TEACHING INSTRUCTIONAL DESIGN (BRP)

COURSE

ELECTROMAGNETIC FIELD 1

by

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PREFACE

Teaching Instructional Design (BRP) of Electromagnetic Field 1 course is the first part systematic teaching design from two consecutive courses, Electromagnetic Field 1 and Electromagentic Field 2, that study the behaviour of charge system on both static and dynamic frames, where on this course, the contents are focused on the static and stationary dynamic charge systems. This course is held on Term 4 with the following prerequisites: Electricity and Magnetism, Vibrations, Waves, Optics, Mathematical Methods in Physics 2, and Mathematical Methods in Physics 3. On this course, students will learn about the general concept of static electromagnetic. We hope this BRP can be a reference of learning process for lecturers and students so the contents of this course can be delivered appropriately.

Depok, 22 December 2017

Prof. Dr. Anto Sulaksono **Dr. Suhardjo Poertadji** **Dede Djuhana, Ph.D.**

I. General Information

1.	Name of Program / Study Level	:	Physics / Undergraduate
2.	Course Name	:	Electromagnetic Field 1
3.	Course Code	:	SCFI602114
4.	Semester	:	4
5.	Credit	:	3 credits
6.	Teaching Method(s)	:	Lecturing, individual- and group-assignments, written exam
7.	Prerequisite course(s)	:	Electricity and Magnetism, Vibrations, Waves, and Optics, Mathematical Methods in Physics 2, Mathematical Methods in Physics 3
8.	Requisite for course(s)	:	Electromagnetic Field 2, Spectroscopy 1
9.	Integration Between Other Courses	:	None
10.	Lecturer(s)	:	1. Prof. Dr. Anto Sulaksono 2. Dr. Suhardjo Poertadji 3. Dede Djuhana, Ph.D.
11.	Course Description	:	Electromagnetic Field 1 is a course about electricity and magnetism in advanced level compared to Electricity and Magnetism course. The content of this course consist of: definition of electrostatic, solution of electrostatic problem, static electric field at conductor and dielectric media, electrostatic energy, electric current, static magnetic field, steady-state current, magnetic properties of materials, magnetic energy, electromagnetic induction.

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

A. CLO

Students are able to solve the static electric and magnetic fields problems and be able to interpret the phenomena regarding the concept of static electric and magnetic fields and their applications in the area of condensed-matter, material, nuclear and particle, instrumentation, and medical physics. (ELO(s) 1, 2, 5, 6, 7)

B. Sub-CLOs

1. To interpret the properties of source (charge distribution and current) and static electromagnetic field induced by the source and construct the formula of the field in appropriate physical and mathematical expressions (C3).
2. To calculate static electric force and energy, static magnetic energy, electric field on conductor, coefficient of capacitance, and coefficient of inductance (C3).
3. To calculate Ohm's Law, electromotive force, magnetic induction, Faraday's Law, and displacement current (C3).
4. To solve the static electromagnetic problems using Laplace's equation, image method, and Poisson's equation (C3).
5. To apply the concept of static electric field on dielectric materials (C3).
6. To apply the concept of static magnetic field on magnetic materials (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	Static and dynamic electric charges, electric field, Gauss' Law, and electric potential	Lecturing	150 minutes	70% O, 30% F	6	To interpret the concept and calculation of electric field due to static electric charges	No. 1 pp. 58-87; no. 2 pp. 1-47
2	1	Magnetic field, Ampere's Law, and magnetic potential	Lecturing	150 minutes	70% O, 30% F	6	To interpret the concept and calculation of magnetic field due to electric current	No. 1 pp. 206-234
3	1	Charge distribution, electric current, and multipole expansion	Lecturing	150 minutes	70% O, 30% F	6	To interpret the concept of an calculation of charge distribution, electric current, and multipole expansion	No. 1 pp. 146-153 and 242
4	2	Electric force and energy on charge distribution, conductor, and coefficient of capacitance	Lecturing	150 minutes	70% O, 30% F	6	To calculate electric force and energy on charge distribution and conductor and coefficient of capacitance	No. 1 pp. 90-103; no. 2 pp. 69-76
5	2	Potential energy from current distribution and coefficient of magnetic inductance	Lecturing	150 minutes	70% O, 30% F	6	To calculate the potential energy of current distribution and coefficient of inductance	No. 1 pp. 310-317; no. 2 pp. 69-76
6	3	Ohm's Law, electromotive force, magnetic flux, and Faraday's Law	Lecturing	150 minutes	70% O, 30% F	10	To calculate Ohm's Law, electromotive force, magnetic flux, and Faraday's Law	No. 1 pp. 285-305; no. 2 pp. 49-54

