

Physics 101: The Science of Sound

Syllabus, fall 2007

Prof. James McLean

Office: Bailey 126

Phone: 245-5897

Website: <http://www.geneseo.edu/~mclean/>

E-mail: mclean@geneseo.edu

Course Website: <http://www.geneseo.edu/~mclean/Sound/>

Sounds are all around us. Sound is one of the two main ways we experience our environment. Our ears may not reveal as much spatial detail as our eyes, but they are far more sensitive and can detect a much, much greater range of “colors.” Sound allows us to hear around corners, down the hall, and even through walls. In this course, we’ll explore what this sound stuff is: how do we create it and detect it, how do we interpret its richness, and how can we shape it.

Physics is all around us, too. The mention of introductory physics usually conjures up images of flying balls and orbiting planets. But objects (like balls and planets) really ought to share the stage with the other great physical model, that of waves. Like objects, waves permeate the physical world; the two models even intertwine, and reach their ultimate marriage in the bizarre world of quantum mechanics. The study of sound will provide us with a wonderful way to explore the behavior of waves.

I hope that you will also develop your understanding of how physicists and scientists approach the world around us. You’ll do that by learning to actually do physics, that is, to solve physics problems. You’ll need to flex your mathematical muscles a bit. You’ll have to pay close attention to some subtle distinctions that you might otherwise gloss over. If you do these things while keeping the “big picture” in mind, the payoff can be a deeper appreciation for how our universe is put together.

Learning Outcomes

1. (*Nat. Sci. Gen. Ed.*) Demonstrate knowledge of the following aspects of the scientific method: scientific observation, hypothesis development, data gathering and analysis, evaluation of evidence.
2. (*Nat. Sci. Gen. Ed.*) Demonstrate understanding of and ability to apply scientific data, method, and models germane to [physics], ...
3. (*This course*) ... specifically: algebraic manipulation methods, graphical data methods, the interrelation between physical quantities, units related to sound, and Fourier analysis.
4. (*This course*) Demonstrate understanding of some of the physical workings of sound propagation, sound production (musical instruments, loudspeakers), and sound detection (ears, microphones).

Times and places:

Lectures: in Bailey 135, Mon. and Fri. 1:30–2:45pm.

Final: in Bailey 135 on Wed., Dec. 12, 12:00–3:00pm

Labs: in Bailey 119, six sections each meet for 2 hours, either Mon. or Tue.

Office hours: Tue. 2:30–3:30pm, Wed. 2:30–4:30pm, Thurs. 12:30–2:30pm

I am also available at other times. See the schedule on my web site. Just stop by my office, or if you want to ensure that I’ll be there, contact me by phone or email.

Required materials:

Textbook: *The Science of Sound, 3rd edition*, by Rossing, Moore, and Wheeler.

Study Guide & Lab Manual: *The Sound of Physics*, by McLean.

Lab notebook: Avery, style 43-591.

Calculator: A calculator that handles logarithms (“LOG” key). This need not be very expensive. You don’t need one of the expensive graphing calculators for this course.

Required coursework and grading (with fraction of final grade):

22% Homework: Due most Fridays at the end of the day

22% Laboratory: An integral part of the course. If you miss your regular lab sessions, you **must** makeup the lab. See the beginning of the lab manual for details. A few topics will be mostly presented in laboratory.

45% Mini-Tests: There will be 5 mini-tests, each 9% of the final grade. The first 4 will be in class on Fridays, one-half of a class period long. The last mini-test is part of the final exam, but treated separately for calculating grades. The lowest mini-test score will be dropped.

11% Final Exam: A comprehensive test, 2 hours long, of the main course topics.

Computer Based Homework:

Homework will be administered through CAPA, the “Computer Assisted Personalized Approach” system. You can access this either from the course’s main web page or directly at <http://capa.geneseo.edu/>. Most answers will be entered via the World Wide Web. A few problems must be handed in during class.

Note that if there are system-wide problem with the network, due dates may be extended.

However, individual computer difficulties will not be accepted as excuses for non-completion of assignments; the public computing resources at Geneseo are sufficient.

Some General Comments:

Homework will have two different types of questions.

Questions in the “Current Material” section are intended to assess what you have learned from the past week and to give you practice for the mini-tests.

Questions in the “Looking Ahead” section ask you to draw from either the assigned reading or your own experience concerning material that is coming up in lecture. Credit will be given for those questions based only on participation.

The material on the mini-tests and final exam will be closely based on what you will see in class, with lots of problems similar to the homeworks. Attending lectures, taking good notes, and working over the assignments thoroughly should be good preparation for them.

Although test scores may be scaled up during grading of each mini-test, there will be no overall “curve” for the course grades. See my web site for more details on my grading policy.

If you need to return materials to me outside of class, your best option is to bring it to my office.

Slide it under my door if I’m not in. Homework will be accepted for full credit if it is in my hands before solutions are posted. After solutions are posted, partial credit may be given.

Help available:

Remember that one important function of homework is for you to monitor your progress. If you are having problems with the homework, it should serve as a warning to take immediate remedial action. If you find yourself getting into difficulties, **do something about it—fast!** The arithmetic of averages shows that you can’t afford to delay if you start to get into grade trouble. Listed below are several resources available to you if you need help with this course.

- The Physics Learning Center, staffed by physics majors in Greene 135, is free. Check the schedule at <<http://physics.geneseo.edu/~pogo/Tutors/Tutors.htm>>.
- Your lab instructors have office hours; they will be most helpful for lab-related material.
- I have regular office hours, and am happy to meet with you at other times as well.
- If you need help with math, you might find the Math Learning Center in 332 South Hall helpful. They have a web page at <<http://www.geneseo.edu/~math/learnctr/>>.
- A list of potential tutors will be on the course web site, to assist you in contacting them for individual help.
- SUNY Geneseo will make reasonable accommodations for persons with documented physical, emotional or learning disabilities. Students should consult with the Director in the Office of Disability Services (Tabitha Buggie-Hunt, 105D Erwin, tbuggieh@geneseo.edu) and their individual faculty regarding any needed accommodations as early as possible in the semester. Further information available at <<http://disability.geneseo.edu/>>.

Tentative Course Schedule

WEEK OF...	LECTURE TOPICS	MINI-TEST (ON FRIDAY)	LAB
Aug. 27	Proportions & Motion		1. Graphing and Uncertainty
Sept. 5 (only F)	Vibrations		
10	Physics by Graphing		4. Oscilloscope Usage
17	Simple Harmonic Motion		2. Springs & SHM
24	Sound Timbre and Spectra	Mini-Test 1	3. SHM, Damped HM
Oct. 1	Intensity and Loudness		7. Frequency Analysis I
10 (only F)	Human Hearing		
15	Human Hearing	Mini-Test 2	6. Loudness Measurements
22	*Microphones and Speakers		8. Frequency Analysis II
29	*Sound Speed, Doppler Effect		X. Real Sound Spectra
Nov. 5	*Diffraction & Speakers	Mini-Test 3	9. Audio System Response
12	*Stereophonics and Interference		5. Ripple Tank
19 (only M)	*Standing Waves		
26	*Musical Scales	Mini-Test 4	10. Waves on a String
Dec. 3	*Musical Instruments		11. Waves in a Cylinder
10 (only M)	Review		
12 12:00 PM		Final Exam (includes Mini-Test 5)	

* For the second half of the semester, which topics and how much time for each will depend on interests expressed by the class.