Syllabus

Indiana Wesleyan University

PHYS-503: Electromagnetism (Online Asynchronous)
Session dates: 1/4/22-2/28/22
Winter/Spring I 2022
Written By: Victor Parkinson, PhD
Instructor: Dr. Bradley Mauger
bradley.mauger@indwes.edu

Course Description

This theoretical and problem-solving course focuses on the development and application of the integral and differential forms of Maxwell's equations from phenomenological observations, culminating in the electromagnetic wave equations. Topics include potential theory, static and dynamic electromagnetic field equations in vacuum and media, and electromagnetic waves with select applications.

Note: This course is designed for those seeking the credentials required by many regiona l accrediting bodies in order to be able to teach advanced placement, concurrent early college, and community college Physics courses.

Credit Hours: 3
Prerequisite Courses: None
Prerequisite Skills and Knowledge: Prerequisites: a bachelor's degree with a physics major or be state certified (in any state) to teach Physics at a secondary school level, and PHYE-501 or equivalent. Note: This course is designed for those seeking the credentials required by many regional accrediting bodies in order to be able to teach advanced placement, concurrent early college, and community college Physics courses.

Course Outcomes

Upon successful completion of this course, you should be able to:

1. Define electric and magnetic fields in electrostatics, magnetostatics and electrodynamics in relation to fundamental electric and magnetic observations.
2. Solve problems involving the application of Maxwell's Equations in differential and integral form in unfamiliar circumstances.
3. Outline how Maxwell's modification to the basic electromagnetic laws unified the phenomena of electricity and magnetism and led to the conclusion that light is an electromagnetic wave.

4. Translate fluidly between phenomenological behavior and mathematical description.
5. Model solutions for electric potential problems and others using technology (e.g. Mathematica, Maple).
6. Interpret the integration of faith and science in the writings of 19th Century pioneers in electromagnetism.

Course Textbook

Fleisch, D. (2008*). A student's guide to Maxwell's equation*. Cambridge University Press.

Course Technology

Each student will need to purchase a temporary site license for Mathematica Online. This can be arranged through Indiana Wesleyan.

For submitting solutions to assigned problems from the text, students may use Microsoft Equation Editor, LatEx, or another text/equation editor and submit a PDF or scans of work written on paper.

IWU Diversity Statement

IWU, in covenant with God's reconciling work and in accordance with the biblical principles of our historic Wesleyan tradition, commits to build a community that reflects Kingdom diversity.

We will foster an intentional environment for living, teaching, and learning, which exhibits honor, respect, and dignity. Acknowledging visible or invisible differences, our community authentically values each member's earthly and eternal worth. We refute ignorance and isolation and embrace deliberate and courageous engagement that exhibits Christ's commandment to love all humankind. (2016)

Grading Scale

NOTE: In graduate level courses, a grade of C- or below will require the course to be repeated.

Grade	Quality Points Per Credit	Percentage	Score
A	4.0	95%–100%	950–1000

A-	3.7	92%–94.9%	920–949
B+	3.3	89%–91.9%	890–919
B	3.0	85%–88.9%	850–889
B-	2.7	82%–84.9%	820–849
C+	2.3	79%–81.9%	790–819
C	2.0	75%–78.9%	750–789
C-	1.7	72%–74.9%	720–749
D+	1.3	69%–71.9%	690–719
D	1.0	65%–68.9%	650–689
F	0.0	0%–64.9%	0–649

Grading Policies

Your grading policy for your course is dependent on your school and program. Your grading policies can be found in the IWU Catalog.

Letter Grade Equivalencies

NOTE: In graduate level courses, a grade of C- or below will require the course to be repeated.

Grade	Description of Work
A	Clearly stands out as excellent performance. Has unusually sharp insights into material and initiates thoughtful questions. Sees many sides of an issue. Articulates well and writes logically and clearly. Integrates ideas

	previously learned from this and other disciplines. Anticipates next steps in progression of ideas. Example "A" work should be of such nature that it could be put on reserve for all cohort members to review and emulate. The "A" cohort member is, in fact, an example for others to follow.
B	Demonstrates a solid comprehension of the subject matter and always accomplishes all course requirements. Serves as an active participant and listener. Communicates orally and in writing at an acceptable level for the degree program. Work shows intuition and creativity. Example "B" work indicates good quality of performance and is given in recognition for solid work; a "B" should be considered a good grade and awarded to those who submit assignments of quality less than the exemplary work described above.
C	Quality and quantity of work in and out of class is average. Has marginal comprehension, communication skills, or initiative. Requirements of the assignments are addressed at least minimally.
D	Quality and quantity of work is below average. Has minimal comprehension, communication skills, or initiative. Requirements of the assignments are addressed at below acceptable levels.
F	Quality and quantity of work is unacceptable and does not qualify the student to progress to a more advanced level of work.