7	3	Law of charge conservation and displacement current	Lecturing	150 minutes	70% O, 30% F	10	To calculate the law of charge conservation and displacement current	No. 2 pp. 54-57
8	**Mid-Term Exam**							
9	4	Laplace’s equation and boundary conditions	Lecturing	150 minutes	70% O, 30% F	10	To use Laplace’s equation to solve electric potential problems in vacuum	No. 1 pp. 110-121; no. 2 pp. 93-139
10	4	Image method and Poisson’s equation	Lecturing	150 minutes	70% O, 30% F	10	To use image method and Poisson’s equation to solve electric potential problems with source	No. 1 pp. 121-137; no. 2 pp. 139-163
11	4	Relation between image method and Poisson’s equation	Lecturing	150 minutes	70% O, 30% F	10	To relate image method and Poisson’s equation to solve electric potential problems	No. 1 pp. 121-137; no. 2 pp. 139-163
12	5	Dielectric materials: polarization, displacement field, polar and nonpolar molecules, and Clausius-Mosotti equation	Lecturing	150 minutes	30% O, 40% E, 30% F	4	To explain the properties of dielectric materials	No. 1 pp. 160-193; no. 2 pp. 165-169
13	5	Application of potential calculation method on dielectric materials	Lecturing	150 minutes	30% O, 40% E, 30% F	6	To apply potential calculation method on dielectric materials	No. 2 pp. 190-191
14	6	Magnetic materials: magnetization, magnetic intensity, paramagnetic, and diamagnetic	Lecturing	150 minutes	30% O, 40% E, 30% F	4	To explain the properties of magnetic materials	No. 1 pp. 255-278; no. 2 pp. 171-174 and 179
15	6	Application of potential calculation method on magnetic materials	Lecturing	150 minutes	30% O, 40% E, 30% F	6	To apply potential calculation method on magnetic materials	No. 2 pp. 194-199

16	**Final Exam**

*) O : Orientation
E : Exercise
F : Feedback

References:

1. D. J. Griffiths, *Introduction to Electrodynamics, 3rd Edition*, Prentice Hall, 1999.
2. J. Vanderlinde, *Classical Electromagnetic Theory, 2nd Edition*, Kluwer Academics Publisher, 2005.

IV. Assignment Design

Week	Assignment Name	Sub-CLO	Assignment	Scope	Working Procedure	Deadline	Outcome
3	Individual-Assignment 1	1	Problem set	Static and dynamic electric charge, electric field, Gauss' Law, electric potential, magnetic field, Ampere's Law, magnetic potential, charge distribution, electric current, and multipole expansion	Homework	1 week	Homework answer sheet
5	Individual-Assignment 2	2	Problem set	Electric force and energy on charge distribution, conductor, coefficient of capacitance, potential energy of current distribution, and coefficient of magnetic inductance	Homework	1 week	Homework answer sheet
7	Individual-Assignment 3	3	Problem set	Ohm's Law, electromotive force, magnetic flux, Faraday's Law, law of charge conservation, and displacement current	Homework	1 week	Homework answer sheet
11	Individual-Assignment 4	4	Problem set	Laplace equation, boundary conditions, image method, and Poisson equation	Homework	1 week	Homework answer sheet
12	Group-Assignment 1	5	Reading materials	Dielectric materials: polarization, displacement field, polar and nonpolar molecules, and Clausius-Mosotti equation	Group discussion consist of 3-4 students	2 weeks	Presentation file in *power point* format
13	Individual-Assignment 5	5	Problem set	Dielectric materials: polarization, displacement field, polar and nonpolar molecules, and Clausius-Mosotti equation	Homework	1 week	Homework answer sheet
13	Group-Assignment 2	6	Reading materials	Magnetic materials: magnetization, magnetic intensity, paramagnetic, and diamagnetic	Group discussion consist of 3-4 students	2 weeks	Presentation file in *power point* format
15	Individual-Assignment 6	6	Problem set	Magnetic materials: magnetization, magnetic intensity, paramagnetic, and diamagnetic	Homework	1 week	Homework answer sheet

