

**Musical Acoustics**  
**AET 339 (19772) / ME 379M (18370)**

“If you want to find the secrets of the universe, think in terms of energy, frequency and vibration” - Tesla

Spring 2017; CLA 0.106; Tu/Th 5-6:30 PM

Instructor: Dr. (James) Gelb; gelb@arlut.utexas.edu; 512-565-8413; Office Hrs: After Class/TBD

The goal of the course is to help students develop the intuition and vocabulary for understanding the basic physical principles relevant to musical instruments and sound (e.g., mechanics, vibrations, acoustics, harmonics, acoustic-electronic conversions, speakers, hearing, perception, room acoustics, and so forth) in order to be able to read basic articles on the subject of musical acoustics. Material is kept relevant to musical principles (e.g., performance techniques, scales/harmony, ...) throughout the course. The level is accessible to students outside of the sciences with no background in physics/engineering/mathematics and to those with limited or no exposure to music. Optional advanced reading can be assigned to those interested. Liberal arts and science/engineering students will both benefit from the course.

**TOPICS:**

<b>I) Introduction and Motion</b>	Position, Speed/Velocity, Acceleration, Force, Mass, Gravity
<b>II) Pressure and Oscillations</b>	Work, Energy, Pressure, Springs, Transverse/Longitudinal Waves
<b>III) Sound</b>	Wavelength, Frequency, Doppler, Phase, Amplitude, Intensity, Decibels, Resonance, Impedance
<b>IV) Strings and Harmonics</b>	Vibrating String, Transients, Standing Waves, Harmonics, Plucked Instruments
<b>V) Properties of Musical Sound and Frequency</b>	Combinations of Waves, Beats, Modes of Vibration, Fourier (Frequency) Analysis
<b>VI) Timbre and Bowed Instruments</b>	Timbre, Driven Systems, Harmonic Structure, Bowed Instruments, Inharmonicity, Mode Locking
<b>VII) Human Ear and Voice</b>	Human Ear, Critical Bands, Intensity, Pitch, Loudness, Voice/Singing
<b>VIII) Scientific Foundations of Music Theory</b>	Piano, Intervals, Scales, Scales/Modes in the World, Tempered Tuning, Consonance (part 1)
<b>IX) Architectural Acoustics</b>	Reverberation, Absorption, Attenuation, Reflection, Refraction, Diffraction, Interference, Sabine's Law
<b>X) Wind, Woodwind, &amp; Brass Instruments</b>	Open/Closed Tubes, Organ Pipes, Reeds, Brass Instruments, Transcription, Impedance Plots
<b>XI) Electronic Music and Signal Processing</b>	Filters, Circuits, Speakers, Sound Synthesis, Properties of Electronic/Acoustical Signals
<b>XII) Percussion</b>	Analysis of Percussion Instruments, Piano, Modes of Vibration, Unpitched Instruments
<b>XIII) Psychoacoustics</b>	Pure and Complex Tones Revisited, Loudness, Pitch Perception, Consonance (part 2), Neural Models

*This syllabus below represents my current plans and objectives. Changes are not unusual and should be expected. Test/presentation dates (in red), however, will be preserved to accommodate your schedule planning.*

Wk	Dates	TUE (PART 1) Part 1 is 1st 40 min.	TUE (PART 2) Part 2 is 2nd 40 min.	THU (PART 1) Part 1 is 1st 40 min.	THU (PART2) Part 2 is 2nd 40 min.
1	Jan 17/19	Introduction	Introduction	Mechanics	Mechanics
2	Jan 24/26	Pressure/Oscillations	Heat	Waves/Sound	Sound
3	Jan31/Feb2	Strings/Harmonics	Strings/Harmonics	SOUND LAB	SOUND LAB
4	Feb 7/9	Frequency Analysis	Frequency Analysis	Timbre / Bowed Strings	Timbre / Bowed Strings
5	Feb 14/16	Miscellaneous	REVIEW	TEST 1	TEST 1
6	Feb 21/23	Miscellaneous	Miscellaneous	Intensity / Loudness	Intensity / Loudness
7	Feb28/Mar2	Hearing	Hearing	Miscellaneous	Miscellaneous
8	Mar 7/9	Scales/Tuning	Scales/Tuning	Scales/Tuning	Winds
9	Mar 14/16	SPRING BREAK	SPRING BREAK	SPRING BREAK	SPRING BREAK
10	Mar 21/23	Winds	Winds	Brass	Brass
11	Mar 28/30	Architectural Acoustics	Architectural Acoustics	WINDS LAB	WINDS LAB
12	Apr 4/6	Miscellaneous	REVIEW	TEST 2	TEST 2
13	Apr 11/13	Architectural Acoustics	Speakers / Filters	Speakers / Filters	Electronic Music
14	Apr 18/20	ELECTRONICS LAB	ACOUSTICS LAB	Percussion	Percussion
15	Apr 25/27	Piano	Psychoacoustics	Instrument Presentations	Instrument Presentations
16	May 2/4	Instrument Presentations	Instrument Presentations	FINAL REVIEW	TECH. REPORT DUE
17	May 9/11	NO CLASS	NO CLASS	FINALS WEEK	FINALS WEEK
18	May 16/18	FINALS WEEK	FINALS WEEK		

### Format and Procedures:

The class and exams are based heavily upon lectures using the white board and computer projected information. Many demonstrations using laboratory equipment will be used in class to enhance learning/intuition/retention. “Lab” days (in blue above) are informal – they represent days that are heavily dependent upon demonstrations.

