Syllabus for PHY 432 Electromagnetism

Dr. Christensen

2013 Spring Semester: MWF 2:00–3:05, S226

Textbook: "Introduction to Electrodynamics" (4e) Griffiths

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PHY 432 (4-0)
Prerequisites:  PHY 142, MAT 202, MAT 302
Electric and magnetic fields in free space and in materials, electromagnetic fields and waves
and radiation are discussed.
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1 Departmental Goals

Through the class discussion and lecture, you will be exposed to *the principles and foundations of classical and modern physics* as they apply to electromagnetic fields at an *advanced* level. Solving the homework problems will help you to incorporate these principles into your general understanding of the world. In the homework problems, you will be asked *to generalize and extend foundational theories in complex applications* of electromagnetic fields at an *advanced* level.

Your grades on the homework and exams will reflect your knowledge of the principles and foundations and your ability to generalize and extend these. The point of turning in work is to show me how well you understand the material. The point of grading work is to show you how well you understand as well as how well you communicate your understanding. Please review returned homework to learn what you didn't understand.

2 Grading

30% **Homework:** You will have two assignments from most chapters, due on the "boxed days" on the schedule. The first will be easy problems due before class discussion. The second will be more difficult problems due after class discussion. The point is encourage you to familiarize yourself with the straightforward material before class time. Solutions will be posted after the assignment is collected.

3x15% +25% **Exams:** There will be three one-hour tests and a two-hour comprehensive final exam. Each exam will have an in-class, closed-book portion. They may also have an open-book and/or take-home portion.

100% **Grades:** Final grades will be reported as a percentage of the sum of the adjusted earned points.

3 Course Policies

Attendance: Physical attendance is mandatory. Mental attendance is appreciated (not to mention helpful). If "something comes up," contact me (note, email, voice mail, courier, same-day word-of-mouth) **beforehand**.

Athletics: It is your personal responsibility to inform me if you will miss class **before** you miss class. Even if an email is being sent on your behalf, see me before or after class so that I can inform you of variations from the syllabus. It is your responsibility to inform me of incoming report cards before you bring them so that I can have a grade available.

Late Policy: No credit will be given for problems worked in class regardless of attendance in the class. Late homework loses 5 points per day (not per class period). Sat & Sun together count as 1 day.

Missed Exams: Make up exams **must** be scheduled before regular exam time. Documented, unforeseen events will be dealt with on a case-by-case basis.

Office Hour Policy My schedule (with office hours) is posted on my office door. I expect to be in my office most days from about 8:00am to about 4:30pm. You are welcome to stop by whenever you have a question. Be aware that my posted schedule also lists times which I will *probably* be in my office. I am also available by appointment.

Expectations: Grades are tied to numerical scores according to the following criterion. I consider a mid-C to be average for physics majors who are going on to graduate school.

"A"	Outstanding	> 90
"B"	Above Average	80-90
"C"	Average	70-80
"D"	Below Average	60-70
"F"	Did not successfully complete requirements	< 60

"+" is the upper half of the range.

3.1 Campus Policies and Services

In compliance with Thomas More College policy and legislation requiring equal access, appropriate accommodations for students with disabilities are available. If you have a documented physical or learning disability for which you require special accommodations, please see Veronica Lubbe, Coordinator Academic Support Services - Administration Building room 3336, (859) 344.3521, as soon as possible. This includes students who have previously received accommodations at TMC.

Policy	Page of Catalog 12-13
Disability Services (344-3521)	24
Tutoring Services	24
Attendance	33
Academic Honesty	35

The catalogs can be found online at

`http://www.thomasmore.edu/registrar/course_catalogs.cfm`

4 Schedule

Week	Day	Topic	Eqns	Pre-class Readings
1/7	M	1. Review Math Meth. 301/302	$\vec{\nabla}\Phi$, $\vec{\nabla}\cdot\vec{E}$, $\vec{\nabla}\times\vec{A}$	Chap 1
	W	2. Review Math Meth. 301/302	$\vec{\nabla}\Phi$, $\vec{\nabla}\cdot\vec{E}$, $\vec{\nabla}\times\vec{A}$	Chap 1
	$\boxed{\text{F}_1}$	3. $\vec{E}$-field, Coulombic Force, Superposition	$\vec{F} = q\vec{E}$	2.1-2
1/14	M	4. Electric Flux, Gauss' Law	$\begin{cases} \oint_S \vec{E}\cdot d\vec{a} = \int_V (\rho/\varepsilon_o)\, dv \\ \vec{\nabla}\cdot\vec{E} = \rho/\varepsilon_o \end{cases}$	2.2
	W	5. Electrostatic Potential and Potential Energy	$\begin{cases} \vec{E} = -\vec{\nabla}V, \vec{F} = -\vec{\nabla}U \\ U = \frac{1}{2}\int_V (\varepsilon_0\vec{E})\cdot\vec{E}\, dv \end{cases}$	2.3-4
	F	6. Capacitors	$U = \frac{1}{2}\sum_i \sum_j c_{ij}\Phi_i\Phi_j = C\Delta\Phi$	2.4-5
1/21	M	======== **MLK Day - No Class** ========		
	$\boxed{\text{W}_2}$	7. Rectangular Poisson & Laplace	$\nabla^2\Phi = -\rho/\varepsilon_o$	2.3.3,3.1,3.3
	F	8. Spherical & Cylindrical Poisson & Laplace		3.1,3.3
1/28	M	9. Multipoles	$\|\vec{r} - \vec{r}'\|^{-2}$	3.4
	W	10. Multipoles & Dirac Delta Function	$\delta(\vec{x} - \vec{a})$	1.5,3.4
	F	11. Method of Images		3.2

. . . Continued. . .