Course Module Summary

Module	Optional Devotion*	Discussion	Quiz	Dropbox	Total Points per Module
Module One	1/0	1/20	1/30	2/75	125
Module Two	-	1/30	1/30	2/90	150

Module Three	1/0	1/20	1/30	1/60	110
Module Four	1/0	1/20	1/30	1/60	110
Module Five	1/0	-	1/30	2/75	105
Module Six	1/0	1/20	1/30	2/90	140
Module Seven	-	1/30	1/30	2/90	150
Module Eight	1/0	1/20	1/30	1/60	110
End-of-Course Survey					10 extra credit
TOTAL	6/0	7/160	8/240	13/600	1000

Module One Outline

Title	Type	Due Dates	Time	Points
1.1 Maxwell's Faith	Devotional	Suggested: Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	30 minutes	0
1.2 Reading	Reading	Complete prior to assignments.	2 hours	0

1.3 Gauss's Law for Electrical Fields	Discussion	Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	2 hours	20
1.4 Introduction to Electromagnetism	Quiz	Due by the end of the module.	2 hours	30
1.5 Gauss's Law (Integral Form) Application Problems	Dropbox	Due by the end of the module.	5 hours	45
1.6 Gauss's Law: Student Video	Dropbox	Due by the end of the module.	2 hours	30
		Totals	**13:30 hours***	**125**

Module Two Outline

Title	Type	Due Dates	Time	Points
2.1 Reading	Reading	Complete prior to assignments.	1 hour	0
2.2 Providence and Nature	Discussion	Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	2 hours	30
2.1 Reading	Reading	Complete prior to assignments.	1 hour	0
2.3 Gauss's Law (Differential Form), Electric Potential, and Electric	Quiz	Due by the end of the module.	2 hours	30

Potential Energy				
2.4 Gauss's Law (Differential Form), Electric Potential, Electric Potential Energy Application Problems	Dropbox	Due by the end of the module.	5 hours	60
2.5 Experiment One Video	Dropbox	Due by the end of the module.	2 hours	30
		Totals	**12:00 hours** *	**150**

Module Three Outline

itle	Type	Due Dates	Time	Points
3.1 Framing of the Worlds	Devotional	Suggested: Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	30 minutes	0
3.2 Reading	Reading	Complete prior to assignments.	1 hour	0

3.3 Gauss's Law for Magnetic Fields	Discussion	Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	2 hours	20
3.4 Gauss's Law for Magnetic Fields	Quiz	Due by the end of the module.	2 hours	30
3.5 Gauss's Law for Magnetic Fields Application Problems	Dropbox	Due by the end of the module.	5 hours	60
		Totals	**10:30 hours***	**110**

Module Four Outline

Title	Type	Due Dates	Time	Points
4.1 Physics and Scripture	Devotional	Suggested: Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	30 minutes	0
4.2 Reading	Reading	Complete prior to assignments.	1 hour	0
4.3 Faraday's Law	Discussion	Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	2 hours	20
4.4 Faraday's Law (Integral Form)	Quiz	Due by the end of the module.	2 hours	30
4.5 Faraday's Law (Integral Form) Application Problems	Dropbox	Due by the end of the module.	5 hours	60
		Totals	**10:30 hours***	**110**

Module Five Outline

Title	Type	Due Dates	Time	Points
5.1 Faraday's Faith	Devotional	Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	30 minutes	0
5.2 Reading	Reading	Complete prior to assignments.	30 minutes	0
5.3 Faraday's Law (Differential Form)	Quiz	Due by the end of the module.	2 hours	30
5.4 Faraday's Law (Differential Form) Application Problems	Dropbox	Due by the end of the module.	5 hours	45
5.5 Faraday's and Lenz's Laws: Student Video	Dropbox	Due by the end of the module.	2 hours	30
		Totals	**11:30 hours***	**125**

