

## Physics 0872, Science of Sound, Section 002

Fall Semester 2014

Dr. T. Burkhardt, office Barton Hall A214

Office hours: 10:30-11:30, 1:00-3:00 on both Wednesday and Friday and by appointment

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Course description: For living things the ability to hear sounds is an essential tool for survival, and sound is central to speech and languages. In the arts sound also plays a fundamental role, above all in music. The close connection between music, mathematics, and physics has long fascinated scientists. Advances in electronics and computing are revolutionizing the composition, production, and recording of sound. Science of Sound is an interdisciplinary course involving elements of physics, physiology, psychology, music, and engineering. After a four-week introduction to the fundamental physics of sound waves, we will consider human hearing and the human voice; scales, harmony, and sound production by musical instruments; architectural acoustics; and the electronic reproduction of sound. The course includes many in-class demonstrations.

This syllabus is also posted at the course web site on Blackboard. To get to the site, type [www.temple.edu](http://www.temple.edu), go to “TUportal,” log on, and then click on “Blackboard.”

The course meets MWF 12:00-12:50 in Barton Hall, room A140. Any student with special needs due to a disability should contact the instructor.

Important dates: First class Mon. Aug. 25, last class Mon. Dec. 8, last day to drop course with tuition refund Mon. Sept. 8, last day to withdraw (without refund) Tue. Oct. 21.

The textbook for the course is *The Fundamentals of Sound Science* by E. Borovitskaya. Other useful references are *Musical Acoustics* by D. E. Hall, a text we have used for many years, and *The Physics of Sound*, by R. E. Berg and D. G. Stork. Several copies of these books are on “Course Reserves” in the Science and Engineering Library on the second floor of the Engineering and Architecture Building (tall red brick building at the intersection of Norris and 12<sup>th</sup> Streets, just north of the new SERC building).

No mathematics beyond elementary arithmetic will be required.

Regular class attendance, taking notes, and keeping up with reading assignments are all strongly recommended. Class attendance will count 3 % of the final grade.

There will be weekly homework. Homework questions will be posted and answers submitted via Blackboard. To get to the course web site on Blackboard, type [www.temple.edu](http://www.temple.edu), click on “TUportal”, log on, and then click on “Blackboard.” The first homework assignment is due by Saturday, September 6, at 11:55 PM. Homework will count 12 % of the final grade.

Students will carry out one experiment involving sound at home or elsewhere and write a report on their results. A list of possible experiments and suggestions for preparing the report will be posted at the course web site on Blackboard. The experimental report (of around 2 pages) is due by Friday Nov. 14 and will count 10 % of the final grade.

CONTINUED ON OTHER SIDE

In keeping with the educational goal of information-literacy, students will also write an essay on some aspect of sound, based on a literature search. A list of possible topics and suggestions for preparing the report will be posted at the course web site on Blackboard. Ms. Margaret Janz of the Temple library staff will attend one of our classes and inform us about search techniques, citation styles, and the difference between scholarly and popular sources. The essay (of around 4 pages) is due on Friday, December 5 and will count 10 % of the final grade.

The remaining 65 % of the final grade will be determined by two midterm exams (Mon. Sept. 29, Fri. Nov. 7) and a final exam (Wed. Dec. 17, 10:30-12:30). The three exams will cover Chapters 1-6, 7-11, and 12-16 plus Electronic Reproduction of Sound, respectively. Each of the three exams will contribute equally to the final grade.

### Topics to be Considered

Week	1	The Nature of Sound, Physical Units [Chapter 1, Appendix A]
	2	Waves and Vibrations [Chapters 2 and 3]
	3	Physical Properties of Sound Waves [Chapters 4 and 5]
	4	Sound Intensity [Chapter 6]
	5	Human Hearing [Chapter 7], EXAM ON CHAPTERS 1-6
	6	Musical Scales and Harmony [Chapter 8]
	7	Fourier Analysis, Sound Spectra [Chapter 9]
	8	Natural Modes, Percussion Instruments [Chapter 10]
	9	Vibrating String, Piano, Guitar [Chapter 11]
	10	The Bowed String [Chapter 12], EXAM ON CHAPTERS 7-11
	11	Wind Instruments [Chapters 13 and 14]
	12	The Human Voice [Chapter 15]
	13	Room Acoustics [Chapter 16]
	14	Electronic Reproduction of Sound [Class notes and textbooks 2, 3, or 4 on list of Useful References]
	15	FINAL EXAM ON CHAPTERS 11-16 and Electronic Reproduction of Sound

### Useful references

1. J. Backus, *The Acoustical Foundations of Music*
2. D. E. Hall, *Musical Acoustics* (4 copies in Science and Engineering library)
3. R. E. Berg and D. G. Stork, *The Physics of Sound* (4 copies in Science and Engineering library)
4. T. D. Rossing, F. R. Moore, and P. A. Wheeler, *The Science of Sound*
5. A. H. Benade, *Fundamentals of Musical Acoustics*
6. H. Helmholtz, *On the Sensations of Tone*
7. C. Hutchins (editor), *The Physics of Music* (reprints from Scientific American)
8. A. Stiller, *Handbook of Instruments*
9. L. Beranek, *Concert and Opera Halls: How They Sound*