Syllabus: PHYS 1300 Introduction to Musical Acoustics
Fall 20XX

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Texts: Donald E. Hall, Musical Acoustics, Brooks/Cole, Pacific Grove, CA

Course Prerequisites: None listed.

Course Description: An introduction for the Music Major (and others interested in music) to the nature of periodic motion, characteristics of sound waves and sources of sound used in music. Additional topics will include a discussion of sound perception, musical scales and temperament, and the recording and reproduction of sound. This course satisfies The University of Texas at Arlington core curriculum requirement in Life and Physical Sciences.

Course Learning Goals/Objectives: The goal of this course is to provide students with an overview and understanding of the physical phenomena underlying sound and music. Students will develop critical thinking, communication and empirical skills.

Proposed topics to be covered:
1. Nature of Sound
2. Waves and Vibrations-Periodic Motion
3. Sources of Sound
4. Sound Propagation
5. Sound Intensity and Measurement
6 The Human Ear and Its Response
7. Sound Spectra and Electronic Synthesis
8. The Physical Underpinning of Modern Musical Instruments
9. The human voice
10. Sound Reproduction
11. Harmonic Intervals and Tuning
12. The Acoustics of Chambers, Rooms and Halls

Attendance and Drop Policy: Attendance is required. Absences should be discussed with the instructor - preferably before they occur. Dropping with a W is possible (for students with a passing average) with the permission of the instructor up to the last drop date allowed by the Graduate school and registrar.
Experiential learning / Lab Reports: Lab report specifications for a particular lab may be provided by your lab instructor. If you are not given specific instructions for a particular lab then the following guidelines would apply: The lab report should consist of at least one sheet (both sides) with as many equations, schematic diagrams, and graphs (hand sketches are fine but be sure to include the relevant units and magnitudes!) as you can fit and think relevant.

Tests and reports: We will have 5 quizzes and a final report.

Homework: Will be collected and evaluated.

Experiential learning / Lab Grade and Final Project: A grade will be assigned based on your overall performance in experiential learning / lab and your lab reports. The final few labs will be devoted to building, playing, and analyzing an instrument. The final project will include a written summary of your analysis of a musical instrument.

\[
\text{Term Average} = \frac{3}{5}\text{(Quiz Average)} + \frac{1}{5}\text{(Lab evaluation and Lab reports)} + \frac{1}{5}\text{(Final Report)} +\text{/- 5 points for homework completion.}
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<table>
<thead>
<tr>
<th>Term Average</th>
<th>Letter Grade</th>
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<tbody>
<tr>
<td>90-100</td>
<td>A</td>
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<td>80-89</td>
<td>B</td>
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<td>70-79</td>
<td>C</td>
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<tr>
<td>60-69</td>
<td>D</td>
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<td>&lt; 60</td>
<td>F</td>
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Signature Assignment: Physical Analysis of a Musical Instrument of Your Choice

Instructions: The signature assignment will require some library research, some laboratory work and measurements. Your results will be reported in a term paper of 8-10 pages (double spaced 12pt including graphs and figures).

1. Choose an instrument for your report
2. Perform web based and library research regarding the history and physical analysis of your instrument.
3. Construct a model instrument based on the same principles as your selected instrument (e.g. if you play a violin, construct a string instrument, if you play a woodwind construct a reed instrument analog. The instrument should include a mechanism for producing sound and for selecting musical notes. The instrument should be capable of playing a simple tune consisting of at minimum 4 distinct musical pitches.
The content of the written paper should include:

I. Introduction
   b. History of your instrument.
   c. Musical role of your instrument.

II. Physics analysis of your instrument (See Chapters 9-15 in Musical Acoustics, Donald E. Hall).
   a. Where does the energy come from—where does it go?
   b. What is the part of the instrument that is oscillating? What causes it to vibrate.
   c. What is the role of resonances in your instrument?
   d. How do the vibrations of the vibrating part (e.g. string, membrane, reed, airstream etc.) produce sound waves in the air?
   e. What are the directional properties resulting from the coupling system (e.g. what are the directional properties of a Bell or Horn or of the soundboard of a piano or the body of a violin)?
   f. How is the pitch selected in your instrument (e.g. string tension and length, length of air column (finger holes, slides, valves and extra piping)? What role does the musician play in pitch selection.
   g. How does temperature affect your instrument?
   h. How and why are overtones generated by your instrument.
   i. How does the design of the instrument affect which of the overtones are present and or emphasized (e.g. full harmonic series, odd harmonics emphasized, formants)?
   j. What is the role of the overtones in determining the timbre of the instrument?
   k. What is the role of transient (short lived) vibrational modes and overtones in establishing the sound of your instrument and its role in music.
   l. How do room acoustics affect your instrument?

