PHYS 1270.003

The Science and Technology of Musical Sound

Spring 2026

Lecture, Physics Building 104, TTh 9:30 am – 10:50 am

Instructor:	Guru Khalsa
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Office Hours:	Thursdays, 11:00 am – 12:00 pm or by appointment
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Course Description: This course provides an introduction to the physical principles underlying musical sound, with emphasis on sound production, propagation, and perception. Topics include vibration and oscillation, wave motion, standing waves, resonance, normal modes, sound radiation, and the acoustical behavior of musical instruments. The course emphasizes the connection between physical models and audible phenomena, using both qualitative reasoning and quantitative analysis.

Instruction is centered on chalkboard lectures, in-class demonstrations, and discussions that illustrate fundamental acoustical principles. Weekly homework assignments develop analytical skill and reinforce conceptual understanding. Laboratory experiments provide direct experience with measurement techniques, data interpretation, and the limitations of physical models. Together, lectures, demonstrations, and labs emphasize how abstract wave descriptions correspond to real sound sources and listening experiences.

By the end of the course, students will be able to analyze musical sounds using physical principles, interpret experimental data related to acoustical systems, and apply wave models to strings, air columns, membranes, and resonant structures encountered in musical contexts.

The physical study of sound and acoustics runs in parallel with a long history of natural philosophy, mathematics, and music, shaping ideas about harmony, proportion, and order in the natural world – including early models of the universe grounded in musical and mathematical relationships – from early theories of vibration and resonance to later developments in wave theory, optics, and modern acoustical technology.

Prerequisite: Math 1100 (or equivalent), or consent of instructor. The course assumes familiarity with algebra; additional mathematical tools will be introduced as needed.

Course Structure: The course is organized around a progression from basic physical concepts to increasingly realistic musical systems. Early portions of the course focus on foundational ideas—simple harmonic motion, waves, and energy transport—developed primarily through chalkboard derivations and carefully chosen demonstrations. These ideas are revisited and extended as more complex systems are introduced.

Weekly homework assignments support the lecture material and reinforce problem-solving skills. Three midterm exams and a comprehensive final exam assess conceptual understanding, physical reasoning, and problem-solving ability. A required laboratory component runs in parallel with the lecture, emphasizing experimental observation, measurement of acoustical quantities, and comparison between theory and experiment.

While the primary instructional mode is lecture-based, demonstrations and laboratory activities are integral rather than supplementary. They are used deliberately to clarify abstract concepts, expose common misconceptions, and connect mathematical descriptions to audible and observable phenomena.

Laboratory: The laboratory component of the course emphasizes hands-on measurement and analysis of sound and vibration, reinforcing concepts introduced in lecture through experiment and data interpretation.

Labs make 25% of your overall grade. You must complete 10 labs and 2 reports to get full credit for labs. The Lab section of this course has its own instructor, Canvas page, and syllabus. Labs and their grading is administered by Matthew Abbot (matthew.abbott@unt.edu).

Course Expectations and Classroom Climate: Students are expected to engage actively with lectures, demonstrations, laboratories, and assignments. Regular attendance and preparation are essential, as many core ideas are developed through live derivations, physical demonstrations, and discussion rather than slides or recordings. Students are encouraged to bring questions—particularly those arising from musical experience or instrument performance—to help ground the physics in concrete examples.

The classroom is intended to be a respectful, focused environment that supports careful reasoning, questioning, and learning from error. Mistakes are a normal part of developing physical understanding and are treated as opportunities for clarification. Students are expected to participate constructively, listen attentively, and contribute to a collegial atmosphere that values both precision and curiosity.

Textbook: Digital copies of the textbook chapters are available in Canvas.

- *Musical Acoustics, 3rd Edition* by Donald E. Hall (Cengage Learning: Mason, Ohio 2004)

Minimum Technology Requirement:

- **Computational Resources:** Students must have access to a laptop or similar device with internet access.
- **Canvas:** Access to Canvas for course materials, assignments, and communications. Canvas will be used to post course materials, notes, announcements, grades, and the most up-to-date version of this syllabus (https://unt.instructure.com/). You may use your UNT EUID and password to log on and select this course.
- **Calculator:** We will occasionally need a scientific calculator for this class with square-root ($\sqrt{}$), logarithm (log), and exponential (y^x) functions.

Computer Skills & Digital Literacy:

- **Basic Computer Literacy:** Students should be comfortable with fundamental computer operations, including file management, and navigating the internet.

Assessment and Grading: Assessment content may be evaluated for preparation, consolidation with previous course material, participation, and completion/correctness of assigned work.

