force. Able to draw visual representation of electric line of force from the electric field magnitude.	V-C	2	27
4th week	Gauss' Law and Closed Surface, 1: Vector Field	Review of basic concepts of vector calculus in 3 dimensional spaces (3D) and surfaces. Able to define and create 2 dimensional (2D) representation of 3D vector field.			
5th week	Gauss' Law and Closed Surface, 2: Concept of Flux	Appreciation of concept of closed surfaces and electric flux.	V-C	2	27
6th week	Gauss' Law and Closed Surface, 3: Application	Able to calculate simple derivatives and integration of functions in the standard problems of electromagnetism: a point charge and an infinite line charge.	V-C	2	28
7th week	Wrap-up of first half of semester	Review and summarization			
8th week	Midterm examination	Contents from week 1-7			
9th week	Return Midterm exam and Feedback	Review learning content of week 1-7			
10th week	Gauss' Law and Closed Surface, 4: Application	Able to calculate simple derivatives and integration of functions in the standard problems of electromagnetism: an infinite plane charge and a spherical charge.	V-C	2	28
11th week	Electric Potential Energy and Electric potential, 1	Appreciation of concept of electric potential energy and the relationship between the electric force and electric potential energy. Able to calculate electric potential for two point charges.	I-A V-C	1 2	71 27
12th week	Electric Potential Energy and Electric potential, 2	Appreciation of concept of electric potential and the relationship between the electric field and electric potential. Able to calculate electric potential for a single point charges.	I-A V-C	1 2	71 27
13th week	Application of electric potential and partial derivatives, 1	Able to calculate simple partial derivatives of functions in the standard problems of electromagnetism: electric field and potential of dipole in 1D.	I-A V-C	1 2	71 27
14th week	Application of electric potential and partial derivatives, 2	Able to calculate simple partial derivatives of functions in the standard problems of electromagnetism: a simple continuous geometry and an electric dipole in 2D.	I-A V-C	1 2	71 27
15th week	Equipotential Surfaces, and Mapping Equipotential Lines (Lab)	Appreciation of concept of equipotential lines and surfaces (contour mapping). Able to draw systematically the equipotential lines for 2D cases and 2D representation of 3D problems.	I-B I-B I-B I-B I-B	1 1 1 1 1	1 2 3 4 9
16th week	Wrap-up of second half of semester	Review and summarization			
17th week	Final examination	Contents from week 9-15			
18th week	Return Final exam and Feedback	Review learning content of week 9-15.			

Do not

	Examination	Quiz	Mutual Evaluations between students	Report	Portfolio	Other
Basic Ability	50				20	
Technical Ability	10				20	
Interdisciplinary Ability						