

PHYSICS 496: The Physics of Music

Christian Brothers University

Spring 2018

General Information

Instructor of Record: Dr. John Varriano Phone: 901-321-3439 jvarrian@cbu.edu

Student Instructor: Luke Wade Phone: 901-299-5876 lwade3@cbu.edu

Class Meeting Time: MWF: 10:00 – 10:50 AM

Course Website: facstaff.cbu.edu/jvarrian/496

Office Hours:
Varriano - see web page at facstaff.cbu.edu/jvarrian
Wade - MWF 1-2 PM, TR 10-11 AM (call/text/e-mail)
- in Math Center on M at 11 and TR at 9

Course Description

The aim of this course is to study the interplay between sound and the physical phenomena that govern it, focusing in particular on its role in musical production, performance, and experience. Time permitting, we will also perform a more general survey of the field of acoustics and its applications, both creative and practical.

Prerequisite: PHYS 251, MATH 232. Three credits.

Textbook: None required. All necessary materials will be provided during lecture and some will later be uploaded on the course page. For additional reference, we recommend the following texts:

- Kinsler, Lawrence E., and Austin Rogers Frey. *Fundamentals of Acoustics*. New York, NY: Wiley, 1962.
- Fletcher, Neville H., and Thomas D. Rossing. *The Physics of Musical Instruments*. New York, NY: Springer, 2010.

Possible Topics

This course is a work in progress, and will remain so throughout its duration. Thus, the topics to be discussed will follow some general guidelines, but will not be set in stone until the class has further progressed. This is done for two reasons. Firstly, it allows the instructors to continuously plan and refine the course. Second, the course is intended to be an interactive and exploratory endeavor which will allow students some say in how it will develop and the material we will cover. Potential topics may include, but are not limited to those outlined below:

1. Introductory Wave Theory and the Wave Equation
2. Fourier Series and the Fourier Transform
3. Simple, Damped, and Forced Harmonic Oscillators
4. Sound Radiation, Reflection, Transmission, and Absorption
5. Modeling of Musical Instruments using Differential Equations
6. Mechanics and Anatomy of the Human Ear
7. Architectural Acoustics and Noise Control
8. Electronic Instruments and Signal Processing
9. Psychoacoustics
10. Mathematical Music Theory

Course Requirements

Homework: Students are expected to complete weekly collected homework problems designed to emphasize and/or expand on certain aspects of topics discussed in lecture. These problems will be assigned each Monday, and will be due the following Monday. In order to fully digest the information covered, it is recommended that you complete these problems in a timely manner. Late problems will be accepted but will be subject to a 5% penalty for each day that they are late. After 5 days, the penalty will not exceed 25% and a problem can be turned in up to the last day of class.

Tests: Two take-home tests will be delivered during the course: one near midterm, and the other near the end of the semester. Each test is to be submitted up to *two* class meetings after it is handed out. Late tests will incur a 10% penalty for each day that they are late.

Presentations: Students will give two 10-12 minute presentations near the middle of each half of the semester. These presentations are intended to help us gauge the interests of the students, and thus will allow some freedom on the topics presented on. A rubric will be provided when each presentation is assigned.

Grading

Your grade will be determined according to the following scheme:

Homework	30%
Presentation 1	15%
Test 1	20%
Presentation 2	15%
Test 2	20%

The screenshot shows the WolframAlpha interface. At the top, the WolframAlpha logo is displayed with the tagline "computational knowledge engine". Below the logo is a search bar containing the expression "30+15+20+15+20". To the right of the search bar are icons for a star and a menu. Below the search bar are several utility icons: a keyboard, a camera, a list, and a refresh icon. To the right of these icons are three menu items: "Web Apps", "Examples", and "Random". The main content area is divided into several sections: "Input:" showing "30 + 15 + 20 + 15 + 20" with an "Open code" link; "Result:" showing "100" with a "Step-by-step solution" button; "Number name:" showing "one hundred" with a refresh icon; and "Number line:" showing a number line from 0 to 100 with five arcs representing the addition of 30, 15, 20, 15, and 20. At the bottom of the interface, there is a "Download page" link and the text "POWERED BY THE WOLFRAM LANGUAGE".

Whew! It checks out.

Your final grade will be determined as follows, where the percentage shown is the minimum allowed to receive the corresponding letter grade:

A	B	C	D	F
90%	80%	70%	60%	0

Absences

Attendance will not be taken, but it is expected that you attend every class, and we hope the course will be interesting enough that you won't want to miss it!