Week	Day	Topic	Eqns	Pre-class Readings
2/4	M_3	12. Dipoles, Dielectric Polarization	$\vec{p}$, $\sigma = \vec{P}\cdot\vec{n}$, $\rho = -\vec{\nabla}\cdot\vec{P}$	4.1,4.2
	W	13. Review		
2/8	F	14. **⇒ Test 1 ⇐**		Chap:1-3
2/11	M	15. $\vec{E}$ & $\vec{D}$ fields, ε, & χ	$\begin{cases}\vec{D}=\varepsilon\vec{E}, \vec{P}=\chi\vec{E}\\ \vec{D}=\varepsilon_o\vec{E}+\vec{P}\end{cases}$	4.3-4
	W	16. $\vec{E}$ & $\vec{D}$ fields, ε, & χ	$\begin{cases}\vec{D}=\varepsilon\vec{E}, \vec{P}=\chi\vec{E}\\ \vec{D}=\varepsilon_o\vec{E}+\vec{P}\end{cases}$	4.3-4
	F	17. Boundary Conditions	$(\vec{D}_{2n}-\vec{D}_{1n})=\sigma, E_{1t}=E_{2t}$	4.4
2/18	M_4	18. Magnetic Force and Source (Current Density)	$\vec{F}_C = q(\vec{E}+\vec{v}\times\vec{B})$	5.1
	W	19. Biot-Savart Law, Magnetic Flux	$\vec{B}(\vec{r}_2)=\frac{\mu_o}{4\pi}I_1\oint_1\frac{d\vec{l}_1\times(\vec{r}_2-\vec{r}_1)}{\lvert\vec{r}_2-\vec{r}_1\rvert^3}$	5.2
	F	20. Ampere's Law	$\oint_C\vec{B}\cdot d\vec{l}=\mu_o\int_S\vec{J}\cdot d\vec{a}$	5.3
2/25	M	21. Magnetic Vector Potentials	$\begin{cases}\vec{B}=\vec{\nabla}\times\vec{A}\\ \vec{\nabla}\times\vec{B}=\mu_0\vec{J}, \vec{\nabla}\cdot\vec{B}=0\end{cases}$	5.4
	W_5	22. Magnetization, Susceptibility, Permeability	$\vec{M}=\chi_m\vec{H}$, $\vec{H}=\frac{1}{\mu_0}\vec{B}-\vec{M}$	6.1,6.3-4
	F	23. Bound Currents	$\vec{J}=\vec{\nabla}\times\vec{M}$, $\vec{K}=\vec{M}\times\hat{n}$	6.2
3/4	M-F	========= **Spring Break**: Do Homework! =========		
3/11	M	24. Boundary Conditions	$(\vec{B}_{2n}-\vec{B}_{1n})=0$, $H_{1t}=H_{2t}$	6.3-4
	W_6	25. Continuity & Ohm's Law	$\frac{\partial\rho}{\partial t}+\vec{\nabla}\cdot\vec{J}=0$, $\vec{E}=\sigma_c\vec{J}$	8.1.1,7.1.1
	F	26. Review		
3/18	M	27. **⇒ Test 2 ⇐**		Chap 4-6
	W	28. Induction & Electromotive "Force"	$\mathcal{V}=-\frac{d\Phi}{dt}$	7.1
	F	29. Faraday's Law	$\vec{\nabla}\times\vec{E}=-\frac{\partial\vec{B}}{\partial t}$	7.2
3/25	M	30. Faraday's Law	$\vec{\nabla}\times\vec{E}=-\frac{\partial\vec{B}}{\partial t}$	7.2
	W	31. Displacement Current Density	$J_D=\frac{\partial\vec{D}}{\partial t}=\frac{\partial}{\partial t}(\varepsilon_0\vec{E}+\vec{P})$	7.3
	F	========= **Easter Break** =========		
4/1	M	========= **Easter Break** =========		
	W	32. Maxwell's Equations		7.3
	F_7	33. Energy (Poynting) in Electromagnetic Fields	$\vec{S}=\vec{E}\times\vec{H}$	8.1
4/8	M	34. (Angular) Momentum in Electromagnetic Fields	$\vec{p}=\mu_o\varepsilon_o\int\vec{S}\,dv$	8.2.3-4
	W_8	35. General Properties of Waves	$v^2\vec{\nabla}^2 f=\ddot{f}$, T, λ, ω, k	9.1
	F	36. Review		
4/15	M	37. **⇒ Test 3 ⇐**		Chap 7-8
	W	38. Boundary Conditions		9.1.3-4
	F	39. Electromagnetic Waves in Vacuum		9.2
4/22	M	40. Electromagnetic Waves in Matter		9.3
	W_9	41. Review: **BRING QUESTIONS**		Comprehensive
	F	42. Review: **BRING QUESTIONS**		Comprehensive
5/2	Th	43. **Final Exam**: 10:45am –12:45pm		Comprehensive