# *Physics 505: Electrodynamics*

## Course Organization



## Overview

This is an intense one semester graduate course in Classical Electrodynamics. This is the only graduate course to meet 5 hours per week, and therefore graduate students should expect that this course will constitute a significant part of their first semester workload.

We begin with a very brief review of electrostatics and magnetostatics where the required special functions and Green function techniques are introduced. After this introduction, we describe Faraday's Law and the quasi-static approximation to the Maxwell system. Following these developments we study the propagation of light in media, and categorize the response functions of typical materials. Subsequently we describe diffractive and scattering phenomena with partially coherent light. Then we discuss multipole radiation, placing classical electrodynamics within the context of special relativity. This formalism is used to study radiation in various contexts. The course will emphasize problem solving.

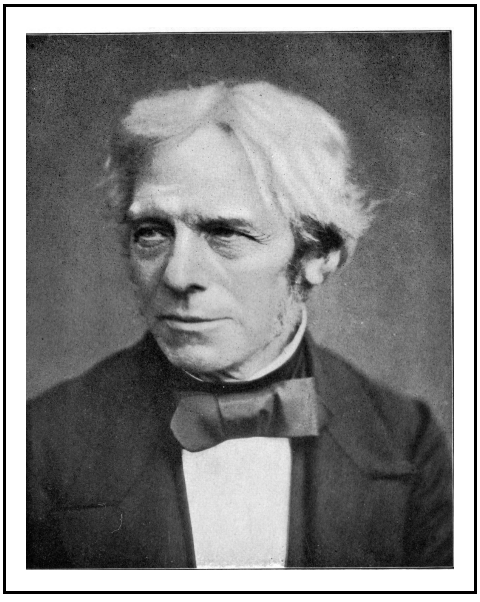
A detailed set of scanned lecture notes and typed formulas will be provided for the course. Examples of the format of these notes is given on the course page for Fall 2014:

http://tonic.physics.sunysb.edu/~dteaney/F14_Phy505/course.htm .

The structure and tentative order of the course is the following

1. **The Maxwell Equations:**
2. **Electrostatics:**
3. **Electric fields in matter:**
4. **Magnetostatics:**
5. **Magnetism and magnetic fields in matter:**
6. **The Maxwell equations and the quasistatic approximation:**
7. **Propagation of waves in media and at interfaces:**
8. **Multipole radiation, and radiation by slow charges:**
9. **Relativity, covariance, and electrodynamics:**
10. **Radiation by fast charges:**
11. **Scattering of radiation and diffraction:**

The following is a portrait of Faraday. May his memory inspire young experimentalists, and young theorists to listen to them.



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## Lecture Notes and Tentative Schedule

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|---|---|
| Week 1: 8/24 | The Maxwell equations and mathematical review |
| Week 2: 8/31 | Electrostatics |
| Week 3: 9/7 | Green Functions |
| Week 4: 9/14 | Dielectrics |
| Week 5: 9/21 | Magnetostatics. Magnetic materials. |
| Week 6: 9/28 | Quasi-statics in vacuum and metals. Maxwell Equations for Potentials. |
| Week 7: 10/5 | Conservation Laws. Propagation of waves in media and interfaces. |
| Week 8: 10/12 | Dispersion. Wave packtes. Retarded Green Functions for oscillator and waves eqn. |
| Week 9: 10/19 | Multipole radiation, and radiation from slow charges. |
| Week 10: 10/26 | Finish multipoles, Relativity |
| Week 11: 11/2 | Relativity and Electrodynamics continued. |
| Week 12: 11/9 | Radiation from relativistic charges. |
| Week 13: 11/16 | Radiation from relativistic charges. Bremsstrahlung. |
| Thanksgiving week: 11/23 | Scattering and Diffraction |
| Week 14: 11/30 | Scattering and Diffraction: |

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## Lecture Instructor:

**Assoc. Professor, Derek Teaney: derek.teaney @ stonybrook.edu**

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**Teaching Assistant, Yao Ma: yao.ma @ stonybrook.edu**

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# Schedules

**Class Meetings**

The course consists of three lecture hours and two hour recitation. Recitations will be used to discuss problems.