Module Six Outline

Title	Type	Due Dates	Time	Points
6.1 Genuine Reality	Devotional	Suggested: Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	30 minutes	0
6.2 Reading	Reading	Complete prior to assignments.	1 hour	0
6.3 Ampère's Law	Discussion	Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	2 hours	20
6.4 Ampère-Maxwell Law (Integral Form)	Quiz	Due by the end of the module.	2 hours	30
6.5 Ampère-Maxwell Law (Integral Form) Application Problems	Dropbox	Due by the end of the module.	5 hours	60
6.6 Experiment Two Video	Dropbox	Due by the end of the module.	2 hours	30
Totals			**12:30 hours***	**140**

Module Seven Outline

Title	Type	Due Dates	Time	Points
7.1 Reading	Reading	Complete prior to assignments.	1 hour	0
7.2 Max Planck on Science and Faith	Discussion	Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	2 hours	30
7.3 Ampère-Maxwell Law (Differential Form)	Quiz	Due by the end of the module.	2 hours	30
7.4 Ampère-Maxwell Law (Differential Form) Application Problems	Dropbox	Due by the end of the module.	5 hours	60
7.5 Ampère-Maxwell Law: Student Video	Dropbox	Due by the end of the module.	2 hours	30
Totals			**12:00 hours***	**150**

Module Eight Outline

Title	Type	Due Dates	Time	Points
8.1 Anthropic Principle	Devotional	Suggested: Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	30 minutes	0
8.2 Reading	Reading	Complete prior to assignments.	1 hour	0
8.3 Electromagnetism Pioneers of the 19th Century	Discussion	Initial post due by the end of the fourth day of the module; two responses due by the end of the module.	2 hours	20
8.4 The Wave Equation	Quiz	Due by the end of the module.	2 hours	30
8.5 The Wave Equation Application Problems	Dropbox	Due by the end of the module.	5 hours	60
		Totals	**10:30 hours***	**110**

Course Assignments

TOTALS	***93 hours**	1000

* These times are only estimates. Actual assignment completion times will vary.

Course Development Resources

CalTech. (2018). *Electromagnetic Induction*. [Video file]. Retrieved from https://www.youtube.com/watch?v=ygVZjQK5z-8

Griffiths, D.J. (2017). *Introduction to electrodynamics* (4th ed.). Cambridge University Press.

Liao, S., Dourmashkin, P., & Belcher. J. (2004). Electric Potential. In *Visualizing E&M*. (Chapter 3). Retrieved from http://web.mit.edu/viz/EM/visualizations/notes/modules/guide03.pdf

Liao, S., Dourmashkin, P., & Belcher. J. (2004). Gauss's Law. In *Visualizing E&M*. (Chapter 4). Retrieved from http://web.mit.edu/viz/EM/visualizations/notes/modules/guide04.pdf

Liao, S., Dourmashkin, P., & Belcher. J. (2004). Magnetostatics. In *Visualizing E&M*. [Video file]. Retrieved from http://web.mit.edu/8.02t/www/802TEAL3D/visualizations/magnetostatics/index.htm

Liao, S., Dourmashkin, P., & Belcher. J. (2004). Sources of Magnetic Fields. In *Visualizing E&M*. (Chapter 9). Retrieved from http://web.mit.edu/viz/EM/visualizations/notes/modules/guide09.pdf

University of Colorado Boulder. (2018). PHET Interactive Simulations. [Video file]. Retrieved from https://phet.colorado.edu/en/simulation/charges-and-fields

Walker, J., Halliday, D., & Resnick, R. (2013). *Fundamentals of physics,* (10th ed.). Wiley.

Yung-kuo, L. (1993). *Problems and Solutions in Electromagnetism*. World Scientific Publishing Company.

Expectations, Policies, and Important Student Information

School/Division	Link
DeVoe School of Business Division of Liberal Arts School of Services and Leadership	View School/Division Expectations, Policies, and Student Information
School of Educational Leadership	View School/Division Expectations, Policies, and Student Information
Wesley Seminary @ IWU	View School/Division Expectations, Policies, and Student Information
Nursing - Undergraduate	View School/Division Expectations, Policies, and Student Information
Nursing - Graduate	View School/Division Expectations, Policies, and Student Information