Activities	**Percentage**
Homework	10%
Quizzes/Participation	10%
Lab	25%
Exam 1	10%
Exam 2	10%
Exam 3	10%
Final Exam (comprehensive)	25%
Total	100%

Grade Scale
A: 90–100
B: 80–89
C: 70–79
D: 60–69
F: < 60

Generative Artificial Intelligence (AI): You are welcome to use generative AI tools (ChatGPT, Claude, etc.) in your exploration of the topics in this course, but they will not be permitted in quizzes or exams. These tools should be used as a supplement to your understanding, not a replacement. *Note that for both physics and mathematics, these tools are often wrong, and often in subtle ways*. I suggest you scrutinize any information presented to you by these models and perform the necessary checks to ensure the information is correct. The assignments you submit and the information you present in this course will be attributed to you. *If you use AI tools, acknowledgment is required for transparency.* If you are unsure, please ask me.

Academic Integrity Standards and Consequences: According to UNT Policy 06.003, Student Academic Integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University. The University Policy can be found at: https://vpaa.unt.edu/ss/integrity.

Course Evaluation – Student Perceptions of Teaching (SPOT): Student feedback is an essential part of participation in this course. Providing the student evaluation of instruction instruments is a requirement for all organized classes at UNT.

A short SPOT survey will be made available April 14 – April 30 to provide you with an opportunity to evaluate how this course is taught. You will receive an email from *"UNT SPOT Course Evaluations via IASystem Notification"* (no-reply@iasystem.org) with the survey link. Simply click on the link and complete your survey. Once you complete the survey you will receive a confirmation email. For additional information, please email spot@unt.edu.

ADA Policy: The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Access (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodations at any time, however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the student. For additional information, refer to the Office of Disability Access website at https://studentaffairs.unt.edu/office-disability-access. You may also contact ODA by phone at (940) 565-4323.

Emergency Notification & Procedures: UNT uses a system called Eagle Alert to quickly notify students with critical information in the event of an emergency (i.e., severe weather, campus closing, and health and public safety emergencies like chemical spills, fires, or violence). In the event of a university closure, please refer to Canvas for contingency plans for covering course materials.

Important Dates: [UNT Academic Calendar]

Week	Dates	Day		
1	Jan 12 – Jan 18	T Th	The Nature of Sound (Ch. 1) Waves & Vibrations (Ch. 2)	No lab
2	Jan 19 – Jan 25	T Th	Sources of Sound (Ch. 3)	Lab orientation
3	Jan 26 – Feb 1	T Th	Sound Propagation (Ch. 4) Sound Intensity & Its Measurement (Ch. 5)	Lab 1: Elements of Sound
4	Feb 2 – Feb 8	T Th	The Human Ear & Its Response (Ch. 6)	Lab 2: Simple Harmonic Oscillator
5	Feb 9 – Feb 15	T Th	Elemental Ingredients of Music (Ch. 7)	Lab 3: Loudness, Freq. & Hearing
6	Feb 16 – Feb 22	T Th	Sound Spectra (Ch. 8)	Lab 4: Vibration Recipes
			EXAM 1 (Ch. 1-7) *Sage Testing Center* – Sage Hall, Room 331 (third floor) Thursday, Feb 19th, 8 am–8 pm Friday, Feb 20th, 8 am–5 pm	
7	Feb 23 – Mar 1	T Th	Percussion Instruments & Natural Modes (Ch. 9)	Lab 5: Synthesizers, Computers & MIDI Madness
8	Mar 2 – Mar 8	T Th	Piano and Guitar Strings (Ch. 10)	Lab Make-up #1–#5
9	Mar 9 – Mar 15	—	Spring Break	
10	Mar 16 – Mar 22	T Th	The Bowed String (Ch. 11)	Lab 6: Vibrational Motion
11	Mar 23 – Mar 29	T Th	Blown Pipes & Flutes (Ch. 12)	Lab 7: Strings
12	Mar 30 – Apr 5	T Th	Blown Reed Instruments (Ch. 13)	Lab 8: Pipes & Air Columns
			EXAM 2 (Ch. 8-12) *Sage Testing Center* – Sage Hall, Room 331 (third floor) Thursday, Mar 2nd, 8 am–8 pm Friday, Mar 3rd, 8 am–5 pm	
13	Apr 6 – Apr 12	T Th	The Human Voice (Ch. 14)	Lab 9: Human Voice
14	Apr 13 – Apr 19	T Th	Room Acoustics (Ch. 15)	Lab 10: Reverberation Time
15	Apr 20 – Apr 26	T Th	Sound Reproduction (Ch. 16)	Lab Make-up #6–#10
16	Apr 27 – May 3	T Th	Reading Day	No lab
			EXAM 3 (Ch. 13-16) *Sage Testing Center* – Sage Hall, Room 331 (third floor) Thursday, Apr 30th, 8 am–8 pm Friday, May 1st, 8 am–5 pm	
17	May 4 – Mar 11	—	**FINAL EXAM (comprehensive)** *Sage Testing Center* – Sage Hall, Room 331 (third floor) Thursday, May 7th 7:30am–3:30 pm	