PHYSICS 416. Electromagnetism.

Lecturer:	Tim Gorringe.
Office:	CP 273.
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Textbook:	Electromagnetic Fields, R. Wangsness, 2nd Ed.
Web page	www.pa.uky.edu/∼gorringe/phy416/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.

1 416/417 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 course includes a short review of the necessary differential vector calculus and integral vector calculus.

3 Course Structure.

PHY416 meets M-W-F from 10:00am to 10:50pm in room CP397. 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 Chem-Phys library. Late homework is not accepted.

4 Course Grading.

Your final grade will be based on homework, two tests, a cumulative final and a 1% bonus for completing the course evaluation.

source	data	contribution
homework		20%
test one	F Oct 10	20%
test two	F Nov 7	20%
cumulative final	1-3 pm T Dec 16	40%
evaluation bonus	19 Nov. - 10 Dec.	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 Fall 2008 will open on Wendnesday, Nov. 19 and close on Wednesday, Dec, 10. 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 Aug 27	Faraday, Maxwell, and electromagnetic fields	1.6–7	1-4,5	
F Aug 29	Div, Grad and curl	1.8–10	1-8,9,10	
M Sep 1	Academic Holiday			
W Sep 3	Line, surface and volume integrals.	1.11–13	1-13,14,15	
F Sep 5	Problem session on vector calculus	1.6–13		
M Sep 8	Cylindrical and spherical coordinate systems	1.16–18	1-16,19	**Hwk due**
W Sep 10	Gauss' and Stoke's Theorems	1.14–15	1-22.23,25	
F Sep 12	Problem session on vector calculus	1.14–18		
M Sep 15	Elements of the electrostatic force	2.1–2		**Hwk due**
	– inverse square law and photon mass		2-2,8	
W Sep 17	Linear superposition and γ–γ and g–g scattering	2.3–5	2-7,9,11	
F Sep 19	Problem session on the electrostatic force	3.1–4		
M Sep 22	Action at a distance and the electric field	3.1–4	3-5,8,10	**Hwk due**
W Sep 24	Problem session on the electrostatic field	2.1–3.4		
F Sep 26	Gauss' flux law – integral version	4.1	4-2,3,4,8	**Hwk due**
M Sep 29	Gauss' flux law – differential version	4.2-3	4-10,11	
W Oct 1	Problem session on Gauss' flux law	4.2-3		
F Oct 3	The concept of the scalar potential	5.1	5-1,9	**Hwk due**
	– what is gauge invariance?			
M Oct 6	The application of the scalar potential	5.2-4	5-14,15,16	
W Oct 8	Problem session on the scalar potential	5.2-4		
F Oct 10	**Test one**	1.6–5.4		
M Oct 13	**Review of test one**			**Hwk due**
W Oct 15	Conductors in electric fields - conceptual	6.1-2	6-1,2	
M Oct 17	Conductors in electric fields - capacitance	6.3	6-3,8,11,12	

Date	Topic	Ch.Sec	Hwk Peob.	Hwk Due
M Oct 20	Problem session on conductors			
W Oct 22	Stored electrical energy in terms of charge	7.1-2	7-1,4,5	**Hwk due**
F Oct 24	Stored electrical energy in terms fields	7.4	7-13,14	**Hwk due**
M Oct 27	Problem session on electrical energy			**Hwk due**
W Oct 29	The multipole expansion	8.1	8-1,2	
F Oct 31	The Legendre polynomials	8.1	8-8,10	
M Nov 3	Electrical energy of a charge distribution	8.2, 8.4	8-17,19	
W Nov 5	Problem session on the multipole expansion	8.1–8.4		
F Nov 7	**Test two**	6.1–8.4		
M Nov 10	**Review of test two**			**Hwk due**
W Nov 12	Boundaries between materials - general case	9.1–4	9-1,3	
F Nov 14	Boundaries between materials - electric case	9.1–4	9-4,5	
M Nov 17	Macroscopic models of dielectrics - charges	10.1-2	10-1,2,3	**Hwk due**
W Nov 19	Macroscopic models of dielectrics - fields	10.3-5	10-7,17,23	
F Nov 21	Types and models of dielectrics	app. B-1	10-28,29	
M Nov 24	Energies and forces involving dielectrics	app. B-1	10-35,36	
W Nov 26	Academic holiday			
F Nov 28	Academic holiday			
M Dec 1	Problem session on dielectrics	10.8-9		**Hwk due**
W Dec 3	The method of images - concepts	11.1-3	11-3,4	
F Dec 5	The method of images - problems	11.1-3	11-9	
M Dec 8	Laplace's equation in rectangular coor.	11.4-5	11-15,16,17	
W Dec 10	Laplace's equation in spherical coor.	11.4-5	11-25	
F Dec 12	Problem session	11.4-5		**Hwk due**
T Dec 16	**1-3 pm Final**			