III. Analysis of your instrument’s sound
   a. Computer plot of the wave forms of your actual and mode instruments playing different notes and under different conditions (with a mute, without a mute, different fingerings).
   b. Computer plot of the absolute value of the amplitude versus frequency (spectral analysis) of your instrument.
   c. Discussion of the relationship between the observed wave form and observed spectral analysis.
   d. Discussion of the relationship between the observed spectral analysis and the physics of how music is produced in your instrument (e.g. do you see the full harmonic series, are odd harmonics emphasized, do you see formants).
Attendance and Drop Policy: Attendance is required. Absences should be discussed with the instructor - preferably before they occur. Dropping with a W is possible (for students with a passing average) with the permission of the instructor up to the last drop date allowed by the Graduate school and registrar.

Academic Dishonesty
It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspension or expulsion from the University.

"Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts."

Disabilities
The Univ. of Texas at Arlington is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public law 9312-The Rehabilitation Act of 1’973 as amended. With the passage of new federal legislation entitled Americans with Disabilities Act - (ADA), pursuant to section 504 of the Rehabilitation Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens.

As a faculty member, I am required by law to provide "reasonable accommodation" to students with disabilities, so as not to discriminate on the basis of that disability. Student responsibility primarily rests with informing faculty at the beginning of the semester and in providing authorized documentation through designated administrative channels.

Library Information: phys.html <http://www.uta.edu/library/research/rt-phys.html>

Drop for non-payment of tuition
If you are dropped from this class for non-payment of tuition, you may secure an Enrollment Loan through the Bursar's Office. You may not continue to attend class until your Enrollment Loan has been applied to outstanding tuition fees.

Introduction to Musical Acoustics Laboratory Syllabus

Required Materials: Physics Lab write ups will be provided each week in lab.

Teaching Assistant:
Attendance Policy: As outlined in the lab manual you are expected to attend the lab section in which you are enrolled. If circumstances arise which prevents you from attending your normal lab time a Request to Attend Alternate Lab form must be completed and authorized prior to attending another lab section, it can be obtained from your lab instructor or the lab coordinator. The physics main office staff cannot give this permission.

University excused absence policy requires that the student notify the instructor a week in advance. Due to the lab schedule a coordinate effort should be made to attend a lab during the scheduled week.

Multiple absences due to chronic medical problems will be handled on an individual basis.

Students with Disabilities: Students who need an accommodation based on disability should arrange to meet with the lab coordinator to see what arrangements need to be made to accommodate their needs.

Missed Labs
There will be no makeup labs at the end of the semester.
For all students the *lowest lab report grade will be dropped* and the lab report average taken from the remaining labs. In the case of a missed lab this will be your lowest lab grade. If more than one lab has been missed the additional missed labs will receive a grade of zero.

### Schedule

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<thead>
<tr>
<th>Week</th>
<th>Lab</th>
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<tbody>
<tr>
<td>2</td>
<td>Speed of Sound I (echo method)</td>
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<tr>
<td>3</td>
<td>Standing Waves I (nodes, $v = \lambda f$)</td>
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<tr>
<td>4</td>
<td>Speed of Sound II (sound tube method)</td>
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<td>5</td>
<td>Harmonic Motion</td>
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<td>6</td>
<td>Diffraction</td>
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<td>7</td>
<td>Beats</td>
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<td>8</td>
<td>Sound Intensity</td>
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<td>9</td>
<td>Build a Speaker</td>
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<td>10</td>
<td>Amplification and Gain</td>
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<tr>
<td>11</td>
<td>Standing II (Harmonics)</td>
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<tr>
<td>12</td>
<td>Power Spectrum and Wave Forms</td>
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<tr>
<td>13-14</td>
<td>Work on lab portion of signature assignment</td>
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**Grading:** The lab grade is part of your course grade and its percentage to the course grade is determined by the course instructor. The lab grade that will be submitted to your course instructor is made up of:

- Lab reports $\quad 100\%$

**Lab report grade break down:**

- Lab report $\quad 60\%$
- Lab participation $\quad 40\%$ (use of cell phones during lab is grounds for deducting points)
Lab reports are due at the end of the lab period. 
There will be no make-up lab see Missed Labs in the preceding section. 
The lowest lab report grade will be dropped and the lab report average taken from the remaining 8 lab grades.