- Lecture Hours: MWF 10:00-10:53 in P112
- Recitation: Friday 11:00-1:00 in P112

**Office Hours**

Please feel free to contact me at anytime. My official office hours are,

- C-135, Mondays 11:00-1:00

**Final Exam**

The final exam is on Tuesday, December 15 from 2:15--5:00 p.m in P112.

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# Grade Determination

The grading will be based *roughly* on the following table. I reserve the right to change these proportions (within reasonable limits) as the course progresses. My intent of course is to follow these guidelines.

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|---|---|
| Homework | 25% |
| Midterm Exam | 35% |
| Final Exam | 40% |

Homework is a major part of this course, and students should expect approximately 8-10 hours of work per week. Homeworks will be assigned weekly, and will be collected *** at the start of class *** . Homework handed in within a day after the due date/time will by given a 5% penalty. After this, late homeworks will be penalized at 10% per day.

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# The Book and Resources

The required book for the course is

1. *Classical Electrodynamics* by John David Jackson

Some other books which I used when preparing the course are:

1. A good source of problems is: *Modern Electrodynamics* by Andrew Zangwill.
2. A interesting perspective on the subject is: *Classical Electrodynamics* by Julian Schwinger, Lester Deraad, Kimball Milton, Wu-yang Tsai.
3. Professor Likharev's Essential Graduate Physics
4. I have found: *Methods of Theoretical Physics, Part I and II* by Morse and Freshbach an invaluable, enjoyable, and surprisingly readable reference over the years.

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# Other Items

**E-mail**

Email to your University email account is an important way of communicating with you for this course. For most students the email address is firstname.lastname@stonybrook.edu, and the account can be accessed here: http://www.stonybrook.edu/mycloud". It is your responsibility to read your email received at this account.

For instructions about how to verify your University email address see this: http://it.stonybrook.edu/help/kb/checking-or-changing-your-mail-forwarding-address-in-the-epo. You can set up email forwarding using instructions here: http://it.stonybrook.edu/help/kb/setting-up-mail-forwarding-in-google-mail. If you choose to forward your University email to another account, we are not responsible for any undeliverable messages.

**Disability Support Services (DSS):**

If you have a physical, psychological, medical or learning disability that may impact your course

work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room 128, (631) 632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

**Academic Integrity:**

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

**Critical Incident Management Statement:**

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.

**Assessment of Student Performance:**

- Homework assignments, examinations, and term papers should be evaluated and returned promptly. Written comments, explaining the instructor's criteria for evaluation and giving suggestions for improvement, should be provided.
- Instructors are responsible for providing students with appropriate and timely notification about their academic performance in a course. An examination or other assessment measure should be administered, graded, and returned to students before the end of the ninth week of classes.
- Examinations and term papers submitted at the end of the term should be graded and either returned to students or retained for one semester.
- Any change to the course grading policy during the semester must be announced and made available to all students enrolled in the course. Assigning additional work to individual students who wish to improve their grades, during or after the semester, is prohibited.
- Instructors must observe the Final Examination Schedule available at http://www.stonybrook.edu/registrar. Instructors of courses taught on the semester schedule may only give a unit exam in class during the last week of the semester if a final examination is also given during the Final Examination Period.
- Instructors must observe state laws, federal laws, and University policies regarding accommodations as noted in the Bulletin (e.g., student participation in University-sponsored activities or equivalent opportunity/religious absences). Accommodations such as make-up exams, assignments, or other coursework that fall outside of the purview of these laws and policies are at the discretion of the instructor.

**Professional Conduct and Interaction with Students:**

- Instructors must report all suspected occurrences of academic dishonesty to the Academic Judiciary

Committee (for classes in the College of Arts and Sciences, College of Business, School of Marine and Atmospheric Sciences, and School of Journalism) or the Committee on Academic Standing and Appeals (for classes in the College of Engineering and Applied Sciences).

- Instructors should always be aware that in teaching and advising they represent the University. They are bound by the University's sexual harassment policies. Instructors are also bound by University policies that prohibit any consensual relationships with students that might compromise the objectivity and integrity of the teacher-student relationship. Examples include romantic, sexual, or financial relationships.
- Instructors should strive to maintain the privacy and confidentiality of students' examinations, homework, and final grades.
- In dealing with students, instructors should be polite, helpful, and fair. They should take into account the wide range of cultural factors and physical challenges that can affect learning, and should attempt to help students overcome any disadvantages.