TEACHING INSTRUCTIONAL DESIGN (BRP)

COURSE

ELECTRICITY AND MAGNETISM

by

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PREFACE

The Electricity and Magnetism course contains basic concepts of physics related to electricity and magnetism. This subject has been taught in the classroom using the teacher-centered learning method. The lecturer explains the basic concepts and provides some examples of their application. Meanwhile, students listen to and take notes on the lecturers' explanations. Students are expected to tutor themselves in mastering this course material through an independent study process and structured homework assignments.

Along with the times followed by the very rapid development of knowledge and the needs of educational stakeholders, necessitates a change in the educational paradigm from a transfer of knowledge paradigm to a knowledge building paradigm. Following this paradigm shift, students will study Electricity and Magnetism courses with a combination of several active learning methods (student centered learning), namely interactive lectures, question based learning, computer assisted learning, and project based learning. With these methods, in addition to learning basic physics concepts, students can practice and sharpen their soft skills through activities during lectures such as during group assignments. Students can also develop skills using information technology and computers through SCELE UI facilities.

This Teaching Instructional Design is prepared for teaching and learning guide at the Department of Physics, FMIPA University of Indonesia. Thus, the learning process by students can be directed and ultimately the learning objectives can be achieved

Depok, 26 November 2016

Efta Yudiarsah, Ph.D.

I. General Information

1.	Name of Program / Study Level	:	Physics / Undergraduate
2.	Course Name	:	Electricity and Magnetism
3.	Course Code	:	SCFI601115
4.	Semester	:	2
5.	Credit	:	3 credits
6.	Teaching Method(s)	:	Lecturing, Question based learning, Computer assisted learning, and Project based learning.
7.	Prerequisite course(s)	:	Mechanics and Heat
8.	Requisite for course(s)	:	Basic of Laboratory Physics 1, Basic of Laboratory Physics 2, Modern Physics, Termodynamics, Electronics 1, Electronics Laboratory 1, Classical Mechanics, Electromagnetic Fields 1, Wave and Vibration, and Energy Physics.
9.	Integration Between Other Courses	:	Basic of Physics Laboratory 1 and Basic of Physics Laboratory 2
10.	Lecturer	:	Efta Yudiarsah, Ph.D.
11.	Course Description	:	The Magnetic Electricity course consists two major topics, magnetism and electricity. Students study this course with a combination of several active learning methods, i.e interactive lectures, question based learning, computer assisted learning, and project based learning. Students have the opportunity to practice integrating basic conceptual understanding, analytical skills, and numeracy skills in studying these topics. Students also practice explaining and analyzing natural phenomena and the results of human engineering that exist in their environment by using basic physics concepts and applying them to everyday life. Also, students can develop the ability to synthesize and evaluate both qualitatively and

quantitatively natural phenomena and human engineering results by using basic physics concepts. After taking this course, first year students are expected to be able to formulate solutions to problems of electricity, magnetism, fluid waves, transient electrical circuits (consisting of resistance, capacitors and inductors) and electromagnetic materials.

II. Course Learning Outcome (CLO) and Sub-CLOs

A. CLO

Students are able to apply the principles and concepts of Electricity and Magnetism for formulating solutions of the problems. **(ELOs 1,2,5,6, and 7)**

B. Sub-CLOs

1. To identify the forces on a charged object and the electric field due to a single charge, a set of charges, and a continuous charge distribution (C3).
2. To uses Gauss's law to determine the electric field around a charged rigid object (C3).
3. To describe the electric field around a set of charges if the electric potential is known (C3).
4. To determine the electric field, energy, and charge stored in a capacitor given a potential difference (C3).
5. To formulate the problem solving circuit of ohmic materials and direct current capacitors (C3).
6. To describe the influence of magnetic fields on charges and current wires and loops (C3).
7. To determines the magnetic field due to the moving charge and distribution of the electric current (C3).
8. To determine the electromotive force and electric field caused by changes in magnetic field flux (C3).
9. To describes the relationship between energy stored in magnetic fields and electric currents and voltages in capacistors, inductors and resistors (C3).
10. To describes alternating current transformers and series resistances, capacitors, and inductors (C3).
11. To describe the relationship between electric fields, magnetic fields, propagation velocity, and energy in electromagnetic waves (C3).

