SC529 - Concepts in Physics V: Electromagnetic Induction; Physical Optics  
April – June 2005

Description: For teachers, mastery of concepts including electromagnetic induction, AC circuits, and physical optics. Discussion will include applications such as the generation of electricity, dimmer switches, and the diffraction of light. 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.

Times: Tuesday 4:30 – 7:30 p.m., Friday 4:30 – 7:30 p.m.

Dates: 13 sessions between April 8th – June 3rd (see the attached schedule).

Location: Metcalf Center for Science, 590 Comm. Ave., room 134, 136, or B-25

Instructors:

<table>
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Grading Scheme:
Homework 10%
Quizzes 7.5%
Midterm test 20%
Final Exam 22.5%
Portfolio 40%
  • Lab Book (10%)
  • Presentation (15%)
  • History/Philosophy/Physics Education Research Literature analysis (15%)

Lab Book: This should contain class notes, results and analyses of the hands-on activities done in class, and notes you take on the presentations from the other members of the class. Including work you do on homework problems is fine but not necessary.

Presentation: This is a group oral presentation, followed by a poster presentation, of a lesson plan or curriculum module for use in your class that connects to the material from this course, along with student worksheets. You will also be graded on your individual evaluation of three of the other presentations.

Literature Analysis: During the course everyone will be assigned to read the same set of readings and journal articles covering various aspects of history, philosophy, and physics education research. Your individual paper is expected to refer to one or more of these readings, and should also include an analysis of how the readings connect both to this course as well as to activities that you do in your own classroom.
Books and Materials:
2. Readings in science education research literature.
3. Readings in history of science.

Course web site: [http://physics.bu.edu/~duffy/SC529_Notes.html](http://physics.bu.edu/~duffy/SC529_Notes.html)
(The web site will be accessible once the course starts)

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 and instruction in electromagnetic induction, AC circuits, and physical optics.

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 topics covered 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 3 hours in length. The typical session will be a mix of laboratory experiments, discussion centered around concepts; 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](http://www.masteringphysics.com), you will be asked for a course code. Please enter the following code:

MPDUFFY0006
SC529 Course Schedule

Fri. Apr. 8  Session 1: Faraday’s Law.
Sections from Knight: 33.1, 33.3, 33.5
Active Physics: Communications Chapter 2, Activity 4
Laboratory experiment: “Faraday’s Law”
Mathematics and Problem-Solving: Applying Faraday’s Law.

Tues. Apr. 12  Session 2: Lenz’s Law.
Sections from Knight: 33.4
Active Physics: Home Chapter 3, Activity 3
Demonstrations: Jumping ring.

Tues. Apr. 19  Session 3: Motional emf and eddy currents.
Sections from Knight: 33.2
Demonstrations: Eddy current pendulum; drop a magnet down an aluminum tube.
Applications: Train brakes.

Tues. Apr. 26  Session 4: Transformers and Generators
Sections from Knight: 33.7
Active Physics: Home Chapter 3, Activity 6
Demonstrations: A generator and a motor; a transformer.
Laboratory experiment: “Generating electricity”
Mathematics and Problem-Solving: Ideal transformers.
Applications: Power generation and transmission.

Fri. Apr. 29  Session 5: Inductors and Inductance.
Sections from Knight: 33.8 – 33.10
Laboratory experiment: “RL Circuits”
Applications: Spark plugs.
Mathematics and Problem-Solving: Using exponentials.

Tues. May 3  Session 6: AC Circuits.
Sections from Knight: 35.1-35.4
Active Physics: Home Chapter 3, Activity 4
Laboratory experiment: “Introduction to AC Circuits”
Mathematics and Problem-Solving: Understanding the impedance triangle.

Tues. May 10  Session 7: Midterm test
Fri. May 13    Session 8: RLC Circuits and Resonance.
Sections from Knight: 35.5-35.6
Laboratory experiment: “RLC Circuits”

Sections from Knight: 34.1-34.7
Active Physics: Communication Chapter 2, Activity 4
Demonstrations: The electromagnetic spectrum; producing EM waves
Computer-Based Activities: EM Waves.
Applications: Radio and television; microwave ovens.
History and Philosophy of Science: The development of Maxwell’s equations

Sections from Knight: 34.8; 20.7
Active Physics: Communication Chapter 2, Activity 8
Laboratory experiment: “Polarized light”
Demonstrations: Polarized light.
Applications: Radar detectors; The Doppler shift as a tool in Astronomy.

Tues. May 24    Session 11: Interference and Diffraction.
Sections from Knight: Chapter 22
Active Physics: Communication Chapter 2, Activity 5
Laboratory Experiment: Interference and diffraction.
Demonstrations: Double slits, single slits, and diffraction gratings.
History and Philosophy: The Experiments of the 19th Century

Tues. May 31    Session 12: Thin-film interference.
Sections from Knight: 21.6
PROJECT PRESENTATIONS
Demonstrations: Various thin films.
Applications: Soap bubbles; non-reflective coatings.
Computer-Based Activities: Thin-film interference.