

## ***Physics 44: The Physics of Music, Fall 2020***

### ***Instructor:***

[Malcolm Sanders](#).

Office: E203B Innovation Hall

Office hours: Thursday 9:00 - 11:00 a.m., or by arrangement. (All office meetings will be via Microsoft Teams)

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### ***Credits:*** 4

### ***Modality:*** MIXD

***Remote meetings:*** MW 3:30 - 4:45 p.m. via Zoom

***In-Person:*** W 3:30 - 4:45 p.m. in room E330, Innovation Hall

### ***Attendance:***

Online attendance will be required at all class meeting times. Physical attendance on Wednesdays in Innovation E330 is optional. We don't have the capacity in the classroom to accommodate the entire class at one time, so we will split the class in approximately half, and each subgroup may attend in person on alternating Wednesdays. If the first initial of your last name begins with the letter A-H, then you may attend class in person on W 9/2 and every 2nd Wednesday after. People with last names that begin with the letters I-Z may come in person on W 9/9 and every 2nd Wednesday after. This arrangement is subject to change.

If you decide to attend class in person, you must adhere to the COVID-19 recommendations outlined in the Green and Gold pledge. In particular, you must wear a mask. Please do not physically attend class if you feel ill.

Under no circumstances will we meet in person on Mondays. The classroom is not available to us during class time on Mondays. Please don't invade another class!

### ***Required Course Materials:***

#### ***Textbook:***

Donald E. Hall, **Musical Acoustics**, 3rd edition (Brooks-Cole Publishing Co., California, 2002). During the semester you will be asked to read nearly all of this book, with the exception of Chapter 16. Selected exercises and projects will also be assigned from this book. At least two copies will be on reserve at the Howe Library.

#### ***Calculator:***

For homework and examinations you will want to have access to a small electronic calculator. If you need to purchase one, the least expensive model available at the UVM Bookstore is appropriate as long as it has sines and cosines and logarithms as well as simple arithmetic operations. The scientific calculator available on a SmartPhone or Tablet is sufficient for this purpose.

#### ***SmartPhone, Tablet, Laptop or equivalent.:***

In order to participate in Zoom meetings, you must have a desktop computer, laptop, or tablet with a front facing webcam and microphone. In addition, I'm hoping that each of you has a smartphone (or tablet) that is capable of audio recording.

#### ***LearningCatalytics(LC) Subscription:***

Please get a subscription to [LearningCatalytics](#) by following the link and registering, for a modest fee. A six-month subscription will be sufficient. Once you've obtained access to LearningCatalytics, with a

username and password, you will be able to participate in the class sessions by logging into LearningCatalytics at the beginning of lecture and joining the class session with the ID that will be announced at the beginning of class.

**Gradescope:**

You will need to set up an account at [gradescope.com](https://www.gradescope.com) (no charge for this). You will submit your weekly (approximately) homework assignments to Gradescope.

**Group Project:**

To allow you to explore your own interests independently and in some depth within the framework of the course, during the last half of the semester the class will be divided into (ideally) four-person teams to do research on a topic of each team's choice. You may form your own teams, or the instructor will suggest team assignments based on interests expressed on your information sheets. Some topics might be how scientific considerations apply to a particular instrument, or how science and technology affected the evolution of a particular instrument or music written for that instrument, or problems in concert hall acoustics. It is expected that most of the research will be done in the library, or through the internet, but other approaches such as interviews with experts may be included. The culmination of the projects will be a 10-15 minute Zoom presentation by each team to the whole class during the last two weeks of the semester and/or during our designated final exam period. The aim is that each presentation has some quantitative component that shows the integration between the art and science of music!

The various deadlines for each stage of the group project will be found under the *Projects* menu in Blackboard. The hope is to have project groups established by early in October, based on common interests that emerge from class discussions and online questionnaires.

**Homework problems, examinations, and grading:**

Selected exercises and projects from the ends of chapters in the textbook will be assigned most weeks during the semester (these will be announced on Blackboard and Gradescope), to help make your knowledge of musical acoustics secure and quantitative. In addition to these problems, I will assign a few exercises based on Mathematica notebooks that you will download from Blackboard. These notebooks are intended to familiarize you with the basic ideas of acoustics, waves, vibrations and to help you gain insight into the basic working principles behind different kinds of musical instruments.

I encourage you to collaborate with your fellow students on individual homework assignments, but the work that you finally submit must be your own. No fair cutting and pasting someone else's assignment and submitting it as your own. An exception to this rule will be that some assignments will be assigned as *group assignments*. These will involve explicit collaboration among your project group members to perform exercises that may take the form of "mini-acoustics-labs" where you will take measurements in the field and analyze your results. Your finished results will be handed in as a group homework assignment and each group member will receive the same grade.

All work on homework assignments, exams and group projects must conform to the [UVM academic integrity code](#). Please read this code and respect it!

Part of your grade will depend on class participation, which in part means simple attendance, but there will also be in class quizzes and other exercises, delivered via LearningCatalytics and that will enter into this.

The various assignments will make the following contributions to your grade:

<b>Grading Scheme</b>	
<i>Midterm (W Oct. 21, during class)</i>	<i>20%</i>
<i>Homework Exercises</i>	<i>30%</i>
<i>Group Projects</i>	<i>35%</i>
<i>Class Participation (LC)</i>	<i>15%</i>

Reduced credit will be given for weekly assignments more than three days late, and no credit will be allowed for assignments more than one week late.

### **Approximate Class Schedule**

<i>Week of</i>	<i>Topic</i>	<i>Textbook Reference</i>
Aug. 31	Sound and its measurement	Ch. 1, 2
Sep. 7	Sources of sound (M 9/7 Labor Day, no class)	Ch. 3
Sep. 14	General properties of waves	Ch. 4
Sep. 21	Sound intensity and loudness	Ch. 5
Sep. 28	Response of the human ear	Ch. 6
Oct. 5	Elements of Music	Ch. 7
Oct. 12	Harmonic Series and natural modes; steady tones	Ch. 8
Oct. 19	Percussion Instruments	Ch. 9
Oct. 26	Hammered and plucked strings, Bowed Strings	Ch. 10, 11
Npv. 2	Flow-driven instruments	Ch. 12
Nov. 9	Valve-driven instruments; pipe organs	Ch. 13
Nov. 16	The human voice; room acoustics	Ch. 14, 15
Nov. 23	Student Presentations (W 11/25 Thanksgiving break, no class)	
Nov. 30	Student Presentations	Ch. 18
Dec. 7	Student Presentations	

**Course Evaluation:**

All students are expected to complete an evaluation of the course at its conclusion. The evaluations will be anonymous and confidential, and the information gained, including constructive criticisms, will be used to improve the course.

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comments to [Malcolm Sanders](#)