Course description:

This course is an *undergraduate-level* course on electromagnetism. Topics include electrostatics, electric currents, magnetic field, electromagnetic induction, Maxwell's equations, electromagnetic radiation, magnetic fields in materials, and some basic notions in kinetic theory, entropy, temperature, and phase transition associated with electricity and magnetism.

Recommended preparation:

We recommend that you take Physics 15a, Physics 16 (or you have a written permission from your Head Tutor in Physics). Mathematics preparation at least at the level of Mathematics 21a taken concurrently is required. Vector calculus (divergence, gradient, curl) is used extensively (and taught) in this course.

Course information:

Meeting Time: Tuesday, Thursday 12:00pm - 1:15pm

Meeting Location: *Science Center D*

Lab Information is available under the Pages heading

Sections:

Tuesdays 5-6:15 pm (at Jefferson 356).

Wednesdays 3-4:15 pm (at Jefferson 356).

Thursdays 1:30-2:45 pm (at Jefferson 256).

Contact information:

Prof. Cora Dvorkin: cdvorkin@g.harvard.edu

â€¢ Office hours: Tuesdays 3-4 pm, Thursdays 3-4 pm (at Lyman 334).

Prof. Mara Prentiss: prentiss@g.harvard.edu

Section TFs:

Richard Huang: rhuang@g.harvard.edu

â€¢ Office hours: Wednesdays 7-8 pm (over zoom; for link see under the "Zoom" tab), Fridays 10-11 am (at Jefferson 256).

Emin Berker: rberker@college.harvard.edu

â€¢ Office hours: Tuesdays 7-9pm (Winthrop House Dining Hall).

Textbook:

Electricity and Magnetism, 3rd Edition, by Edward Purcell and David Morin (available as an ebook here).

Resources:

The course will use Mathematica. A student edition can be downloaded for free from FAS software downloads

Notes for this course:

Prof. Cora Dvorkin's notes will be published on this Canvas site (under the "Files" link).

Grading:

The course grade will consist of the following components:

- Midterm exam (30% of the grade).
- Final exam (30% of the grade).
- Problem sets (40% of the grade)
- Laboratory: 100% lab completion is required to pass this course.

Problem Sets:

There will be weekly problem sets (except during midterm or final week), due every Friday by 6 pm. You are encouraged to discuss with your classmates and work together, but you need to acknowledge with whom you worked in your problem set.

Make sure to check limiting cases as well as units!

Except in unusual circumstances, we will not accept late homework, but we will drop your lowest homework score when computing your final grade.

Outline of the course:

When appropriate, the lecture will include demonstrations to illustrate the physical phenomenon being learned.

Electrostatics:

Lecture 1: Introduction, electric charge, Coulombâ€™s law -- Sep 2

Lecture 2: Potential energy, electric field -- Sep 7

Lecture 3: Flux, Gaussâ€™s law, application of Gauss's law -- Sep 9

Lecture 4: Energy, electric potential, relation between electric field and potential -- Sep 14

Lecture 5: Dipoles, divergence theorem, differential form of Gauss's law, Laplacian -- Sep 16

Lecture 6: Poisson equation, Stokes's theorem, physical interpretation of the curl and divergence -- Sep 21

Lecture 7: Conductors, uniqueness theorem, image charges -- Sep 23

Lecture 8: Capacitors, capacitance, energy in a capacitor, force on a capacitor -- Sep 28

Currents:

Lecture 9: Currents, Ohmâ€™s law, resistance circuits -- Sep 30

Lecture 10: Kirchhoffâ€™s rules, Theveninâ€™s theorem, RC circuit, Voltmeters/Ammeters -- Oct 5

Lecture 11: Transformation of electric field, electric field from charges in motion -- Oct 7

Midterm exam -- Oct 12

Magnetism:

Lecture 12: Derivation of magnetic field from relativity -- Oct 14

Lecture 13: Ampereâ€™s law, differential form, vector potential **A**-- Oct 19

Lecture 14: Biot-Savart law with examples, transformation of electric and magnetic fields -- Oct 21

Lecture 15: Magnetic flux, Lenzâ€™s law, Faradayâ€™s law -- Oct 26

Lecture 16: Mutual/self-inductance, LR circuit -- Oct 28

Lecture 17: Energy in a magnetic field, RLC circuit, alternating current -- Nov 2

AC circuits:

Lecture 18: AC circuits -- Nov 4

Maxwell's equations:

Lecture 19: Impedance, power -- Nov 9

Lecture 20: Maxwellâ€™s equations, displacement current -- Nov 11

Electromagnetic waves:

Lecture 21: Electromagnetic waves, Poynting vector -- Nov 16

Lecture 22: Topics in statistical mechanics -- Nov 18

Lecture 23: Summary of concepts learned -- Nov 23

(There will not be a class on November 25 due to Thanksgiving).

Lecture 24: Final Review -- Nov 30

Final Exam -- Dec 14