Course Description - *PHY 2010, Physics for Audio Engineering, 4 semester hours credit.*
Prerequisite: PHY 1140 or PHY 1120 or PHY 2120.
This course is designed to introduce the use of principles of physics to applications in acoustics, recording media, and equipment used in the production of sound. The course will consist of three (3) hours of lecture and two (2) hours of lab.

Instructor: Dr. Hawley
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MW 4-6pm, F 4-5pm, WF 11am-noon, and by appointment

Class Meeting Times and Location:
Turn off all cell phones, pagers, recorders etc before coming to class. If you do not you will be asked to leave class and it will count as an unexcused absence.

Section 2010.01:	Class:	MWF	2:00 pm - 2:50 pm	AYRS 2096
	Lab:	Thurs	1:00 pm - 2:50 pm	AYRS 4078
Section 2010.03:	Class:	MWF	3:00 pm - 3:50 pm	AYRS 2096
	Lab:	Thurs	3:30 pm - 5:20 pm	AYRS 4078

Course Objectives:
To acquaint the students the physics necessary to understand the generation of sound, generation of music by instruments and how sound/music interacts in structures.
To provide students with laboratory experience that will enhance their ability to make physical measurements and analyze data.
To utilize cooperative learning in laboratory exercises, problem solving experiences and in group projects.

Textbooks:
Required: The Physics of Sound, 3rd Edition, by Richard Berg and David C. Stork
Required: Master Handbook of Acoustics, 7th Edition (paperback), by F. Alton Everest & Ken Pohlmann
We want a text which geared toward physical principles, which is more technical than "Physics for Musicians," but not as technical as a full acoustics class (which would have differential equations). Such a text has not yet been found. As such, we will use a combination of two books:

Laboratory Manual:
Physics for AET Laboratory Manual by Scott H. Hawley, downloadable via course web page (below).

Course Web Page:
http://hedges.belmont.edu/~shawley/PHY2010/
Course Topics:
Fundamentals of Sound (Chapters 1-4 Berg & Stork, Chapter 1 Everest)

Simple Harmonic Motion and Applications (Chapter 1 Berg & Stork, + Supplemental Notes)
Waves and Sound (Chapter 2 Berg & Stork, + Supplemental Notes)
Standing Waves and the Overtone Series (Chapter 3 Berg & Stork)
Analysis and Synthesis of Complex Waves (Chapter 4 Berg & Stork)
Sound Intensity Scales (Section 6.4 Berg & Stork, Chapter 2 Everest)
Room and Auditorium Acoustics (Chapter 8 Berg & Stork)
Reverberation (Chapter 7 Everest)
Absorption (Chapter 9 Everest)
Diffusion (Chapter 13 Everest)
Modal Resonances (Chapter 15 Everest)

Grading Procedure:

20% Final exam
45% Tests (3 at 15% each)
15% Project (See separate project rubric)
10% Labs (Each lab grade is 90% lab work, 10% pre-lab quiz)
10% Homework

Course Average	Letter Grade
90 -100	A
87 - 89	B+
83 - 86	B
80 - 82	B-
77 - 79	C+
73 - 76	C
70 - 72	C-
67 - 69	D+
63 - 66	D
60 - 62	D-
Below 60	F

Policy on Attendance:

Do not schedule appointments, interviews, practice time, music sessions, advising, taking family and friends to places, work-related activities, travel plans, vacation time, doctor appointments, dental appointments, court dates, lawyer appointments, trips or other types of activities during class time, **These will not constitute valid excuses. Please do not schedule** airline reservations to leave campus or return to campus on days class meets**. These will *not* constitute valid excuses if a class is missed because of flight delays due to weather etc. Plan your life in every way possible to avoid exceeding the absence policy. The recommendation is that your guiding principle is to attend every single class, saving your absences for instances, should they occur, when you truly need one.**

Class and labs will start promptly **at its designated times**. It is your responsibility to be on time. **Attendance will be taken at the beginning of class, and not revised later. Thus, to be late is to be marked absent.** If you should arrive late, enter silently and do not disrupt the class in any way. Also note that Belmont University policy requires that 12 or more absences must result in a failing grade being granted for the entire course.

Note that days preceding and following Belmont Holidays are not holidays. You will be expected to attend class accordingly. Travel plans will not constitute excused absences. Failure to return because of travel related delays etc. will not constitute excused absences.