### Grading Procedures: Grades will be based on:

- (a) Midterms (2x20=40%)
- (b) Homework (8x3=25%, one free point)
- (c) Presentation (mandatory, 10%) – topics/details will be provided shortly
- (d) Final (mandatory, 25%)

### Requirements:

1. Class attendance and participation policy: Attendance is strongly recommended because the exams are primarily based on the lectures. Attendance will be taken and can influence borderline grades.

**Religious Holy Days:** By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, I will give you an opportunity to complete the missed work within a reasonable time after the absence.

2. Course Readings/Materials:

(a) Required Textbook: "The Science of Sound," 3rd Ed., Rossing, Moore, Wheeler

(b) Supplementary texts if interested (I can show you my versions if interested):

“Musician’s Acoustics” by Parker and Smith –

nice, succinct, intuitive descriptions, very simple math

“Musimathics” Volumes I and II by Gareth Loy –

accessible, all aspects of musical acoustics, for musicians, moderate mathematics

“The Physics and Psychophysics of Music” by Juan G. Roederer

accessible treatment, moderate mathematics, mostly psychoacoustics

“The Physics of Musical Instruments” by Fletcher and Rossing

highly technical, upper division / graduate level

“Musical Acoustics” by Hall

simple math, descriptive, standard textbook for musical acoustics for musicians

(c) A simple scientific calculator is recommended. You can find one for under \$10.

(d) URL for course website: <https://canvas.utexas.edu>

3. Assignments, Assessment, and Evaluation

(a) Homework (with due dates) will be posted approximately every 1-2 weeks.

(b) Make up exams must be scheduled prior to exam date.

(c) Students are responsible for knowing add/drop/... dates: <http://registrar.utexas.edu/calendars/16-17>

(d) Date and time of Final Exam: <http://registrar.utexas.edu/students/exams>

4. Use of *Canvas* in class

In this class I use *Canvas*—a Web-based course management system with password-protected access at <http://courses.utexas.edu>—to distribute course materials, to communicate and collaborate online, to post grades, and to submit assignments. You can find support in using Canvas at the ITS Help Desk at 475-9400, Monday through Friday, 8 a.m. to 6 p.m., so plan accordingly.

## Academic Integrity

### University of Texas Honor Code

The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community.

Any work submitted by a student in this course for academic credit will be the student's own work.

You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e-mail, an e-mail attachment file, a diskette, or a hard copy.

Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Code can also be extended to include failure of the course and University disciplinary action.

During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

## Other University Notices and Policies

### Use of E-mail for Official Correspondence to Students

- All students should become familiar with the University's official e-mail student notification policy. It is the student's responsibility to keep the University informed as to changes in his or her e-mail address. Students are expected to check e-mail on a frequent and regular basis in order to stay current with University-related communications, recognizing that certain communications may be time-critical. It is recommended that e-mail be checked daily, but at a minimum, twice per week. The complete text of this policy and instructions for updating your e-mail address are available at: <http://www.utexas.edu/its/help/utmail/1564>

### Documented Disability Statement

Any student with a documented disability who requires academic accommodations should contact Services for Students with Disabilities (SSD) at (512) 471-6259 (voice) or 1-866-329-3986 (video phone). Faculty are not required to provide accommodations without an official accommodation letter from SSD. (*Note to Faculty: Details of a student's disability are confidential. Faculty should not ask questions related to a student's condition or diagnosis when receiving an official accommodation letter.*)

- Please notify me as quickly as possible if the material being presented in class is not accessible (e.g., instructional videos need captioning, course packets are not readable for proper alternative text conversion, etc.).
- Please notify me as early in the semester as possible if disability-related accommodations for field trips are required. Advanced notice will permit the arrangement of accommodations on the given day (e.g., transportation, site accessibility, etc.).
- Contact Services for Students with Disabilities at 471-6259 (voice) or 1-866-329-3986 (video phone) or reference SSD's website for more disability-related information:  
[http://www.utexas.edu/diversity/ddce/ssd/for\\_cstudents.php](http://www.utexas.edu/diversity/ddce/ssd/for_cstudents.php)

**Behavior Concerns Advice Line (BCAL)**

If you are worried about someone who is acting differently, you may use the Behavior Concerns Advice Line to discuss by phone your concerns about another individual’s behavior. This service is provided through a partnership among the Office of the Dean of Students, the Counseling and Mental Health Center (CMHC), the Employee Assistance Program (EAP), and The University of Texas Police Department (UTPD). Call 512-232-5050 or visit <http://www.utexas.edu/safety/bcal>

**Q drop Policy**

The State of Texas has enacted a law that limits the number of course drops for academic reasons to six (6). As stated in Senate Bill 1231:

“Beginning with the fall 2007 academic term, an institution of higher education may not permit an undergraduate student a total of more than six dropped courses, including any course a transfer student has dropped at another institution of higher education, unless the student shows good cause for dropping more than that number.”

**Emergency Evacuation Policy**

Occupants of buildings on the UT Austin campus are required to evacuate and assemble outside when a fire alarm is activated or an announcement is made. Please be aware of the following policies regarding evacuation:

- Familiarize yourself with all exit doors of the classroom and the building. Remember that the nearest exit door may not be the one you used when you entered the building.
- If you require assistance to evacuate, inform me in writing during the first week of class.
- In the event of an evacuation, follow my instructions or those of class instructors.

Do not re-enter a building unless you’re given instructions by the Austin Fire Department, the UT Austin Police Department, or the Fire Prevention Services office.