# 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:**

| Name | Office | e-mail | Phone |
|---|---|---|---|
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**Grading Scheme**:

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|---|---|---|
| Homework | 10% | |
| Quizzes | 7.5% | September 21st; September 28th; October 22nd |
| Midterm test | 20% | October 5th |
| Final Exam | 22.5 % | October 29th |
| Portfolio | 40% | |

- Lab Book (15%)
- Presentation I (20%) Group presentation and poster (10%), and a paper (10%).
- Presentation II (5%) A short individual presentation.

**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?
Session 8: (a) How does a pacemaker work?
Session 9: (a) Paleomagnetism (b) Inside a Magna Doodle
Session 10: (a) The Mass Spectrometer
Session 11: (a) Who are all these French guys, anyway?
Session 12: (a) MAGLEV trains (b) DC motors

## Books and Materials:

1. Knight, Randall (2003). *Physics: A Strategic Approach.* Addison-Wesley.
2. Readings in science education research literature.
3. Readings in history of science.

**Course web site: 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**
**Topic:** Charge. A discussion of the photocopier. Coulomb's Law. Electric Field.
**Sections from Knight:** Chapter 25

***Assignments for next session***
Mastering Physics: Assignment 1

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**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

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**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

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**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

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**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

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**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

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**Session 13: Friday October 29th**

**FINAL EXAM + COURSE EVALUATIONS**

**HAND IN LAB BOOKS**