SUNY Geneseo, Department of Physics and Astronomy

PHYS 102: The Science of Sound

Syllabus, Fall 2021

Prof. James McLean Office: ISC 228G (old Greene) Phone: 245-5897
Website: http://www.geneseo.edu/~mclean/ E-mail: mclean@geneseo.edu
Course Websites: http://www.geneseo.edu/~mclean/Sound/ and in Canvas

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 questions. 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 production (musical instruments, loudspeakers), and sound detection (ears, microphones), and sound propagation.

Times and places:

Class time: Newton 214, Mon, Wed, and Fri 8:30–9:20AM
Final exam: Newton 214, Mon, Dec. 20, 8:00–10:30AM
Labs: separate companion course PHYS103, required for Gen. Ed. credit
Office hours: Tue 1:30–3:30PM, Thu 9:00–11:00AM, Fri 2:00–4:00PM
During these times, available for office walk-ins, office phone, or Zoom link (available on the schedule page of my web site).

I am also available at other times; see the schedule on my web site. Just stop by my office, or contact me by phone or email.

Required materials:

Textbook: *Sound Physics*, by McLean. Free, only available online through Canvas. If you wish to have a hard copy, you should print it.

Calculator: A calculator that handles logarithms ("LOG" key). This need not be very expensive. You don't need a graphing calculator for this course.

Required coursework (with fraction of final course grade):

41% Homework: Normally due at 8:00pm each Friday. The lowest score will be dropped.

39% Exams: There will be 3 midterm exams, each 13% of the final grade, during Wed class periods.

20% Final Exam: Split between new material, like a 4th midterm, and a review of the main course topics.

+3% "Frequent Flyer" homework bonus points, earned by working on homework throughout the week, rather than only just before it is due.

Course Structure:

Preparation for Class: On a calendar in Canvas, there will be a link for preparing for each lecture. This will include textbook readings, often a short video, and perhaps other short items (such as a survey). These will be posted at least by the previous lecture. I will assume that you have completed this preparation.

Class time: A mixture of demonstrations, review and questions about the preparation materials, and practice problems. Questions from the homework are always welcome.

Homework: Done via an online system (see below). Due mostly on Fridays, except when the schedule is disrupted by exams. Posted one week before they are due.

Exams: Administered during a class period, on paper.

COVID-19 may disrupt this plan. Large numbers of students unable to attend class, due to quarantining or other pandemic-related reasons, will trigger the following modifications.
Preparation videos will become more extensive.
Class activities will be more supportive, and no longer crucial to completing the course.
Exams may transition to use the same online system as homework, but still administered during class time.

ONLINE MODE: In an extreme situation, the college might need to go fully remote.
Class time would be held as a Zoom meeting, and focused on homework help and practice questions.
Exams would certainly switch to the homework system.

Computer Based Homework:

Homework will be administered through *CAPA*, the "Computer Assisted Personalized Approach" system. There is no cost! Most answers will be entered via a web browser. A few questions (roughly one each week) require handwritten work to be scanned an uploaded.

- You can access CAPA directly at http://capa.geneseo.edu/ . Links are also on the Canvas home page, my home page, etc. Detailed instructions at the end of this syllabus.
- "Frequent Flyer" points are earned by working on homework steadily throughout the assignment period. Details are available at a link in the homework sets.

In-class polling will be used through the Top Hat system. This is free for Geneseo students!

- Access with a smartphone app, or via the web. You should either already be "enrolled" in your Top Hat account (if you have used the system before), or you will receive an email with instructions on how to join.
- Participation will not form a part of the course grading.

General Comments:

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 or place in the tray on the door. Work that reaches me (in my hands) after the due date may still receive partial credit (the earlier the better).

Exam scores may be scaled up during grading of each exam. There will be no overall "curve" for the course grades. See my web site for more details on my grading policy.

If you must miss an exam for a college-sanctioned reason, contact me **before** the exam. If you miss a test due to an emergency, contact me **as soon as possible** and **with documentation**. Absences that don't fall into the above categories will result in a zero for the missed work!

Copyright:

Materials provided for this course are intended for the sole use of registered students. Sharing of course materials outside that audience, including uploading to websites open to the general public (with or without a subscription or membership) is strictly prohibited.

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.

There are several resources available to you if you need help.

- ***CIT*** provides a range of technology support resources. In Canvas, the Help menu on the left side of the screen will direct you to several CIT supports.
- The ***Physics Learning Center,*** in ISC 214, is available at no charge. Check the schedule at https://www.geneseo.edu/~pogo/PLC/Tutors.htm . It is staffed by physics majors. Note that PLC tutors are most helpful for physics-oriented question, but may not be familiar with topics specific to this course.
- Your ***PHYS103 lab instructor*** has 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.
- The ***Math Learning Center*** can help with math-specific issues, such as recalling the methods of high-school algebra which are assumed in this course. The web page is https://www.geneseo.edu/math/mlc .
- ***KOALA (Knights' Online Academic Learning Assistance),*** run by the Office of the Dean for Academic Planning and Advising, is particularly for help with online learning strategies. They will assist you with identifying resources and strategies for success.
- ***A list of potential tutors*** is often assembled by the Physics Department secretary, to assist you in contacting them for individual help. The fee is determined by the individual tutor.
- The Provost has prepared a reference page for Student Success Resources.
- SUNY Geneseo is dedicated to providing an equitable and inclusive educational experience for all students. The Office of Accessibility will coordinate reasonable accommodations for persons with physical, emotional, or cognitive disabilities to ensure equal access to academic programs, activities, and services at Geneseo. Students with letters of accommodation should submit a letter to each faculty member and discuss their needs at the beginning of

each semester. Please contact the Office of Accessibility Services for questions related to access and accommodations: (585) 245-5112, access@geneseo.edu .

