TEACHING INSTRUCTIONAL DESIGN (BRP) COURSE
ELECTROMAGNETIC FIELDS II

By

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Faculty of Mathematics and Natural Sciences
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UNIVERSITAS INDONESIA
FACULTY OF MATHEMATICS & NATURAL SCIENCES
UNDERGRADUATE PROGRAM IN PHYSICS

TEACHING DESIGN BOOK

Course	Electromagnetic Fields II	**Credit**	**Prerequisite course(s)**	**Requisite for course(s)**	**Integration Between Other Courses**
Course Code	SCFI603115	3 Credits	Electromagnetic Fields I	None	None
Course Cluster	Compulsory Course for Undergraduate Program in Physics				
Term	5				
Lecturer(s)	Agus Salam				

Course Description	**Achievements:** After taking this course students are able to apply the concepts and principles that apply to time-dependent electromagnetic fields in solving physics problems that involve electromagnetic interactions. **Scope:** Maxwell's equations, laws of conservation of energy and momentum, electromagnetic waves, potential and fields, radiation, special theory of relativity. **Language of instruction:** Indonesian**. Learning Method(s):** interactive lectures and independent learning.
Online Class Link	https://emas.ui.ac.id/course/view.php?id=6889

LO-STUDY PROGRAM charged to the course	
CLO-1	Applying classical and modern physics concepts in solving general physics problems

CLO-2	Build insights into the latest developments in science and technology related to physics
CLO-3	Applying physics in the production process.
Course Learning Outcomes (CLO)	
CLO	Applying concepts and principles that apply to time-dependent electromagnetic fields in solving physics problems involving electromagnetic interactions.
Sub-CLO	
Sub-CLO 1	Applying Maxwell's equation to calculate time-dependent electromagnetic fields.
Sub-CLO 2	Applying Maxwell's equations to calculate the energy and momentum of an electromagnetic field.
Sub-CLO 3	Applying Maxwell's equation to the propagation of electromagnetic waves.
Sub-CLO 4	Applying the concept of time-dependent potentials in moving charges.
Sub-CLO 5	Applying the concept of time-dependent potentials to radiation by moving charges.
Sub-CLO 6	Applying the special theory of relativity to electrodynamics problems.
Study Materials: Learning materials	Gauss's law, Ampere's law, Faraday's law, Maxwell's equation, continuity equation, Poynting theorem, Maxwell's pressure tensor, electromagnetic (EM) waves in vacuum, EM waves in matter, absorption and dispersion of EM waves, EM wave guides, scalar and vector potentials, gauge transformation, retarded potentials, Lienard-Wiechert potentials, dipole radiation, point charge radiation, special relativity, relativistic mechanics, relativistic electrodynamics.
Bibliography	**Compulsory:** [Griffiths] D.J. Griffiths, *Introduction to Electrodynamics*, 3rd edition, Prentice Hall, 1999. **Optional:** [Reitz] J.R. Reitz, F.J. Milford, and R.W. Christy, *Foundations of Electromagnetic Theory*, 4th edition, Addison Wesley, 1993. [Jackson] J.D. Jackson, *Classical Electrodynamics*, 3rd edition, John Wiley & Sons, 1999.

LESSON PLAN

*Wk	Sub-CLO (Expected Final Competence)	Bahan Kajian (Materi Pembelajaran) [Rujukan]	Learning Method(s) [Time Estimation]	Moda pembelajaran	Learning Experiences		Sub-CLO Achievement Indicators	Sub-CLO Application Weight in courses
					Orientation; Exercise; Feedback		General Indicator; Special Indicator	
					Online	Offline		
1	Sub-CLO 1: Applying Maxwell's equation to calculate time-dependent electromagnetic fields.	Gauss' Law, Ampere's law. [Chapter 2 & 5 Griffiths]	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes] **Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive Lectures) [50 minutes]	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	**Exercise:** Students look for additional reading sources to better understand the discussion materials (30%)	**General indicator:** Students are able to calculate the electromagnetic field from a steady-state charge system. **Special indicator:** Students are able to calculate the electric field from static charge and magnetic field from the steady current.	7%
2	Sub-CLO 1: Applying Maxwell's equation to calculate time-dependent	Faraday's Law, Maxwell's Equation. [Chapter 7 Griffiths]	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes]	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in	**Exercise:** Students look for additional reading sources to better	**General indicator:** Students are able to calculate time-dependent electromagnetic fields.	7%