Policy on Assignments:

All work is due at the time the assignment is due. ***Late work is not accepted, at all.***

Policy on Labs and Examinations:

No make-up labs or examinations will be given. If you have a **valid reason** (as determined by the instructor) for missing a midterm exam, the grade you receive on the final exam will be applied (i.e., copied) to stand in for your grade for the missed examination. Note that lab time will be used either for lab assignments or to administer examinations, so it is never a good idea to miss lab. **Lab will begin promptly at the designated time, beginning with a quiz about your reading of the lab book beforehand.** If you arrive late, you will miss 10% of your lab grade in the form of this quiz.

University policies:

Honor Code - The Belmont community values personal integrity and academic honesty as the foundation of university life and the cornerstone of a premiere educational experience. Our community believes trust among its members is essential for both scholarship and effective interactions and operations of the University. As members of the Belmont community, students, faculty, staff, and administrators are all responsible for ensuring that their experiences will be free of behaviors, which compromise this value. In order to uphold academic integrity, the University has adopted an Honor System. Students and faculty will work together to establish the optimal conditions for honorable academic work. Following is the Student Honor Pledge that guides academic behavior:

"I will not give or receive aid during examinations; I will not give or receive false or impermissible aid in course work, in the preparation of reports, or in any other type of work that is to be used by the instructor as the basis of my grade; I will not engage in any form of academic fraud. Furthermore, I will uphold my responsibility to see to it that others abide by the spirit and letter of this Honor Pledge."

Disabilities Compliance - In compliance with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act, Belmont University will provide reasonable accommodation of all medically documented disabilities. If you have a disability and would like the university to provide reasonable accommodations of the disability during this course, please notify the Office of the Dean of Students located in Beaman Student Life Center (460-6407) as soon as possible.

Disclaimer:

The policies, topics and course organization described in this syllabus are subject to change. Adequate prior notice will be provided to all students in the event of a change.

Motivation: Quotes from Previous Students:

- "I was applying for an internship...and the interviewer was talking about how the low frequencies next to their practice room weren't very loud but in their offices a little farther away, were very loud. I was able to explain...several things we could do to fix the problem. I'm sure it helped them to hire me."
- "Many concepts, such as the inverse square law,...became increasingly...important as I learned about live sound reinforcement. It already helped on my final for that class."
- "I can now sound proof and manipulate the acoustic qualities of a room. People pay high-end dollars for what I learned in this class. Also, with my Audio Engineering, I will better be equipped with the tools to manipulate my environment to achieve a desired sound when recording."
- "Since I am in the process of designing a couple studios for friends, I can use what I have learned about the way waves behave and how to absorb & diffuse them to create a recording environment that could produce the next big hit."

How to Succeed in this Course:

- *Prepare.* Studies in education research show that learning occurs best when students' *first exposure* to course material occurs in private, *prior* to class. (Note: This does *not* include sitting in the hallway immediately before class trying to cram.) Thus this instructor recommends reading the relevant section of the text the evening before class.
- *Work problems, answer questions, work problems*. Physics can be regarded as a *reasoning skill* which can be acquired through *practice*. By doing so, you *train your brain* through the *actions* of applying the concepts you're learning. Reading the text is helpful for first exposure and clarification, but for "studying" (e.g., before a test) there is little substitute for experience. In particular, "memorization" is rarely a useful avenue for success in a physics course.
- Become skilled in using ***both*** the *concepts* as well as the *mathematical tools* used in the course. Being able to "do the math" without understanding the concepts behind it is a frequent pitfall of engineering students. Likewise, lack of mathematical proficiency will severely limit your performance in the course.
- Complete all assignments on time and in compliance to Academic Standards (below).
- *Begin* assignments at least two days prior to due date, so you can ask the instructor prior to the due date
- *Make use of the instructor's office hours.* Come ask questions, share concerns, make suggestions, etc.
- *Stay current*. This course will move quickly. Do not fall behind!
- *Put in the time.* You are (very) unlikely to attain proficiency without investing substantial, *focused* time *daily* toward studying and working problems. Unfortunately, there are no shortcuts.

Academic Standards:

- Clarity: Written work (e.g., homework) will be clearly *readable, intelligible* and *explain* the *reasoning* behind each solution, exercise, etc. A simple list of formulas --- or worse, an "answer" with no supporting work --- will not do. Imagine that you are writing to explain to fellow students, such that if they picked up your paper, they could follow your reasoning and arrive at your conclusion.
- Presentation: In addition to clarity of *content* described above, assignments will be neatly written (recopy your original calculations as needed, vast amounts of scribbling should be omitted, etc.), any "ratty spiral binder detritus" will be removed, and multiple pages will be *stapled* or secured with a paperclip.
- Accuracy: Answers will be numerically and conceptually correct, and not claim undue degrees of numerical precision (i.e. pay attention to "significant digits")
- *Units*: Rarely in physics is a dimensionless number the requested quantity. All (applicable) answers will contain the appropriate units (meters, volts, etc.).