III. Teaching Plan

Week	Sub-CLO	Study Materials	Teaching Method	Time Required	Learning Experiences (*O-E-F)	Sub-CLO Weight on Course (%)	Sub-CLO Achievement Indicator	References
1	1	Dynamics of many objects	Lecturing	200 minutes	20% O, 60% E, 20% F	**6**	Explain the concept and calculation of gravitational and potential fields due to mass distribution. Motion on a non-inertial frame of reference (D'Alembert force) Work and Energy by Non-conservative Forces (friction, viscosity, drag force, etc.). Distributed mass translational motion. The translational motion of the system with mass changes The moment of inertia is a discrete and continuous mass distribution Gyroscope motion. Fundamental forces, quantization concepts of energy, energy and momentum of objects moving at high velocity	[1] Sub-unit 9.12, 10.7, 11.9, 11.12, 13.3, 13.5 [2] Sub-unit 8.5, 8.6, 9.9 and 9.10, 10.5, 10.7, 11.7, 11.8, 11.9
2	2	Electric charge and field	Lecturing	200 minutes	20% O, 60% E, 20% F	8	Explains the concepts and calculations of electric charges,	[1] Unit 21 and Unit 22

							conductors, insulators and induced charges, Coulomb's law, electric forces and fields, electric field calculations, electric field lines, motion of charges in an electric field, and electric dipoles.	
3	3	Gauss's law	Lecturing	200 minutes	20% O, 60% E, 20% F	6	Explain the concept and calculation of electric charge and flux, calculate electric flux, Gauss law and application of Gauss law.	[1] Unit 23
4	4	Electric potential	Lecturing	200 minutes	20% O, 60% E, 20% F	6	Explain the concept of electric potential energy, electric potential, calculate electric potential, equipotential surface and potential gradient.	[1] Unit 24
5	5	Capacitance and dielectric	Lecturing	200 minutes	20% O, 60% E, 20% F	6	Describes the concepts of capacitors and capacitances, the arrangement of series and parallel capacitors, energy storage in capacitors and energy in electric fields, and dielectrics.	[1] Unit 25
6	6	Electric current, resistance and direct current	Lecturing	200 minutes	20% O, 60% E, 20% F	6	Describes the concepts of electric current,	[1] Unit 26 and Unit 27

							resistance and resistivity, electric circuits and induced electromotive force, energy and power in electrical circuits, series and parallel array resistors, kirchoff rules, measuring instruments and power distribution systems	
7	7	Magnetic field and magnetic force	Lecturing	200 minutes	20% O, 60% E, 20% F	6	Explains the concepts of Magnet, magnetism, and magnetic fields, magnetic field lines and magnetic flux, motion of charged particles in a magnetic field, magnetic force on charged particles, consequences of magnetic force on charged particles, magnetic force on electric currents, magnetic force in current loops, direct current motors, and hall effects	[1] Unit 28
8	8	source of the magnetic field	Lecturing	200 minutes	20% O, 60% E, 20% F	6	Explain the concept of magnetic field in moving charges, magnetic field in current wire, magnetic field in current	[1] Unit 29

							conductors, force between current conductors, magnetic field in centrally current loops, ampere law and applications of ampere law.	
9	**Mid Term Exam**							
10	10	Electromagnetic Induction	Lecturing	200 minutes	20% O, 60% E, 20% F	6	Applying Faraday's equations of discovery and the law of inductance, Lenz's law, induced electromotive force, induced electric field, displacement currents and Maxwell's equations	[1] Unit 30, Sub-unit 30-1,..,30-6
11	11	Inductance	Lecturing	200 minutes	20% O, 60% E, 20% F	6	Describes the concept of mutual inductance, self inductance and inductors, inductors and magnetic field energy, R-L circuits, L-C circuits, R-L-C circuits	[1] Unit 30, Sub-unit 30-7,..,30-12
12	12	Alternating current	Lecturing	200 minutes	20% O, 60% E, 20% F	6	Describes the concepts of phasors and alternating electric currents, resistance and reactance, alternating electric currents and series RLC circuits, power in alternating current circuits, and resonance in	[1] Unit 31

							alternating current circuits.	
13	13	Maxwell's Equations and Electromagnetic Waves	Lecturing	200 minutes	20% O, 60% E, 20% F	6	Describes the concepts of Maxwell's equations and electromagnetic waves, flat waves / electromagnetic fields, energy and momentum of electromagnetic waves, dipole radiation and polarization.	[1] Unit 32, Sub-unit 32-1, 32-5, and Unit 33, Sub-unit 33-1,.., 33-6
14	**Final Exam**							

*) O : Orientation
E : Exercise
F : Feedback

References:

[1] Halliday, Resnick, and Walker, *Principles of Physics 9th Edition*, Wiley, 2011.
[2] Serway Jewett,*Physics for Scientists and Engineers 7th Edition*, Thomson Brooks/Cole, 2010.
[3] Giancoli, *Physics for Scientists and Engineers 4th Edition*, Pearson, 2008