	electromagnetic fields.			**Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive Lectures) [50 minutes]	EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	understand the discussion materials (30%)	**Special indicator:** Students are able to calculate time-dependent electric field and magnetic field and vice-versa.	
3	Sub-CLO 2: Applying Maxwell's equations to calculate the energy and momentum of an electromagnetic field.	Continuity equation, Poynting vector. [Chapter 8 Griffiths]	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes] **Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive Lectures) [50 minutes]	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	**Exercise:** Students look for additional reading sources to better understand the discussion materials (30%)	**General indicator:** Students are competent in applying Maxwell's equation to continuity equation and Poynting vector. **Special indicator:** Students are competent in calculating Poynting vectors from an electromagnetic system.	7%
4	Sub-CLO 2: Applying Maxwell's equations to calculate the energy and momentum of an electromagnetic field.	Maxwell's Stress Tensor. [Chapter 8 Griffiths]	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes] **Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-	**Exercise:** Students look for additional reading sources to better understand the discussion materials (30%)	**General indicator:** Students are competent in applying Maxwell's equation to energy and momentum in an electromagnetic field. **Special indicator:** Students are competent in calculating the tensor	7%

				Lectures) [50 minutes]	TEAMS or in the EMAS chat-room (10%)		of energy and momentum in an electromagnetic field.	
5	Sub-CLO 3: Applying Maxwell's equation to the propagation of electromagnetic waves.	Electromagnetic (EM) waves in vacuum, EM waves in matter. [Chapter 9 Griffiths]	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes] **Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive Lectures) [50 minutes]	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	**Exercise:** Students look for additional reading sources to better understand the discussion materials (30%)	**General indicator:** Students are competent in applying Maxwell's equation to reflection and transmission of EM waves. **Special indicator:** Students are competent in calculating the coefficients of reflection and transmission of EM waves.	7%
6	Sub-CLO 3: Applying Maxwell's equation to the propagation of electromagnetic waves.	Absorpsi dan dispersi gelombang EM. [Chapter 9 Griffiths]	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes] **Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive Lectures) [50 minutes]	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	**Exercise:** Students look for additional reading sources to better understand the discussion materials (30%)	**General indicator:** Students are competent in applying Maxwell's equation to absorptions and dispersions of EM waves. **Special indicator:** Students are competent in calculating the coefficients of absorption and dispersion of EM waves.	7%

7	Sub-CLO 3: Applying Maxwell's equation to the propagation of electromagnetic waves.	EM wave guides. [Chapter 9 Griffiths]	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes] **Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive Lectures) [50 minutes]	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	**Exercise:** Students look for additional reading sources to better understand the discussion materials (30%)	**General indicator:** Students are competent in applying Maxwell's equation to EM wave guides. **Special indicator:** Students are competent in calculating the cut-off frequency of EM wave guides.	7%
8	**Mid-Term Exam**								
9	Sub-CLO 4: Applying the concept of time-dependent potentials in moving charges.	Scalar and vector potentials, gauge transformation. [Chapter 11 Griffiths]	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes] **Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive Lectures) [50 minutes]	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	**Exercise:** Students look for additional reading sources to better understand the discussion materials (30%)	**General indicator:** Students are competent in applying the gauge transformation to calculate the scalar and vector potentials. **Special indicator:** Students are competent in calculating the scalar and vector potentials from charge distribution.	7%
10	Sub-CLO 4: Applying the concept of time-	Retarded potentials, Lienard-	Interactive lectures,	**Asynchronous:** Using EMAS (Independent	**Orientation:**	**Exercise:** Students look for	**General indicator:** Students are competent in applying	7%

	dependent potentials in moving charges.	Wiechert potentials. [Chapter 11 Griffiths]	independent learning. [150 minutes]	Learning) [100 minutes] **Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive Lectures) [50 minutes]	Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	additional reading sources to better understand the discussion materials (30%)	the concept of retarded potentials in moving charges. **Special indicator:** Students are competent in calculating the retarded potentials from moving charges.	
11	Sub-CLO 5: Applying the concept of time-dependent potentials to radiation by moving charges.	Dipole Radiation [Chapter 12 Griffiths]	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes] **Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive Lectures) [50 minutes]	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	**Exercise:** Students look for additional reading sources to better understand the discussion materials (30%)	**General indicator:** Students are competent in calculating the EM radiation fields from dipole systems. **Special indicator:** Students are competent in calculating the retarded potentials from dipole systems.	7%
12	Sub-CLO 5: Applying the concept of time-dependent potentials to	Point charges radiation. [Chapter 12 Griffiths]	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes]	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:**	**Exercise:** Students look for additional reading sources to	**General indicator:** Students are competent in calculating the EM fields radiated by accelerated charges.	7%

