SC526  Concepts in Physics II: Electricity and Magnetism  
September/October 2004

**Description:** For teachers, mastery of concepts involving electric charge, electric and magnetic fields, electric potential and potential energy, and direct current (DC) circuits. These concepts will also be discussed in a historical and philosophical context to build pedagogical content knowledge, and there will be additional discussion of pedagogy rooted in science education research.

**Proposed times:** Tuesday 5:15 – 8:15, Friday 5:15 – 8:15

**Dates:** September 14 – October 29. (SC 527 will immediately follow.)

**Location:**  
- Tuesdays: School of Education, room 309  
- Fridays: Metcalf Center for Science, 590 Comm. Ave., room 134 or 136

**Instructors:**

<table>
<thead>
<tr>
<th>Name</th>
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**Grading Scheme:**

<table>
<thead>
<tr>
<th>Grade Type</th>
<th>Percentage</th>
<th>Dates</th>
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<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
<td></td>
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<tr>
<td>Quizzes</td>
<td>7.5%</td>
<td>September 21&lt;sup&gt;st&lt;/sup&gt;; September 28&lt;sup&gt;th&lt;/sup&gt;; October 22nd</td>
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<tr>
<td>Midterm test</td>
<td>20%</td>
<td>October 5th</td>
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<tr>
<td>Final Exam</td>
<td>22.5%</td>
<td>October 29th</td>
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<tr>
<td>Portfolio</td>
<td>40%</td>
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<tr>
<td>Lab Book (15%)</td>
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<tr>
<td>Presentation I(20%)</td>
<td></td>
<td>Group presentation and poster (10%), and a paper (10%).</td>
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<tr>
<td>Presentation II (5%)</td>
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<td>A short individual presentation.</td>
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**Lab Book:** Your lab book should contain notes from class, results and analyses of the laboratory activities done in class, as well as notes you take from the presentations done by the other members of the class. Including work you do on homework problems is fine but not necessary.

**Presentation I:** A group oral presentation analyzing an assigned education research article. You will also prepare a group poster summarizing your presentation.

**Paper:** A paper based on the oral and poster presentation. This paper will be an individual paper and is expected to refer to material on the history and philosophy of science as discussed in class.
**Presentation II:** Each student will be assigned some aspect of the history of science relating to electricity (either a biography or the development of a piece of electrical or magnetic technology) and asked to make a short presentation about this topic.

**Possible topics for Presentation II**

The idea of the Presentation II is for each of you to take a short amount of class time to present something about the history behind what we’re studying, or an application of what we’re studying. When you decide on a topic let Andrew Duffy know so he can work you into the schedule for an appropriate session.

Here are some ideas for topics, but feel free to come up with a topic yourself.

Session 2: (a) Who was Gauss?  
(b) Electrostatic precipitators.
Session 3: (a) The history of the van der Graaff generator.
Session 4: (a) How does a defibrillator work?  
(b) Applications of capacitors.
Session 5: (a) A Brief History of Batteries  
(b) Who was Ohm?
Session 6: (a) The Battle Between AC and DC.  
(b) Thomas Edison.
Session 7: (a) Who was Kirchoff? And how do you pronounce his name?  
(b) Who was Kirchoff? And how do you pronounce his name?
Session 8: (a) How does a pacemaker work?  
(b) Inside a Magna Doodle
Session 9: (a) Paleomagnetism  
(b) Inside a Magna Doodle
Session 10: (a) The Mass Spectrometer  
(b) DC motors
Session 11: (a) Who are all these French guys, anyway?  
(b) DC motors
Session 12: (a) MAGLEV trains  
(b) DC motors

**Books and Materials:**

2. Readings in science education research literature.
3. Readings in history of science.

**Course web site:** [http://physics.bu.edu/~duffy/SC526_Notes.html](http://physics.bu.edu/~duffy/SC526_Notes.html)
Objectives and Goals

The goal of this course is to support the development of a mastery of fundamental physics with deep pedagogical content knowledge by teachers of physics. The immediate objectives are:

1. Provide a review of, and instruction in, electric charge, electric and magnetic fields, and direct current (DC) circuits.
2. Assist teachers in developing their creativity in the development of laboratory activities to support inquiry-based learning in physics as described in the National Science Education Standards.
3. Offer teachers a historical and philosophical context for the science of electricity and magnetism so as to help them develop the analogies, metaphors, and direct examples that, in part, constitute the basis for a teacher’s pedagogical content knowledge.
4. Prepare the teachers for the next course in this sequence.
5. Continue preparing the teachers to take the Massachusetts Teachers Educational Licensure examination in physics.

