

# ES 151 — Applied Electromagnetism

Spring 2015

SEAS, Harvard University

<http://www.seas.harvard.edu/courses/es151>

Tuesday and Thursday, 1pm - 2:30pm

Maxwell-Dworkin 119

## Teaching Staffs

Professor: Donhee Ham, Gordon McKay Professor of Applied Physics and EE

— Maxwell-Dworkin 131, 6-9451, [donhee@seas.harvard.edu](mailto:donhee@seas.harvard.edu)

— ([office hours](#)) TBA

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## Course Description

Electromagnetism and its applications in science and technology. See Topics in the next page.

## Prerequisite

Basic electromagnetism (Physics 11b or 15b or equivalent), basic vector calculus (Applied Math 21a or equivalent), basic differential equations (Applied Math 21b or equivalent) and familiarity with Fourier analysis (Applied Math 21b or equivalent).

## References

There is no textbook. I will hand out my lecture notes throughout the semester. Useful/excellent references (although not required to read) are below.

(Reference 1) Purcell, *Electricity and Magnetism*

(Reference 2) Feynman et al, *The Feynman Lectures on Physics - II*

(Reference 3) Jackson, *Classical Electrodynamics*

(Reference 4) Ramo, Whinnery, and van Duzer, *Fields and Waves in Comm. Electronics*

## Grading

1. Homework (30%): Solutions need not be wordy, but you should detail your reasoning. If we can't figure out what you did, your points will not be high. *Limited* collaboration is allowed, but you should turn in your own homework — You can discuss problems with other students taking the course, but final solutions should not be exchanged. You should make it sure that you understand the solution you turn in, and write up the solution in your own words. Basic guideline is not to take undue advantage of any other student. Assignments will be handed out every Thursday in class and are due following Thursday by 12:45 pm sharp (15 minutes before class) in the drop box outside my office (Maxwell-Dworkin 131), and will be graded by the following Thursday. Late work will be reduced 25% per week. There's no exception to this rule, other than University-established emergency cases (a letter from authorized official is required).
2. Midterm (30%)
3. Final (40%)

## Topics

| NO. | SUBJECT   |
|-----|---|
| 1   | Maxwell's equations — electrostatics, magnetostatics, electromagnetic induction, displacement current.                            |
| 2   | Electromagnetic waves (light, microwaves, etc.)   |
| 3   | Electromagnetic wave propagation through media discontinuity  |
| 4   | Guided electromagnetic waves — transmission lines and waveguides  |
| 5   | Electromagnetic resonators/cavities and microwave circuits  |
| 6   | Electromagnetic radiation and antenna — classical treatment   |
| 7   | Interactions between electromagnetic waves and solid-state matters (dielectrics and conductors) — optics and plasmonics of solids |
| 8   | Optical devices   |
| 9   | Origin of colors  |
| 10  | Interference and diffraction  |
| 11  | Nuclear magnetic resonance and magnetic resonance imaging   |
| 12  | Diamagnetism, paramagnetism, and ferromagnetism   |
| 13  | Lasers and masers   |
| 14  | Radio astronomy   |
| 15  | Radar and wireless communication systems  |
| 15  | Electromagnetism and relativity   |