

UNIVERSITY OF CALGARY  
DEPARTMENT OF PHYSICS AND ASTRONOMY  
COURSE OUTLINE

1. **Course:** Physics 457, Electromagnetic Theory III

Lecture Sections:

L01: MWF, 13:00-13:50, SA 147

**Instructor**      Dr. E. Donovan  
Office: SB 5XX  
Phone: 220-6337 (no voicemail)  
e-mail: [edonovan@ucalgary.ca](mailto:edonovan@ucalgary.ca)  
Office Hours: Friday 10:00-12:00  
D2L: No

2. **Prerequisites:** Physics 455 and Applied Math 413

3. **Grading:** The University policy on grading and related matters is described sections [F.1](#) and [F.2](#) of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Assignment	10%
In Class Tests (4)	50%
Final Examination	40% (To be scheduled by the Registrar )

Percentage grades will be given for all elements of term work and examinations. A weighted course percentage will be calculated for each student after the final exam is written. Conversion from final course percentage to final course letter grade will be as follows:

Percentage Grade	Letter Grade
<45	F
45-49	D
50-53	D+
54-57	C-
57-60	C
60-64	C+
65-69	B-
70-74	B
74-79	B+
80-84	A-
85-90	A
90-100	A+

4. **Missed Components of Term Work:** The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in [Section 3.6](#). It is the student's responsibility to familiarize himself/herself with these regulations. See also [Section E.6](#) of the University Calendar

5. **Scheduled out-of-class activities:** Not Applicable

6. **Course Materials:** "Introduction to Electrodynamics", 3<sup>rd</sup> Edition. David Griffiths, Prentice-Hall 1999

7. **Examination Policy:** Closed book, no calculators, formula sheet to be provided (Students should also read the Calendar, [Section G](#), on Examinations).

8. **Approved Mandatory and Optional Course Supplemental Fees:** Not Applicable.

9. **Writing across the curriculum statement:** Not Applicable

10. **Human studies statement:** Not Applicable

**11. OTHER IMPORTANT INFORMATION FOR STUDENTS:**

- (a) **Academic Misconduct:** (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under [Section K, Student Misconduct](#) to inform yourself of definitions, processes and penalties
- (b) **Assembly Points:** In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on [assembly points](#).
- (c) **Academic Accommodation Policy:** Students with documentable disabilities are referred to the following links: [Calendar entry on students with disabilities](#) and [Student Accessibility Services](#).
- (d) **Safewalk:** Campus Security will escort individuals day or night (<http://www.ucalgary.ca/security/safewalk/>). Call 220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.
- (e) **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). As one consequence, students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information see also <http://www.ucalgary.ca/secretariat/privacy>.
- (f) **Student Union Information:** VP Academic Phone: 220-3911 Email: [suvpaca@ucagary.ca](mailto:suvpaca@ucagary.ca). SU Faculty Rep. Phone: 220-3913 Email: [sciencerep@su.ucalgary.ca](mailto:sciencerep@su.ucalgary.ca) [Student Ombudsman](#)
- (i) **Internet and Electronic Device Information:** You can assume that in all classes that you attend, your cell phone should be turned off unless instructed otherwise. Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.

The following signature lines should be added to the course outline as appropriate

Department Approval \_\_\_\_\_ Date \_\_\_\_\_

Associate Dean's Approval for out of regular class-time activity: \_\_\_\_\_ Date: \_\_\_\_\_

Associate Dean's Approval for Alternate final examination arrangements: \_\_\_\_\_ Date: \_\_\_\_\_

## **P457 (Winter 2014) - DETAILED COURSE SYLLABUS**

### Electrodynamics

Electromotive Force: Ohm's law, Joule heating, Motional EMF  
Electromagnetic Induction: Faraday's & Lenz's laws, Induced E-field, Inductance  
Electromagnetic Energy: Review of E-field Energy, Introduction to B-field Energy  
Maxwell's equations: displacement & polarization current, boundary conditions

### Conservation laws

Conservation Relations: Mathematic Form  
Conservation of Charge and Energy: Continuity Equation, Poynting Flux  
Momentum: Maxwell Stress Tensor, Momentum Flux Density, Angular Momentum

### Electromagnetic waves

Waves in 1D: Wave Equation, Sinusoids, Reflection & Transmission, Polarization  
Waves in Vacuum: EM Wave Equation, Monochromatic Plane Waves, Energy & Momentum  
Waves in Matter: Linear Media, Normal Incidence Reflection & Transmission, Oblique Incidence, Snell's Law, Fresnel Equations, Brewster's Angle  
Absorption and Dispersion: Waves in Conductors, Reflection at Conductors, Group Velocity, Phase Velocity, Dispersion  
Guided Waves: Wave Guides, TE/TM, Cutoff Frequency, Coaxial Transmission Lines  
Potential Formulation: Scalar and Vector potentials, Gauge Transformations, Coulomb Gauge, Lorentz Gauge  
Continuous Distributions: Retarded Potentials, Jefimenko's Equations  
Point Charges: Lienard-Weichert Potentials, Moving Point Charges

### Radiation

Dipole Radiation: Electric & Magnetic Dipole, Arbitrary Source  
Point Charges: Radiated Power, Radiation Reaction

### Relativity

Special Theory: Einstein's Postulates, Time Dilation, Lorentz Contraction, Lorentz Transformations, Four-Vectors  
Mechanics: Proper Time and Velocity, Energy and Momentum, Kinematics, Dynamics  
Electrodynamics: Magnetism, Field Transformation, Field Tensor, Potentials

## P457 Strawman Schedule

January 8, 2014

E&M is a two-part story. On the one hand you have the “overview”, which is this beautiful story of how the whole thing fits together. This is a high-level view, very good if one has most of it as part of your intellectual toolkit. On the other hand, there is *what we can do with E&M*. In a practical sense, this is everything that matters, but for scientists the overview matters too.

My objective here is to provide (1) new material corresponding to Chapters 7 and forward in Griffiths, focussing on *what we can do with this* and (2) leave you with a coherent *overview* of E&M at the upper-undergrad level.

I start with an overview of the static formulation of Maxwell’s Equations. With this overview, I attempt to attend to the key steps in the development of the key concepts that make up the static formulation of E&M, and then justify a time-dependent “fix” of Ampere’s Law.

Looking forward to the term, here is a “strawman” schedule. I will update this as the term progresses and get the revised schedule to you as appropriate.

Week Starts	# Lect.	Test	Topics	Notes
Jan.	6	2	Overview; Math Review	
	13	3	Chapter 7	
	20	2	✓ Up to TD Maxwell’s Equations	
	27	3	Conservation Laws (Ch 8)	
Feb.	3	3	Start EM Waves	
	10	2	✓	
	17	-		Reading Week
	24	3		
Mar.	3	3		
	10	2	✓	
	17	3		
	24	3		
	31	2	✓	
Apr	7	3		
	14	1		Last class Apr. 14 <sup>th</sup> .
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Eric Donovan