	radiation by moving charges.			**Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive Lectures) [50 minutes]	Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	better understand the discussion materials (30%)	**Special indicator:** Students are competent in calculating the radiation energy from accelerated charges.	
13	Sub-CLO 6: Applying the special theory of relativity to electrodynamics problems.	The Special Theory of Relativity: Einstein's postulate, Lorentz transformation, structure of spacetime. [Chapter 13 Griffiths]	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes] **Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive Lectures) [50 minutes]	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	**Exercise:** Students look for additional reading sources to better understand the discussion materials (30%)	**General indicator:** Students are competent in applying the Lorentz transformation to calculate kinematics units. **Special indicator:** Students are competent in calculating the time dilation, length contraction, and relative velocity.	7%
14	Sub-CLO 6: Applying the special theory of relativity to electrodynamics problems.	Relativistic Mechanics: Proper time and proper velocity, relativistic energy and momentum, relativistic kinematics, relativistic	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes] **Synchronous:** Using MS-TEAMS or EMAS chat-room	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:**	**Exercise:** Students look for additional reading sources to better understand the discussion	**General indicator:** Students are competent in applying Lorentz transformation to calculate dynamical units. **Special indicator:**	8%

		dynamics. [Chapter 13 Griffiths]		(Interactive Lectures) [50 minutes]	Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	materials (30%)	Students are competent in calculating the relativistic energy and momentum.	
15	Sub-CLO 6: Applying the special theory of relativity to electrodynamics problems.	Relativistic Dynamics: magnetism, tensor field transformation, relativistic notation, relativistic potentials. [Chapter 13 Griffiths]	Interactive lectures, independent learning. [150 minutes]	**Asynchronous:** Using EMAS (Independent Learning) [100 minutes] **Synchronous:** Using MS-TEAMS or EMAS chat-room (Interactive Lectures) [50 minutes]	**Orientation:** Students view files or watch videos on EMAS (30%) **Exercise:** Students discuss in MS-TEAMS or in EMAS chat-rooms (30%) **Feedback:** Lecturers are issued discussions in MS-TEAMS or in the EMAS chat-room (10%)	**Exercise:** Students look for additional reading sources to better understand the discussion materials (30%)	**General indicator:** Students are competent in applying Lorentz transformation to time-dependent EM fields. **Special indicator:** Students are competent in calculating relativistic potentials.	8%
16	**Final Exam**							

*) Wk: Week
**) Synchronous: learning interactions between lecturers and students are carried out at the same time, using video conferencing or chat technology. Asynchronous: learning interactions are carried out flexibly and not necessarily at the same time, for example using a discussion forum or independent learning / student assignments.

DESIGN OF ASSIGNMENTS AND EXERCISES

Week	Assignment Name	Sub-CLO	Assignment	Scope	Working Procedure	Deadline	Outcome
1	Individual-Assignment1	Sub-CLO1	Answer questions	Gauss' Law, Ampere's Law.	Doing assignments at home	1 week	Upload answers in EMAS
2	Individual-Assignment2	Sub-CLO1	Answer questions	Faraday's Law, Maxwell's Equation.	Doing assignments at home	1 week	Upload answers in EMAS
3	Individual-Assignment 3	Sub-CLO2	Answer questions	Continuity Equation, Poynting Vector.	Doing assignments at home	1 week	Upload answers in EMAS
4	Individual-Assignment 4	Sub-CLO2	Answer questions	Maxwell's Stress Tensor.	Doing assignments at home	1 week	Upload answers in EMAS
5	Individual-Assignment5	Sub-CLO3	Answer questions	Electromagnetic (EM) waves in vacuum, EM waves in matter.	Doing assignments at home	1 week	Upload answers in EMAS
6	Individual-Assignment 6	Sub-CLO3	Answer questions	EM waves absorption and dispersion.	Doing assignments at home	1 week	Upload answers in EMAS
7	Individual-Assignment 7	Sub-CLO3	Answer questions	EM wave guides.	Doing assignments at home	1 week	Upload answers in EMAS
8	Mid-Term Exam	Sub-CLO1,2,3	Answer questions	Poynting vector, Maxwell's stress tensor, EM waves absorption and dispersion, EM wave guides.	Online Exam in EMAS	100 minutes	Download question sheets and upload answers in EMAS

