PHYSICS 417. Electromagnetism.

Lecturer:	Tim Gorringe.
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Textbook:	Electromagnetic Fields, R. Wangsness, 2nd Ed.
Web page	www.pa.uky.edu/∼gorringe/phy417/index.html
Class hours:	MWF 10:00 - 10:50
Office hours:	T 2:00 - 3:00.
	R 2:00 - 3:00.

PHY416 and PHY417 are a two-semester sequence on electromagnetic theory.

1 Course Objectives.

The electromagnetic field binds electrons to nuclei to make atoms, atoms to atoms to make molecules, and molecules to molecules to make the material world. Light is an self-sustaining vibrating bundle of electromagnetic fields. Our aim is to understand how electromagnetic fields work.

- We will discover how electric and magnetic fields work in terms of two basic field properties - flux and circulation. We will develop physical pictures of these field properties, learn how to describe them mathematically, and explore in depth the equations for flux and circulation of electromagnetic fields.
- We will assemble an electromagnetic theory tool box and become sophisticated electromagnetic problem solvers. Div, grad and curl, Gauss's theorem and Stokes theorem are just some of the tools in the box.
- We will also discover some fascinating electromagnetic properties of matter. From reflection and refraction to ferromagnetism and piezoelectricity we will develop macroscopic and microscopic models of the electromagnetic material world.

2 Course Prerequisites.

The prerequisites for PHY416 are two semesters of general university physics (either PHY211/213 or PHY231/232 sequences) and calculus III (MA213). The prerequisite for PHY417 is PHY416. PHY416 includes a short review of the necessary differential vector calculus and integral vector calculus.

3 Course Structure.

PHY417 meets M-W-F from 10:00am to 10:50pm in room CP183. The following tables on pages 3-4 give the material we will cover in each lecture class. Generally there are 2-3 regular lecture classes followed by a problem-solving orientated class.

Typically 2-3 homework problems are assigned per lecture class. The homework problems from the preceding classes will be collected at the beginning of the classes on the dates shown. You are encouraged to get together with other students to discuss the homework problems but your homework solutions must be written-up independently. The homework solutions with be available in the Science library (211 King Building). Late homework is not accepted.

4 Course Grading.

Your final grade will be based on homework, two tests and a cumulative final in the following proportions: homework 20%, each test 20%, and the final 40%. A 1% bonus is awarded for completing the course evaluation.

source	data	contribution
homework		20%
test one	F Feb. 20	20%
test two	F Mar. 27	20%
cumulative final	1-3 pm M May 4	40%
evaluation bonus	15 April - 29 April	1%

5 Course evaluations.

Course evaluations are an important component of our instructional program. Our on-line course evaluation was developed to allow each student ample time to complete the evaluation of the course and the instructor. The evaluation window for Spring 2009 will open on Wendnesday, April 15 and close on Wednesday, April 29. To access the system go the physics department web page at www.pa.uky.edu and click the course evaluations link.

6 Course Schedule.

Date	Topic	Ch.Sec	Hwk Prob.	Hwk Due
W Jan 14	Currents – I	12.1–2	12-1,3,7	
F Jan 16	Currents – II	12.3–5	12-9,13,17	
M Jan 19	Martin Luther King Day			
W Jan 21	Introducing the magnetic force	13.1	13-2,3,4	**Hmk due**
F Jan 23	Applications	13.2	13-6,9	
M Jan 26	Introducing the magnetic induction	14.1	14-5,8,9	**Hmk due**
W Jan 28	Kentucky freezing rain holiday			
F Jan 30	Applications	14.2–3	14-12,14,15	
M Feb 2	The magnetic ciculation	15.1, 15,3	15-1,2,3,6	
	Applications	W Feb 4 15.2	15-8,9,10,11	**Hmk due**
F Feb 6	The vector potential	16.1–2	16-2,3,4,5	
M Feb 9	Applications	16.3–4	16-11,14,15	
W Feb 11	The relativity of E and B fields	17.1		**Hmk due**
F Feb 13	Induction - a link between E and B fields	17.1	17-2,7	
M Feb 16	One equation - two effects	17.2–3	17-8,10	
W Feb 18	Self and Mutual Inductance	17.4	17-18,20,23	**Hmk due**
F Feb 20	**Test One**	Ch. 12-17		
M Feb 23	Review of test One			
W Feb 25	Magnetic energy in terms of currents	18.1	18-1,5	**Hmk due**
F Feb 27	Magnetic Energy in terms of fields	18.2	18-8,10	
M Mar 2	Magnetic forces and magnetic energies	18.3	18-16,18	
W Mar 4	The multipole expansion of the vector potential	19.1-3	19-2,3	**Hmk due**
F Mar 6	Applications	19.4	19-5,10	

Date	Topic	Ch.Sec	Hmwk	
M Mar 9	The Abaranov–Bohm Effect			
W Mar 11	Magnetic properties of matter - bound currents	20.1-2	20-1,2,3,4	**Hmk due**
F Mar 13	Magnetic properties of matter - B, H and M	20.3-5	20-7,8	
M Mar 16	Spring Break			
W Mar 18	Spring Break			
F Mar 20	Spring Break			
M Mar 23	Magnetic properties of matter - energy and force	20.6	20.27	
W Mar 25	Microscopic models of magnetic materials			**Hmk due**
F Mar 27	**Test Two**	Ch 18–20		
M Mar 30	Review of Test Two.			
W Apr 2	Maxwell's eqns and the displacement current	21.1-3	21-1,2	**Hmk due**
F Apr 3	Maxwell's eqns and the displacement current	21.1-3	21-3,8	
M Apr 6	Energy and momentum flow	21.4-5	21-9,10,11	
W Apr 8	The electromagnetic wave equation	24.1	24-5	**Hmk due**
F Apr 10	Waves in non-conducting media	24.2	24-15	
M Apr 13	Waves in conducting media	24.3	24-7	
W Apr 15	Models of matter immersed in e/m waves	24.8		**Hmk due**
F Apr 17	Understanding reflection and refraction	25.1-3		
M Apr 20	Understanding reflection and refraction	25.1-3	25-2,3	
W Apr 22	Special relativity - the speed of light	29.1-2		**Hmk due**
F Apr 24	Special relativity - intro to 4-vectors	29.3	29-1,2	
M Apr 27	Special relativity - e/m in 4-vectors	29.5	29-20	
W Apr 29	Special relativity - a moving point charge	29.6	29-26,28	**Hmk due**
F May 1	Introducing quantum electrodynamics			
M May 4	**1-3 pm – Final**			