V85.0095 Physics III Fall 2010

Instructor

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Administration

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Meeting Times & Places

Lectures:	Mondays and Wednesdays, 9:30 a.m. - 10:45 a.m.	Room 122 Meyer
Recitation I:	Tuesdays, 3:30 p.m. - 4:45 p.m.	Room 264 Meyer
Recitation II:	Thursdays, 9:30 a.m. - 10:45 a.m.	Room 264 Meyer

Course Description

Why can't one make a light microscope to see individual atoms? The answer to this question is in the properties of diffraction. Why was Ludwig Boltzmann convinced of the reality of atoms, when in the 1870's one could not image them in any way? The answer to this question comes from the kinetic theory of gases. ("Boltzmann's Atom" by David Lindley is a nice book about the history of the debate regarding the reality of atoms.) You will appreciate these questions and topics that are both beautiful and important in physics and for your future studies of quantum mechanics and statistical physics.

Continuation of Physics II (V85.0093). Topics include wave motion; sound; the reflection, refraction, interference, and diffraction of light; polarization; thermodynamics; kinetic theory and statistical physics. This is the third semester of a three-semester calculus-based introduction to physics and is intended for physics majors and other interested students.

Course Goals

- Seeing characteristics common to all wave phenomena, regardless of what type of wave it is.
- Recognizing the wave equation, testing proposed solutions and the superposition principle.
- Learn Fourier series and apply it to solving the wave equation.
- Become familiar with Mathematica.
- Appreciate the importance of optics in understanding the telescope and microscope.
- Introduce the laws of thermodynamics.
- Connect the macroscopic science of thermodynamics to the atomic and molecular scale in kinetic theory.
- Gain experience writing physics.

Text
Physics, 5th edition by Halliday, Resnick and Krane, John Wiley and Sons (2001), chapters 18-19, 21-24 and 38-44. Lecture notes on Fourier series, Mathematica and Thermal and Statistical Physics are available on the course Blackboard site.

Prerequisites & Corequisite
Prerequisite: Physics II (V85.0093) with a grade of C- or better, or permission of the Department. Corequisite: Calculus III (V63.0123) or Intensive Calculus II (V63.0222). Physics majors must also register for Physics III Lab (V85.0096).

Problem Sets
Problem sets will be assigned about once a week. Completed problem sets are due in lecture when the next problem set is handed out. A subset of these problems will be graded and returned the week after in recitation. At that time, solution sets will be posted to Blackboard.

Recitation
You will engage is problem solving in recitation both on your own and in groups. Your recitation grade will be based on recitation assignments and participation. If you are not going to be able to attend a recitation, ask for an excused absence from Mr. Duffell in advance. Note that because recitation assignments are intended to fuel discussion, if they are not done they cannot be made up at a later time.

Writing Assignments
Physicists spend a large amount of their time writing – writing research papers, grant proposals and grant reports summarizing their research achievements made during the lifetime of a grant. Some write articles for the popular press. The ability to solve physics problems is necessary but not sufficient. You will gain writing experience with physics by composing detailed descriptions of the physics behind problems drawn mostly from a collection (called "Leighton Problems" by some) prepared for students who took the course upon which the Feynman Lectures on Physics are based. Credit will be awarded based on the solution to the problem, written descriptions of how you solved it and the physics that the problem is based on.

Exams
There will be two in-class midterm exams and a final exam (see the last page for days/times.)

Grading (approximate guidelines)

2 mid-term exams	35%
Final exam	25%
Homework	15%
Recitation activities	15%
Writing Assignments	10%

Schedule of Lectures, Exams and Sources (approximate)

Date	Topic	Reading
Wed Sep 8	Mechanical waves: kinematics	HRK Ch. 18
Mon Sep 13	Wave equation & Introduction to Mathematica	HRK Ch. 18 & Lecture notes (handout)
Wed Sep 15	Mechanical waves: dynamics	HRK Ch. 18
Mon Sep 20	Harmonic analysis: Fourier series	Lecture notes (handout), Feynman Ch. 50
Wed Sep 22	Sound: pressure waves	HRK Ch. 19
Mon Sep 27	Sound: standing waves & interference	HRK Ch. 19
Wed Sep 29	Sound: Doppler effect & beats	HRK Ch. 19
Mon Oct 4	Light: electromagnetic waves	HRK Ch. 38
Wed Oct 6	Light: Reflection & refraction	HRK Ch. 39
Mon Oct 11	No classes scheduled.	
Wed Oct 13	Mid-Term Exam I	
Mon Oct 18	Light: polarization	HRK Ch. 44
Wed Oct 20	Geometrical optics: spherical mirrors	HRK Ch. 40
Mon Oct 25	Geometrical optics: thin lenses	HRK Ch. 40
Wed Oct 27	Optical devices: telescope & microscope	HRK Ch. 40
Mon Nov 1	Interference: two-slit & film interference	HRK Ch. 41
Wed Nov 3	Huygen's principle, single-slit diffraction	HRK Ch. 42
Mon Nov 8	Multiple-slit diffraction & gratings	HRK Ch. 43
Wed Nov 10	x-rays, holography, resolving power	HRK Ch. 43
Mon Nov 15	Temperature & heat capacity	HRK Ch. 21
Wed Nov 17	Equations of state & kinetic model of gases	HRK Ch. 22
Mon Nov 22	Mid-Term Exam II	
Wed Nov 24	Gas velocity distribution & heat capacities	HRK Ch. 22
Mon Nov 29	Phase changes & thermal transport	HRK Ch. 23
Wed Dec 1	First law & work, thermodynamic paths	HRK Ch. 23
Mon Dec 6	Adiabatic processes etc, specific heat ratio	HRK Ch. 24
Wed Dec 8	Heat engines: Stirling engine/cycle	HRK Ch. 24
Mon Dec 13	Heat engines: cyclic processes & efficiency	HRK Ch. 24
Wed Dec 15	Entropy & the 2nd law of thermodynamics	HRK Ch. 24
Mon Dec 20	Final Exam (8:00--9:50 a.m. Meyer 122)	Comprehensive