V. Assessment Criteria (Learning Outcome Evaluation)

Evaluation Type	Sub-CLO	Assessment Type	Frequency	Evaluation Weight (%)
Individual-Assignment	1-4	Answer sheet	6	20
Group-Assignment	5-6	Presentation	2	20
Mid-Term Exam	1-3	Answer sheet	1	30
Final Exam	4-6	Answer sheet	1	30
Total				**100**

VI. Rubric

A. Criteria of Presentation Score

Score	Presentation Delivery
85-90	Group is able to deliver the explanation logically, fluently, and punctual and be able to answer the questions from other students and lecturer
75-84	Group is able to deliver the explanation logically and fluently and be able to answer the questions from other students and lecturer, but be less punctual on delivering the explanation
65-74	Group is able to deliver the explanation fluently, but be less able to deliver the reasoning logic of the explanation
55-64	Group is less able to deliver the explanation fluently and punctual and be less able to deliver the reasoning logic of the explanation
<55	

B. Criteria of Assignment and Exam Scores

Score	Answer Quality
100	Answer is very precise and all the concept and main component are explained completely
76-99	Answer is fairly precise and the concept and main component are explained fairly complete
51-75	Answer is less precise and the concept and main component are explained less complete
26-50	Answer is poorly precise and the concept and main component are explained poorly complete
<25	Answer is wrong

VII. Appendix: Example of Exam Problems

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UTS MEDAN ELEKTROMAGNETIK I Waktu : 2 Jam

S1 FISIKA UI SIFAT :BUKA BUKU

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1. Sebuah bola kosong berjari-jari R di pusat bola diletakan muatan titik q. Muatan tersebut merupakan satu-satunya muatan didalam dan diluar bola. Pada permukaan bola dibuat sedemikian hingga potensialnya dibuat menjadi V(r,θ) $=V_0$ cos(θ) dengan V_0 konstan. Tentukan medan listrik didalam dan diluar bola !

2. Sebuah bola kosong berjari-jari R di permukaannya diberi muatan sedemikain hingga kerapatan muatannya $\sigma = \sigma_0$ cos(θ) dengan σ_0 konstan. Bola tersebut diputar pada sumbu simetrinya dengan kecepatan sudut konstan ω_0. Tentukan medan magnet di dalam dan diluar bola !

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UAS MEDAN ELEKTROMAGNETIK I Waktu : 2 Jam

S1 FISIKA UI SIFAT :BUKA BUKU

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1. Sebuah bola matrial dielektrik yang linier dan homogen berjari-jari R diletakan dalam sebuah medan listrik tertentu diamana pada daerah r amat jauh dari R medan tsb membawa konsekuensi dideteksinya potensial dengan kelakuan $V_{out} \rightarrow \quad E_0 \; r \; cos(2\theta)$ Tentukan potensial dan medan listrik didalam dan diluar bola.

2. Sebuah silender panjang takberhingga dengan jari-jari R membawa Magnetisasi pararel pada sumbu, $\vec{M}=ks\hat{z}$. Dimana k adalah konstanta, s komponen radial dari kord. silender. Tentukan medan magnet didalam dan diluar silender.

3. Tuliskan kembali dalam bahasa anda sendiri arti dari ke empat persamaan Maxwell di medium dan jelaskan pebedaannya dengan divakum.

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