- If you have difficulties accessing any online materials (including needs for alternative formats), please let me know as soon as possible and I will rectify the situation.

Expected Weekly Calendar

Daily detail available on Canvas home page

WEEK OF…	LECTURE TOPICS	EXAM (on Wed)	PHYS103 LAB
Aug. 30	Proportions & Speed of Sound		1. Speed of Sound
Sep. 6 (only WF)	Vibrations		…complete 1
13	Graphs and the Circle of Physics		2. Uncertainty & Graphing
20	Simple Harmonic Motion		3. SHM & DHM
27	Sound Perception		4. Hooke's Law & SHM
Oct. 4	Sound Spectra and Timbre	Exam 1, F	5. Signals
11 (only WF)	Sound Intensity		6. Loudness Measurements
18	Loudness		7. Complex Signals
25	Hearing		8. Ripple Tanks
Nov. 1	Audio Transducers		9. Audio System Response
8	Voice	Exam 2, M	(NO LAB)
15	Waves		10. Waves on a String
22 (only M)	Standing Waves		(NO LAB)
29	Musical Scales	Exam 3, W	11. Waves in a Tube
Dec. 6	Musical Instruments		12. Tube Resonances
13 (only M)	Review		(NO LAB)
20 (only M)	Final Exam		

Using CAPA

Doing Homework

Get your personalized homework set:

Step a: Find a computer. Login. Start a web browser (*Firefox, Safari, Internet Explorer, Chrome*…).
Step b: In the address bar enter **http://capa.geneseo.edu/** to see the ***main CAPA page***.
Step c: Click on "Download Your Homework Set," then click on the link for this class (i.e., "phys###fXX" where ### is the course number and XX is the year).
Step d: Click on the homework set you want (e.g., "set01" or "set03").
Step e: Click on the PDF file having your own name, which is in Portable Document Format format.
Step f: To view or print this file, you need software to view PDF files (pre-installed on virtually all computers, e.g., *Adobe Reader, Mac Preview,* or built-in to most browsers). Instructions are on the ***main CAPA page.***

You are not required to print a hardcopy of each week's homework assignment. However, a hardcopy is very useful when working on problems away from your computer, when coming to office hours for help, and to keep in your records for use while studying for tests.

Enter your answers:

Step 0: Solve the problems first, on paper.
Step 1: From the ***main CAPA page*** (steps a, b above), click on "*Go to CAPA to enter your homework solutions*."
Step 2: From the "Class" menu at the top, select this class (i.e., "p###fXX").
Step 3: In the "Student Number" field, type your student ID (a "G" followed by eight digits).
Step 4: Find your CAPA ID (a unique 4-digit number) at the top of YOUR PDF homework assignment. In the "*CAPA* ID" field, type this 4-digit number.

- ***This number will be different for you every week.***
- ***DO NOT use a CAPA ID from any other source. Examples that WILL NOT work: your own CAPA ID from a previous homework; your friend's CAPA ID; a CAPA ID your instructor showed the whole class.***

Step 5: Click on the button in the sentence "Click here to work on *CAPA*."
Step 6: Click on "Try current set". CAPA knows which set is the "current" set based on your CAPA ID.
Step 7: For as many questions as you wish, type in an answer. Then click any of the "Submit all answers" buttons.

- ***DO NOT*** use your web browser's "Reload" button. This will resubmit the answers you tried last, charging you a "try." If you need to refresh your screen, use CAPA's "Reload" button at the top of the page.

Step 8: Clicking on the "Exit" button at the top of the page tries to close the window, but in many browsers the result is to do nothing at all. When you are done, simply close your browser window.

You can submit one answer at a time, or all of them together. You will typically get multiple tries to do each question, with no penalty for incorrect entries. If you use all the allowed tries without getting it correct, you will not be permitted to attempt that question again.
At NO POINT do you need to "Save" anything. Nor do you need to return anything to the instructor unless specifically instructed to do so. The computer saves *everything* you submit. The instructor can see all of it.

Tips:

Be sure you use adequate sig-digs throughout the problem. I recommend that you keep all intermediate results to *at least* 5 sig-digs, even though *CAPA* usually only requires answers to have 3 sig-digs.
A list of all accepted units, abbreviations, and how to enter compound units are at links on the ***main CAPA page***.
Scientific notation is entered using either "E" or "*10^" notation. CAPA accepts either "E" or "e".

For example, to enter $1.09 \times 10^{-8} \frac{\text{kg·m}}{\text{s}^2}$, type "1.09E–8 kg*m/s^2" or "1.09*10^-8 kg*m/s^2".

It's a good idea to keep a record of answers you have attempted. If you enter the same answer multiple times, you waste tries.
It's a good idea to keep your work all in one notebook. This makes it easier to return to past, makes it easier for you to find typographical errors, and makes it easier for you to get help from the instructor.

Reviewing Homework

Step A: Enter *CAPA* (steps 1–5 above) using the *CAPA* ID from the highest numbered set you have available.
Step B: Next to "View previous set" enter the number of the set to review. Then click the "View previous set" button.
Step C: If scheduled by your instructor, correct answers will be displayed for each question.