Meaning of Letter Grades:

A - Truly exceptional, remarkably excellent work, going well beyond what is typically 'expected'.
B - Above average work. Extra effort and/or attention was paid to producing quality work.
C - *Average*, satisfactory work. Meets the requirements and nothing more.
D - Unsatisfactory work. e.g., inadequate, incorrect, incomplete presentation of material.
F - Completely inadequate. Unacceptably poor or incomplete work.

Class Schedule: *Italics indicate the reading or other preparation you are expected to have performed for that day*: *"BS" = sections to have read in Berg & Stork texbook, "Ev"= Everest book*

Week of	Mon	Wed	Thurs (Lab)	Fri
Jan-8		Course overview & Syllabus	No Lab	"Physics" - *BS 1.1* Simple Harmonic Motion, *BS 1.2*
Jan 15	MLK Holiday	Waveforms & more SHM *BS 1.3*	*Read the Lab* Lab 1: Orientation / Fun with Excel	Driven SHM, Resonance, Coupled SHM -*BS 1.4*
Jan 22	*HW 1 Due (before class)* Waves in General *BS 2.1*	Wave Properties BS 2.2, 2.4	*Read the Lab* Lab 2: Hooke's Law & SHM	Wave Behavior *BS 2.3, 2.5*
Jan 29	*HW 2 Due* Standing waves, SW on Strings - *BS 3.2-3.3*	Long. SW, Others *BS 3.4, 3.5*	*Read the Lab* Lab: Sound Speed	Work problems from Chapters 1-3 / Start HW3
Feb 5	*HW 3 Due* Complex Waves *BS 4.1*	***Bring an Instrument!*** Fourier Analysis - *BS 4.2*	*Read the Lab* Lab: Resonance in Strings	Resonance Curves BS 4.4
Feb 12	*HW 4 Due* Review for Test, Start Practice Test 1	*Practice Test 1* Talk about Projects, Assign groups	***Test 1** **(On BS Ch 1-3, not 4)**	Logarithms & SIL, *BS 6.4*
Feb 19	SIL, *Ev Ch 2* Activity: SIL (HW5)	Criteria in Ac. Design, *BS 8.1*	Lab: SIL Meter & Inverse Square Law	Modal Resonance *BS 8.2, Ev pp 350-351*
Feb 26	***Project Proposals Due*** Problems in Ac. Design, *BS 8.2*	Reverb Time, Sabine Eq. *BS 8.3*	Work on your Projects / Hawley speaking at CCCU	Group project consultations via Zoom, by request. (Optional)
Mar 4	Spring Break	Spring Break	Spring Break	Spring Break
Mar 11	*HW 6 Due* Reverb in Detail, Measuring Reverb *Ev pp 155-170*	Reverb Issues w/ Real Rooms *Ev pp 170-180*	Lab: Room Design (Spreadsheet)	Absorption in Detail *Ev pp 179-186*
Mar 18	*HW 7 Due* Porous Absorption *Ev pp 187-200* Project status updates	No Class – Hawley at NVIDIA	Lab: Measuring Reverb Time – Virtual / Online	Helmholtz Absorbers *Ev pp 209-220*
Mar 25	*HW 8 Due* *Diffusion in Detail* *Ev pp 125-133*	Achieving Diffusion *Ev pp 258-266,272-274*	Easter Break	Easter Break
Apr 1	Easter Break	*Practice Test 2*	***Test 2** **(On BS Ch 4, §6.4 & Ch 8, Ev Ch 2 & 11)**	Modes in Detail *Ev pp 223-230*
Apr 8	Mode Decay / BW *Ev pp 230-240*	***Project Presentations*** (in our usual classroom)	***Project Presentations*** (Not in lab; will reserve a room somewhere)	*HW 9 Due* Mode Distribution *Ev pp 241-250,254-256*
Apr 15	**Paper Drafts Due** Acoustical Impedance (from notes)	Home Studio Design	Paper Feedback Returned / Work on papers	Review for Final
Apr 22	***Full Papers Due b4 class*** Group Evals, Course Evals			

Date & Time of Final Exam: see http://www.belmont.edu/registrar/exam-schedules.html *(2pm May 3 in lab)*