IV. Assignment Design

Week	Assignment Name	Sub-CLOs	Assignment	Scope	Working Procedure	Deadline	Outcome
2	Individual assignment 1	2	Problem set	Electric charge and electric field	Homework	1 week	Answer sheet
3,4	Group Work 1	3,4	Problem set	Gauss's law and electric potential	Group work	1 week	Answer sheet
5	Individual assignment 2	5	Problem set	Capacitance and dielectric	Homework	1 week	Answer sheet
6	Individual assignment 3	6	Problem set	Electric current, resistance and direct current	Homework	1 week	Answer sheet
7	Group Work 2	7	Problem set	Magnetic fields and magnetic forces and sources of magnetic fields	Group work	1 week	Answer sheet
8	Individual assignment 4	8	Problem set	Electromagnetic Induction	Homework	1 week	Answer sheet
9	Mid Term Exam						
11	Individual assignment 5	11	Problem set	Inductance	Homework	1 minggu	Answer sheet
12	Individual assignment 6	10	Problem set	Alternating current	Homework	1 minggu	Answer sheet
13	Individual assignment 7	11	Problem set	Maxwell's Equation	Homework	1 minggu	Answer sheet

*) Group work grades: attractive poster display (20%), completeness of the contents of posters and papers (50%), and readiness of participants for presentation (30%).

V. Assessment Criteria (Learning Outcome Evaluation)

Evaluation Type	Sub-CLOs	Assessment Type	Frequency	Evaluation Weight (%)
Post- and Pre-test	1-13	Quiz in SCELE	26	10
Quiz	1-13	Answer sheet	4	10
Individual assignment	1-13	Answer sheet	17	8
Group assignment	8	Assessment sheet	1	7
Activeness	1-13	Assessment sheet	1	5
Mid Term Exam	1-8	Answer sheet	1	30
Final Exam	10-13	Answer sheet	1	30
Total				**100**

VI. Rubric(s)

A. Criteria of Self-Assignment

Score	Answer Quality
>90	If the student can complete more than 90% problem correctly
70-89	If the student can complete more than 70% - 89% problem correctly
60-69	If the student can complete more than 60% - 69% problem correctly
55-59	If the student can complete more than 55% - 59% problem correctly
50-54	If the student can complete more than 50% - 54%problem correctly

B. Criteria of Group Assignment

Score	Answer Quality
90-100	If students can apply basic concepts in explaining on natural phenomena and technology with 80-90% accuracy, coherence and correct language
70-89	If students can apply basic concepts in explaining on natural phenomena and technology with 70-89% accuracy, coherence and correct language
60-69	If students can apply basic concepts in explaining on natural phenomena and technology with 60-69% accuracy, coherence and correct language

C. Quiz, Mid Term Exam and Final Exam

1) Able to express ideas in solving problems (25%);
2) Able to determine the right basic concepts in solving problems (35%);
3) Able to formulate the final solution of problems correcting language errors (30%);
4) Able to use the appropriate important units and figures (10%);

VII. Appendix: Example of Exam Problems

EXAMPLE OF ASSIGNMENTS AND EXAM (MID TERM, FINAL EXAM, ETC)

Appendix 1. Example of Assignments

1. Example of group assignment:

Group assignment: Discuss how do the airplanes can fly. Analyze the phenomenon based on basic physical principles 1. Write a report in the form of papers and posters. Posters will be presented in the twelfth week.

2. Example of individual assignment:

Individual assignment, Electric Charge and Electric Field. Do the questions in the main textbook (Halliday) Unit 21 question number: 12, 32, and 36, and Unit 22 question number: 2, 13, 24, 36, 50, and 60

Appendix 2 . Example of Evaluation Test

1. Multiple Choice

1. A battery is connected by a series of two identical resistors. If the battery potential difference is V, and the electric current produced is i, then

A. the potential difference for each resistor is V and the electric current in each resistor is i.

B. The potential difference for each resistor is V/2 and the electric current in each resistor is i/2.

C. the potential difference for each resistor is V and the electric current in each resistor is i/2.

D. the potential difference for each resistor is V/2 and the electric current in each resistor is i.

E. all wrong.

2. A parallel strip capacitor has a chip area 0,2 m^2 and the distance between the pieces 0.1 mm. In order to obtain an electric field of 2,0 x 10^6 V/m between two pieces, the amount of charge on each chip isA. 8,9 x 10^{-7} C

B. 1,8 x 10^{-6} C

C. 3,5 x 10^{-6} C

D. 7,1 x 10^{-6} C

E. 1,4 x 10^{-7} C

3. If a virtual image is formed along the principal axis 10 cm from a concave mirror with the focal length 15 cm, what is the object distance from the mirror?

A. 30 cm

B. 10 cm

C. 12 cm

D. 6.0 cm

E. 4.4 cm

2. Essay

A plastic ball is hung by a long rope 20 cm. If the plastic ball experiences a balanced state by forming an angle 15˚ to the vertical after being given an electric field $\vec{E} = 1.0 \times 10^3 \hat{i}$ N/C, specify (a) the electric force experienced by the ball and (b) the total charge of the ball.