

SC527 - Concepts in Physics III: Fluids, Rotation, and Thermodynamics  
November 2004 - January 2005

**Description:** For teachers, mastery of concepts including fluids, rotational motion, and thermodynamics. Connections between microscopic and macroscopic behavior in thermodynamics as an example of the role of models in the physical sciences. 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 4:30 – 7:30 p.m., Friday 4:30 – 7:30 p.m.

**Dates:** November 5 - January 11th.

**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
Andrew Duffy	PRB 353	<a href="mailto:aduffy@bu.edu">aduffy@bu.edu</a>	617-353-9089
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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:**

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/SC527\\_Notes.html](http://physics.bu.edu/~duffy/SC527_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 and instruction in static and dynamic fluids, rotational motion, heat, and thermodynamics.
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 be thirteen or fourteen class sessions, each 3 hours in length. The typical session will be a mix of laboratory experiments, discussion centered around concepts of fluids, rotation, or thermodynamics; 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:

MPDUFFY0004

## SC527 Course Schedule

**Session 1: Friday November 5<sup>th</sup>**

**Topic:** Pressure. The Buoyant Force. Archimedes' Principle. Static Fluids.

**Sections from Knight:** Sections 15.1 – 15.4

*Assignments for next session*

Mastering Physics: Assignment 1

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**Session 2: Tuesday November 9<sup>th</sup>**

**Topics:** Bernoulli's Principle and Fluid Dynamics. Viscous Fluids.

**Sections from Knight:** Section 15.5

*Assignments for next session*

Mastering Physics: Assignment 2

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**Session 3: Tuesday November 16<sup>th</sup>**

**Topics:** Torque and Rotational Inertia.

**Sections from Knight:** Sections 13.3 – 13.4

*Assignments for next session*

Mastering Physics: Assignment 3

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**Session 4: Friday November 19<sup>th</sup>**

**Topic:** Rotational Kinematics. Newton's Second Law for Rotation. Static Equilibrium.

**Sections from Knight:** Sections 13.1 – 13.2; 13.4 – 13.6

**QUIZ #1**

*Assignments for next session*

Mastering Physics: Assignment 4

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**Session 5: Tuesday November 23<sup>rd</sup>**

**Topic:** Applying Newton's Second Law for Rotation.

**Sections from Knight:** Sections 13.4 – 13.5

*Assignments for next session*

Mastering Physics: Assignment 5

**Session 6: Tuesday November 30<sup>th</sup>**

**Topic:** Angular momentum. Rotational kinetic energy.

**Sections from Knight:** Section 13.7 and 13.9

**QUIZ #2**

*Assignments for next session*

Mastering Physics: Assignment 6

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*There will be no class on Friday November 26<sup>th</sup> because of the Thanksgiving holiday.*

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**Session 7: Friday December 3<sup>rd</sup>**

**Topic:** Rolling motion.

**Sections from Knight:** Section 13.8

*Assignments for next session*

Mastering Physics: Assignment 7

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**Session 8: Tuesday December 7<sup>th</sup>**

**Topic:** Temperature and Thermal Expansion.

**Sections from Knight:** Sections 16.1 – 16.3

**MIDTERM TEST (90 minutes)**

*Assignments for next session*

Mastering Physics: Assignment 8

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**Session 9: Tuesday December 14<sup>th</sup>**

**Topic:** Heat and calorimetry. Convection, conduction, and radiation.

**Sections from Knight:** Sections 17.5 – 17.6

**PROJECT PRESENTATIONS**

*Assignments for next session*

Mastering Physics: Assignment 9

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**Session 10: Friday December 17<sup>th</sup>**

**Topic:** The ideal gas law. Kinetic theory.

**Sections from Knight:** Sections 16.5; 18.1 – 18.4

**PROJECT PRESENTATIONS and POSTER SESSION**

*Assignments for next session*

Mastering Physics: Assignment 10

**Session 11: Tuesday December 21<sup>st</sup>**

**Topic:** The First Law of Thermodynamics. Thermodynamic Processes.

**Sections from Knight:** Section 17.1 – 17.4; section 16.6

**PAPERS DUE**

**QUIZ #3**

*Assignments for next session*

Mastering Physics: Assignment 11

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**Session 12: Tuesday January 4<sup>th</sup>**

**Topic:** More Thermodynamic Processes.

**Sections from Knight:** Section 17.7

*Assignments for next session*

Mastering Physics: Assignment 12

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**Session 13: Friday January 7<sup>th</sup>**

**Topic:** Second Law of Thermodynamics. Entropy. Heat engines.

**Sections from Knight:** Section 18.5-18.6; chapter 19

*Assignments for next session*

Mastering Physics: Assignment 13

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**Session 14: Tuesday January 11<sup>th</sup>**

**FINAL EXAM + COURSE EVALUATIONS**

**HAND IN LAB BOOKS**