

PHYS 102

Physics of Sound and Music

Fall 2023

Dr. Matt Severson

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PHY 3124C - Toll Phys Bldg

UGTAs

John Labbatte

Jacob Weglarz

Lecture - TTh 9:30 - 10:45 - PHY1410

Phys 103 Lab is an entirely separate course managed by Dr Skuja

Some pre-record lecture content will be used asynchronously
Class time will be occasionally used for Discussion sessions (TBA)

NOTE: Details in this syllabus should be taken as tentative. I will notify you when changes are made.

Course Description

This course (and the accompanying lab) are designed to provide a fundamental physical understanding of the nature of sound, hearing, and music. After introducing the basic physics of waves and oscillation, we will begin to explore increasingly intricate aspects of how simple waves are combined in extremely precise ways to create the complex sounds we experience in every day life, with a focus on how our perception of these sounds works, how the phenomenon of music arises, how certain instruments create their own unique versions of it, and how music is recorded and/or presented to an audience.

Prerequisite: at least MATH107 (or equivalent)

Learning Outcomes

Upon completing the course, students will be able to:

1. Apply simple formulaic relationships to straightforward applications in **quantitative** problem solving, and readily do so for the topics of waves and sound.

Examples: computing sound wavelength from a frequency, finding the frequency of a standing wave mode

2. Give some insight into the frequency spectrum content of any particular sound, provided the right tools are available.

3. Describe in moderate detail the processes through which a human creates and perceives sound.
4. Describe in minimal detail the way that a given musical instrument creates its unique sound.
5. Describe in minimal detail the way certain spaces are acoustically treated to enhance their effectiveness in delivering musical content to a listener.

Optional Reference Textbooks

Musical Acoustics, 3rd ed., Donald Hall (Brooks/Cole, 2002).

The Physics of Sound, 3rd ed., R. Berg and D. Stork (Pearson, 2005).

Assignments

Homework: I will assign homework due every 2-3 weeks; the homework will be designed to increase the depth of your **quantitative** understanding and intuition for the ideas discussed in lecture.

Homework will usually be in ELMS but with some exercises worked on paper and scanned for submission (or electronic equivalent).

A late assignment may incur a penalty, depending on the extent and circumstances. I will drop your lowest assignment score before computing your average.

Participation: Starting after a short buffer period, I will regularly incorporate basic or interesting questions or other interactive activities during the lecture to quiz you on recent material and improve both your comprehension of the concepts and also my perception of that comprehension. These exercises are normally submitted using the University "Clicker" system (I recommend the app rather than an actual clicker).

*I will drop up to 25% of these submissions in the end to accommodate ordinary absences. ****The drop grades are **instead of** dealing with excused absences. You cannot make them up! No exceptions will be mad except under extreme circumstances (hospitalization etc).***

Musical Instrument Project: There will be one group presentation late in the semester in which you will present the details of the structure and function of one musical instrument. You will make 5-10 minute video presentations in groups of 3-5. Details will be posted later.

Exams: You will also have 3 exams, consisting of multiple choice and short-answer questions. Because the course material consistently builds on what we've already covered, exams will be pseudo-cumulative, but they will not explicitly test on material covered in previous exams.

Grading Scheme

Homework	33%
Participation	12%
Instrument Proj.	10%
Exams (3)	45%

ELMS Posts and Communicating with Me

I will clearly post all announcements, assignments, due dates, and other important information on the course ELMS page. I will also use ELMS to send course-wide emails when necessary. ***It is your responsibility to find such information on ELMS.*** Please check the page regularly for updates. I will be rather inflexible in dealing with problems that arise due to your failure to know things that have been said on ELMS.

That said, I will be happy to answer any other questions about course material, trouble with assignments, etc as they arise. Please feel free to send me email at any time for such reasons.

Attendance, Religious Observances, and University Closures

The clicker questions in lecture will monitor "attendance" in the course; again you will have **around 3 excused omissions/absences** there to accommodate the usual illnesses or minor emergencies that arise.

If you need to miss a hw deadline or an exam for a religious observance or other legitimate reason, please notify me in advance, and preferably ASAP.

If you miss an exam due to illness or emergency, please get in touch ASAP after the fact.

In all exam cases above, a makeup exam will be arranged accordingly.

Academic Integrity

The abstract nature of any physics often leads to difficulty in its study; often students find it beneficial to work with a partner on solving homework questions and problems. This sort of behavior is encouraged, although you should avoid larger groups to discourage stragglers.

That said, it is crucial that ***all students create and submit their own assignments***. It will usually be easy for me to tell your assignments apart, and so also easy to see if you have copied someone else's work. You will be monitored during exams to ensure no cooperation among individuals. If detected, such behavior will not be tolerated and may result in an XF grade for the course and/or further action taken by the Student Honor Council.

Students with Disabilities

Accommodations will be provided to enable students with disabilities to participate fully in the course. Please discuss any needs with me **at the beginning of the semester**, so that appropriate arrangements can be made. Students who are registered with ADS and plan to take exams with extended time should provide the pertinent authorization forms (electronic format is fine) prior to each exam date.

Tentative Fall 2023 Schedule

Wk	Week of	Berg Ch	Hall Ch	Content	Assignments
1	Aug 28	1	2.4	intro , simple harmonic oscillation , Relation between harmonic oscillation and circular motion	
2	Sep 4	2	1, 2	oscillation and traveling waves	
3	Sep 11	2	4	wave properties, superposition , longitudinal waves and sound	Hw1 - due 9/14
4	Sep 18	3, 6.4	5, 6	sound perception, intensity, loudness, decibel level	
5	Sep 25	3	10.1, 12.1	standing waves , overtones for strings and pipes	Hw 2 - due 9/28
6	Oct 2	3	8	intro to music, harmonic series Exam 1 - Tue, Oct 3	
7	Oct 9	4, App A	7, 8, 18	Fourier synthesis and spectra, inharmonicity	
8	Oct 16	4	8	details of hearing and speech	Hw 3

9	Oct 23	4	8	musical temperament ↓	
10	Oct 30	6	6, 14, 17	woodwinds ↓	Hw 4
11	Nov 6	9	Box 7.1, 18.4-5	brass ↓ <i>Exam 2 - Tue, Nov 7</i>	
12	Nov 13	10, 11	3.4, 12, 13	strings.piano ↓	
13	Nov 20	12	11, 10.1-2	percussion ↓ <i>No class Thu - Thanksgiving</i>	Hw 5
14	Nov 27	13, 14, 6	10.3-4, 9, 14	acoustics ↓	
15	Dec 4	7, 8	15, 16	sound recording and production <i>Exam 3 - Thu, Dec 7</i>	Hw 6
16	Dec 11			Instrument Projects due Mon, Dec 11	