PHYSICS 110A, Fall 2016

Class Time: T Th 9:30-11am, 101 Moffitt

Instructor: Prof. Mike Crommie, *office:* 345 Birge, *phone:* 642-3316
email: crommie@berkeley.edu, *office hours:* T Th 11-12pm (right after class on T Th)

TA: Niladri Chatterji *email:* niladri.chatterji@berkeley.edu (M Th 1-2pm at 419 Birge)
    Ka Hei Leung *email:* kaheileung@berkeley.edu (Wed 2-3pm Fri 11-12pm at 419 Birge)

Course Website: bCourse

Text: *Introduction to Electrodynamics* by David J. Griffiths (3rd or 4th ed.)

Grading: H. W. --   27%
        Midterm Exam (in class) ------------------   30%
        Final Exam   --------------------------------   43%

H.W. Policy: H.W. will typically be posted on Tuesday at the course website and will be due on Friday at 5pm of the *following week* (i.e., the week after being assigned). No late H.W. will be accepted. Note: it is good for students to work together on the H.W., but each student is required to produce their own solution to a given problem and not just copy from a friend or the internet.

Overview of Course Content:

1) Math review of vector calculus
2) Electrostatics (E-fields, potentials, effects of matter)
3) Magnetostatics (B-fields, vector potential, effects of matter)
4) Time-varying E and B-fields: Maxwell's equations
5) Electromagnetic waves

The main source for this course is the lectures. **YOU ARE RESPONSIBLE FOR EVERYTHING DISCUSSED IN CLASS**.

Recommended books:

E & M:

Electromagnetic Fields by Wangsness
Classical Electrodynamics by Jackson
Introduction to Electromagnetic Fields and Waves by Corson & Lorrain
Foundations of Electromagnetic Theory by Reitz, Milford, & Christy

Math Methods:

Mathematical Methods for Physicists by Arfken
div grad curl and all that by Schey

Tentative List of Specific Topics for 110A E&M Course

Electrostatic forces
E-field of pt. charge distribution
E-field of charge density continuum
Gauss's law
Electrostatic potential of pt. charges plus continuum
Boundary conditions on E-field
Electrostatic energy
Conductors
Pressure on conductors w/ charge
Capacitance
Poisson's eq'n, uniqueness th'm
Method of images
Separation of variables (cartesian, spherical)
Multipole expansion
Dielectrics: Polarization definition, D-field, bound charge
Linear dielectrics, def'n of Σ
Boundary conditions on E, D in presence of material
Role of Σ in Poisson's equation and field behavior
Solving Laplace's equation around a dielectric using separation of variables
Electrostatic force and energy involving dielectrics
Magnetostatics, Biot-Savart law, forces on currents in a B-field
Divergence and curl of B-field
Vector potential (A)
Boundary conditions for various fields
Magnetic dipoles
Magnetism in materials: orbital and spin
Paramagnetism, diamagnetism, ferromagnetism
Bound currents from magnetization (M)
Definition of H
Electrodynamics: Ohm's law, Faraday's law, induced EMF
Inductance
Magnetic energy
Displacement current
Maxwell's equations in matter
Poynting vector (energy flow in EM field)
Momentum density in EM field
EM wave equation, waves
Average power intensity of EM wave, momentum density, energy density
Index of refraction
Law of reflection
Law of refraction (Snell's law)
Fresnel equations in dielectrics
EM waves in a conductor (skin depth)
Fresnel equation for reflection at a conductor surface
Waveguides: rectangular and coaxial geometry
TE, TM, TEM modes