Foundations of Physics II

PHYS 352 Winter Quarter 2006

Oscillations and waves: the physics of musical instruments; thermal physics

MWF at 11:00 in Pacific 30.

The course: this is the second quarter of a three quarter course. Fall quarter was devoted to oscillations and waves. This quarter we continue to study oscillations and waves. We will cover parts of Chapters 8, 10 and 11 in “The Physics of Vibrations and Waves” by H. J. Pain (electromagnetic waves, optics, normal modes, standing waves and Fourier analysis) with examples taken from musical instruments.

Then we turn to thermal physics, which concerns the properties of systems containing large numbers of particles. In spring quarter, we will continue with thermal physics, or statistical thermodynamics: probability, work, heat, temperature, entropy, equations of state, heat engines.

News:

Listen to a 9000 year old flute! (.wav file). The flute was found in China and is described in Nature 410, p366 (1999). The musical scale is pentatonic. Note the tiny hole next to the A5 finger hole -- its purpose is apparently to correct the pitch resulting from an incorrectly drilled opening.

What the ####?

In touch-tone telephone technology, the symbol "#" is called an “octothorpe” and is coded by two frequencies, 941 and 1477 Hz.
For the story, see http://www.sigtel.com/tel_tech_octothorpe.html

Instructor:

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TA:

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- office hours: Tues 1-2 and 2-3 (drop in) and by appointment.

Textbooks:

- Also useful: Physics for Scientists and Engineers, Paul A. Tipler (5th Ed.).
- An introduction to Thermal Physics, Daniel V. Schroeder (will be used Spring term as well).

Homework:

There will be problems assigned each week in class, due on Monday.
Problem and reading assignments (updated as term progresses):

(graded homework can be picked up outside room 377 Willamette Hall)

- Week of Jan 9:
  - Pain Chapter 8, Electromagnetic waves. Review E&M from your first year textbook!
  - Reading: Pain, Ch 8 p199-223 (we won't cover all this material!); Also read "Optics" notes from 2003 p 1-8 (download below).
  - Homework 1 is due Wednesday, 18 Jan. (16th is MLK holiday).

- Week of Jan 16:
  - Pain Chapter 11 p305-320 (optics) and optics material (e.g. thin lens equation) from any standard textbook.
  - "Optics" notes from 2003 p 9- (download below).
  - Homework 2 is due Monday, 23 Jan.

- Week of Jan 23:
  - Pain Chapter 1: p305-320 (optics) and optics material (e.g. thin lens equation) from any standard textbook.
  - "Optics" notes from 2003 p 9- (download below).
  - Guest lecture Wednesday (Terry Takahashi)
  - Friday: Standing Waves; Reading: "Standing Waves" notes (below), Pain p 245-251 (6th ed.)
  - Homework 3 will be assigned on Friday, due Friday Feb. 3

- Week of Jan 30:
  - Pain Chapter 9, p 243-251 (6th ed., Normal Modes)
  - "Standing Waves" notes from 2003 (download below).
  - Here is Homework 3, due Friday Feb. 3

Solutions

- Problemset 1 2 3 4 5 6 7 8 9 10
- Exam keys MT1 MT2 Final

If the homework keeps you up late at night, have a cup and **click to learn more...**!

Available Notes:

- PH351 web page (from last term) is located here.
- Optics notes (Prof. Soper, December 2003)
- Standing Waves notes (Prof. Soper, 2003)
- To see free videos of Feynman giving non-technical lectures on light and matter at the University of Auckland, click [here](#).
  - Highly recommended! Feynman was an entertaining lecturer (requires RealPlayer).
- Principle of Least Action (web page by Prof. Edwin Taylor, MIT)
- (see especially) Simple derivation of Newtonian mechanics... (pdf)

Notes from previous courses/terms (by Prof. Soper) in .pdf and .nb format:

- Shooting method (Mathematica notebook for finding normal modes of loaded string)
- Oscillators (23 October version)
- Waves I (14 November 2003)
- Standing Waves (4 February version)
- Thermal I (10 March version).

Exams:

- Midterm Exam I: Monday, February 6 (in class).
- Midterm Exam II: Monday, March 6 (in class).
- Final Exam: 10:15 Thursday, March 23.

**Grading:**

The homework assignments will count for 25% of the course grade. There will be two midterm exams, which will each count for 20% of the course grade. The final exam will cover the whole course, approximately 1/2 waves and 1/2 thermal physics. It will count for 35% of the course grade.

**Approximate schedule:**

- More about waves (Weeks 1-5)
  - (5 days) Electromagnetic waves, basic optics
  - (3 days) Normal modes of continuous systems, stretched strings and air columns. Physics of musical instruments. Standing waves.
    - Pain p 130-133, lecture notes.
  - (2 days) Fourier analysis.
  - (1 day) Matter waves in quantum mechanics, electron in a 1-D box.
  - Exam Monday Feb. 6.

- Thermal physics
  - (11 days) Ideal gas, energy, heat and work, Schroeder Ch. 1.1-1.6
  - Exam Monday March 6, Schroeder Ch 1.1-1.6
  - (5 days) Rates of processes, Ch 1.7; The second law, Schroeder Ch. 2.

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