Curriculum

There will thirteen class sessions, each of length 3 hours. The typical session will be a mix of laboratory experiments, discussion centered around concepts of electricity and magnetism, a problem-solving session, and either a discussion of the history and philosophy of science, or a discussion of the science education research literature and its bearing on the teaching of physics.

Code for Mastering Physics On-Line Homework System

When you register for the Mastering Physics homework system, at http://www.masteringphysics.com, you will be asked for a course code. Please enter the following code:

MPDUFFY0003
SC526 Course Schedule

Session 1: Tuesday September 14th  
Sections from Knight: Chapter 25

Assignments for next session  
Mastering Physics: Assignment 1

Session 2: Friday September 17th  
Topics: Electric Field; Electric Flux and Gauss’ Law  
Sections from Knight: Sections 26.1 – 26.2; Sections 26.5 – 26.6; Chapter 27

Assignments for next session  
Mastering Physics: Assignment 2

Session 3: Tuesday September 21st  
Topics: Electric Potential Energy and Electric Potential  
Sections from Knight: Chapter 29

QUIZ #1

Assignments for next session  
Mastering Physics: Assignment 3

Session 4: Friday September 24th  
Topic: Connecting Potential and Field; Capacitors and Dielectrics  
Sections from Knight: Chapter 30

Assignments for next session  
Mastering Physics: Assignment 4

Session 5: Tuesday September 28th  
Topic: Current, Batteries, Resistance, and Ohm’s Law  
Sections from Knight: Chapter 28; Section 31.1

QUIZ #2

Assignments for next session  
Mastering Physics: Assignment 5
Session 6:  Friday October 1st  
**Topic:** Series and parallel circuits; Kirchoff’s Rules; Ammeters and voltmeters  
**Sections from Knight:** Sections 31.2 – 31.7

**Assignments for next session**  
Mastering Physics: Assignment 6

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Session 7: Tuesday October 5th  
**Topic:** Series-parallel combination circuits  
**Sections from Knight:** Sections 31.8

**MIDTERM TEST (90 minutes)**

**Assignments for next session**  
Mastering Physics: Assignment 7

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There will be no class on Friday October 8th because of the Columbus Day long weekend.

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Session 8: Tuesday October 12th  
**Topic:** Multi-loop circuits; RC Circuits  
**Sections from Knight:** Section 31.9 – 31.10

**Assignments for next session**  
Mastering Physics: Assignment 8

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Session 9: Friday October 15th  
**Topic:** Magnetic Fields  
**Sections from Knight:** Sections 32.1 – 32.3

**PROJECT PRESENTATIONS**

**Assignments for next session**  
Mastering Physics: Assignment 9

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Session 10: Tuesday October 19th  
**Topic:** The force on a charged particle in a magnetic field  
**Sections from Knight:** Section 32.7

**PROJECT PRESENTATIONS and POSTER SESSION**

**Assignments for next session**  
Mastering Physics: Assignment 10
Session 11: Friday October 22nd
Topic: Biot-Savart Law, Ampere’s Law, and calculating magnetic fields.
Sections from Knight: Sections 32.4 – 32.6

PAPERS DUE

QUIZ #3

Assignments for next session
Mastering Physics: Assignment 11

Session 12: Tuesday October 26th
Topic: Forces on wires, torques on wire loops; Magnetic materials
Sections from Knight: Sections 32.8 – 32.10

Assignments for next session
Mastering Physics: Assignment 12

Session 13: Friday October 29th

FINAL EXAM + COURSE EVALUATIONS

HAND IN LAB BOOKS