University of Colorado's
SEI: Junior Electricity & Magnetism materials

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(work supported by University of Colorado's Science Education Initiative,
NSF CCLI Grant #0737118, PIs K. Perkins, S. Pollock, M. Dubson, N. Finkelstein, J. Cumalat)

The University of Colorado undertook a 3-year effort to research and transform our upper-division courses. Here you will find our research-based materials on junior-level Electricity and Magnetism. This course is the first semester of a two-semester course covering electro- and magneto-statics and closely follows the standard text by David Griffiths, "Introduction to Electrodynamics." In this record, you will find a number of materials that we have developed during the course of these efforts. This work was supported by University of Colorado's Science Education Initiative, (NSF CCLI Grant #0737118, PIs K. Perkins, S. Pollock, M. Dubson, N. Finkelstein, J. Cumalat). Developers include Steven Pollock, Stephanie Chasteen, Mike Dubson, Ed Kinney, Darren Tarshis, Thomas Schibli, and Rachel Pepper.

To help hide sensitive materials from students, these online materials do NOT include the assessments developed as part of the course: Midterm and final exams, solutions to homework and exams and, particularly, the conceptual diagnostic developed to probe student understanding of key concepts in the course (The Colorado Upper-division Electrostatics diagnostic, or CUE). If you would like access to those materials, please email Steven Pollock at steven.pollock@colorado.edu.

If you would like to download the course materials as one large zip file (conveniently organized for ease of use), please visit our website at http://www.colorado.edu/sei/departments/physics_3310.htm.

You may explore our course materials in two ways through the "Related" links to this item:

1. **By topic** (e.g., all materials on Gauss' Law, or vector potential). The topics included are:
    a. Mathematical Fundamentals
    b. Electrostatics
        1. Coulomb's Law and E fields
        2. Gauss' Law and Divergence
        3. Curl of E and Electric Potential
        4. Work and Energy
        5. Conductors and Capacitors
        6. Poisson and Laplace
        7. Method of Images
        8. Separation of Variables
        9. Multipole Expansion
    c. Electric Fields in Matter

1. Polarization, Fields, Dielectrics
2. Electric Displacement (D)
3. Boundary Value Problems

d. Magnetostatics
1. Lorentz Force
2. Charge Density and Current
3. Biot-Savart
4. Divergence and Curl of B; Ampere's Law
5. Vector Potential (A)

e. Magnetic fields in Matter
1. Magnetization and Dipoles
2. Bound Current and Fields
3. Auxiliary Field (H) and Linear Media

f. Electrodynamics
1. EMF
2. Inductance
3. Maxwell's Equations
4. Relativity

2. By type

a. Concept Tests (a.k.a. Clicker Questions). *These are questions intended to be used with a personal response system (PRS) and peer instruction*
b. Homework banks . *These documents provide a broad range of homework questions from various instructors and texts.*
c. Tutorials. *These small-group activities are intended to last 1-2 hours and help students grapple with the core concepts in the course.*
d. Student Difficulties. *These "resource documents" include common student difficulties observed during the course of our research, as well as learning goals and classroom activities for individual topics.*

Attached are a few administrative documents that you might find useful.

1. Course User's Guide. This provides you a directory of the different materials provided to you in these course archives, as well as our course approach.
2. Weekly Schedule. If you would like to see the activities of the course, and the pace with which topics were covered, consult this detailed document.
3. Course Learning Goals. In collaboration with a faculty working group, we determined the core ideas and skills that students should gain in this course. These goals provided direction for the course transformation efforts.
4. Tutorial Guide. This document provides additional information about how the tutorials were administered and run.
5. Maxwell's Equations. These large-format PNG files show Maxwell's Equations in both integral and differential form. Suitable for poster printing and displaying during the course. You may also purchase these

posters from Zazzle at http://tinyurl.com/y937uxj and http://tinyurl.com/yc25cv6

6. Purple Crib Sheet. This sheet contains the useful equations in the course, primarily from the front and back covers of the text by D.J. Griffiths. This was printed on purple paper, and students could bring it to exams.
7. Publications on this Work. This is a research project, and we have reported on the efficacy of this course approach over 4 semesters at the University of Colorado at Boulder.

These materials are based upon work supported by the National Science Foundation under Grant No. 0737118. Any opinions, findings and conclusions or recomendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation (NSF).