9	Individual-Assignment8	Sub-CLO4	Answer questions	Scalar and vector potentials, gauge transformation.	Doing assignments at home	1 week	Upload answers in EMAS
10	Individual-Assignment9	Sub-CLO4	Answer questions	Retarded potentials, Lienard-Wiechert potentiasl.	Doing assignments at home	1 week	Upload answers in EMAS
11	Individual-Assignment10	Sub-CLO5	Answer questions	Dipole radiation	Doing assignments at home	1 week	Upload answers in EMAS
12	Individual-Assignment11	Sub-CLO5	Answer questions	Point charge radiation.	Doing assignments at home	1 week	Upload answers in EMAS
13	Individual-Assignment12	Sub-CLO6	Answer questions	Einstein's postulate, Lorentz transformation, structure of spacetime.	Doing assignments at home	1 week	Upload answers in EMAS
14	Individual-Assignment13	Sub-CLO6	Answer questions	Proper time and proper velocity, relativistic energy and momentum, relativistic kinematics, relativistic dynamics.	Doing assignments at home	1 week	Upload answers in EMAS
15	Individual-Assignment14	Sub-CLO6	Answer questions	Magnetism, tensor field transformation, relativistic notation, relativistic potentials.	Doing assignments at home	1 week	Upload answers in EMAS
16	Final Exam	Sub-CLO4,5,6	Answer questions	Retarded potentials, dipole radiation, relativistic potentials.	Online Exam in EMAS	100 minutes	Questions answered in EMAS

ASSESSMENT CRITERIA (EVALUATION OF LEARNING OUTCOMES)

In this section it is written

Evaluation Type	Sub-CLO	Assessment Type	Frequency	Evaluation Weight (%)
Individual-Assignment	1,2,3,4,5,6	EMAS Assignment Attachment	14	40
10 Mid-Term Exam	1,2,3	Online Exam in EMAS	1	30
Final Exam	4,5,6	Online Exam in EMAS	1	30
Total				**100**

Guidelines for Assessment Criteria

Conversion of the student's final grade based on the provisions applicable at the University of Indonesia. The conversion values are:

Score	Grade	Weight
85—100	A	4.00
80—<85	A-	3.70
75—<80	B+	3.30
70—<75	B	3.00
65—<70	B-	2.70
60—<65	C+	2.30
55—<60	C	2.00
40—<55	D	1.00
<40	E	0.00

Rubric:

Criteria	A (90)	B (75)	C (60)	D (50)
Organization (Overall sequences,	Information is presented in an effective order. The excellent	Information is logically ordered by paragraphs and transitions.	Information is scattered and needs further development.	There is no clear sequence of paragraphs, so there is no

flows, and transitions)	structure of paragraphs and transitions improves readability and comprehension. Executive summary or abstract is presented first, allows readers to easily follow the rest of the report	Within a section, the order in which ideas are presented may be confusing at some times		progressive flow of ideas. The details and examples are disorganized, difficult to follow and understand.
Information Quality	Supporting details are specific to the topic and provide the necessary information.	Some details do not support the topic of the report.	Details are a bit vague.	Unable to find certain details.
Introduction	The introductory paragraph is clearly stated, has a sharp focus, is different and increases the impact of the report	The introductory paragraph is clearly stated with focus.	The introductory paragraph is unclear.	The introductory paragraph is unclear.
Conclusion	Summarize the following paragraphs that are well summarized and interesting, conclusions that	Summarize the following paragraphs and summarize the discussion report and draw conclusions.	Closing paragraphs are only remotely related to the topic of the report.	Closing paragraphs are not clear.

	are effective and improve the impact of the report.			
Use of language: choice words, grammar, and sentence structure	Sentences are complete and grammatical, and they flow together easily. The word is chosen for its proper meaning.	For the most part, sentences are complete and grammatical, and they flow together easily. Every mistake is minor and doesn't distract the reader. Repetition of the same words and phrases.	Minor mistakes in sentence structure and grammar are frequent enough that they detract from the reader and distract from meaning. There are unnecessary repetitions of the same words and phrases.	Major mistakes in sentence structure and grammar are frequent enough that they distract the reader and interfere with meaning. There are unnecessary repetitions of the same words and phrases.
Use of images: graphics, graphics & images	All numbers, graphics, graphics, and pictures are accurate, consistent with text, and of good quality.	For the most part, numbers, graphics, graphics, and images are accurate, consistent with text, and are of good quality.	Few of the numbers, graphics, graphics, and images are accurate, consistent with text, and of good quality. They are not labeled.	Numbers, graphics, graphics, pictures & are of poor quality, have a lot of inaccuracies & mislabelings, or may be lost.