For information about the labs please see:http://www.physics.sc.edu/~kunchur/p155lab.htm

Welcome to Musical Acoustics: Physics 155, Spring 2012

Tentative course schedule and syllabus

Lectures:	Tue and Thu. 2:00pm – 3:15pm, PSC Bldg. room 006
Professor:	M. N. Kunchur, Office: PSC 303
	Phone: 777 1907, Email: kunchur@sc.edu
	Homepage: http://www.physics.sc.edu/~kunchur (has info. on acoustics research)
Office hours:	You may drop by at anytime on Tue. or Thu. or call/email to make an appointment.
Course website:	http://wind.physics.sc.edu/p155 Backup server http://frost.physics.sc.edu/p155

Course objectives and scope:

This course will address the "how and why" aspects of sound and music. It is intended to be a journey from the starting point where a sound is produced (vibrating bodies), through its reception and enjoyment in the mind. You will gain a basic understanding of the physical principles that underlie vibrating bodies and the behavior of the resulting sound waves they produce, through how our ear and brain work together to give us the deeply moving emotional experience of music. As a "science course for non-science majors", it covers biology, neuroscience, audio engineering, and other interdisciplinary topics -- in other words its is a "science course" and not just a "physics course". I understand that most of you are not majors in science or engineering, so some of the technical concepts will be new to you. As far as possible all ideas will be built up from scratch without assumptions -- always let me know if you are lost and need extra clarification.

Tentative list of topics to be covered:

Overview of sound, hearing, and the elements of music (first lecture)
Fundamental concepts of physics – physical quantities, fields, vectors/scalars, basic laws and equations of physics
Physics of vibrating bodies – harmonic oscillators, Hooke's law, resonance
Physics of waves – phenomenology of waves, interference, dispersion, diffraction, refraction, standing waves and frequency spectra, beats, Fourier analysis
Sensation of sound and the biology of hearing – power levels, structure and function of components in ear, causes of hearing loss, properties of sound and parameters of sound sensation, sound localization, etc.
Neurophysiology of hearing and musical perception – functional breakdown and neural processing in the different components of the brain from the cochlear nucleus and olivary complex to the colliculi.
Precedence effect and reverberation and their roles in sound localization and sonic memory extension.
Tones and their roles in evolution and survival, complex tones and Fourier theory, Ohm's law, etc.
Psychology – timbre perception, chorus effect, neural fatigue, pitch detection and perception, categorization, natural basis for consonance and musical scales, search for order and patterns, temporal predictability, relation modeling, response to changes, etc.
Musical scales and their basis – Pythagorean, tempered, diatonic, chromatic, and mean-tone scales. Scales in other cultures.
Dimensions of music – melodies, harmony, rhythm, etc. Basic rules of melodic contour (Gestalt laws). Information processing through "chunking", themes, neurology and melodies, etc.
Acoustic environment – architectural acoustics and the science of reverberation, Sabine equation. Basic parameters, design and modification of spaces using different types of absorbers and treatments. Active methods of noise reduction and room treatment (e.g., phantom acoustic shadows). Diffusion through reflection-phase gratings (quadratic-residue and primitive-root diffusers). Helmholtz resonators. Room dimensions.
Fundamentals of electricity and magnetism and electrical circuits – current and voltage, Faraday effect, oscillators, capacitors, filters, crossovers, feedback and cancellation, etc.

Equipment used for recording music – microphones and preamplifiers, analog (tape and records) and digital formats for recording.
Home playback and reproduction of music – general categorization of mass-Fi, mid-Fi and HiFi qualities and philosophies. Sources (tape, record, CD, DVD-audio, SACD, etc.), preamplifiers (tubes and solid-state, chips vs discrete), amplifiers, speakers (dynamic, electrostatic, planar magnetic, etc.). Room choice and placement of components. Wiring and interfacing (concept of impedance mismatch and mechanical and dielectric degradation).
Working of some acoustical and electronic musical instruments – electric guitar and its effects, etc.

Learning outcomes:

1. Understand how a harmonic oscillator works and the concepts of resonance and formants.
2. Understand the concepts and interrelationships between wavelength, frequency, and speed of a wave.
3. Understand the origin of harmonics in string and wind instruments.
4. Understand the concepts of loudness, intensity levels and decibels.
5. Understand some basics of the neurophysiology of the hearing process and the causes of (and protection against) hearing loss.
6. Understand tones and the basis of musical scales.

Text (completely optional): *The Acoustical Foundations of Music* by John Backus, Second Edition, W. W. Norton, ISBN: 0-393-09096-5.

A certain fraction of the material will be from outside the book -- so what you learn in the lectures is what matters. Don't miss any classes! If you do, obtain notes from a classmate asap and come and see me if you are still lost. Tests will be based on whatever is covered in class. Ask lots of questions and make sure your understanding and absorption of the material is complete before you leave the classroom. This will make it easier and save you time later. Remember that no questions are too naive and don't worry about slowing down the class--that's not your worry!

PDF files of the classroom presentations will be posted on the web. However, these notes are outlines that will make most sense if you've heard the related lecture. The server/s or network can be inaccessible sometimes, so it is your responsibility to download or print the notes and to save a copy for your later use.

Additional reading:
Contemporary College Physics by Jones and Childers (WCB/McGraw-Hill ISBN 0-8151-4328-1)
Science of Sound by Thomas D. Rossing Richard F. Moore, Paul A. Wheeler
An Introduction to the Psychology of Hearing by Brian C. J. Moore (Academic Press ISBN 0-12-505628-1)
Integrative Functions in the Mammalian Auditory Pathway by D. Oertel, R. R. Fay, and A. N. Popper (Springer ISBN 0-387-98903-X)
The Art of Electronics by Horowitz and Hill (Cambridge Univ. Press)
Good Sound by Laura Dearborn (Quill ISBN 0-688-06424-8)
The Complete Guide to High-End Audio by Robert Harley and Keith Jarrett

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Grades will be based on 4 tests (the last one is the “final exam”) each of which has an equal weight of 25%. There is a 2% bonus for participation in classroom discussions. There is a 1% bonus for the timely (within 1 week) return of the completed questionnaire. There is a 1% bonus for attendance. And there is a 4% bonus for pop quizzes given in class from time to time to obtain a spot check of your understanding. Makeup exams are given only for genuine medical emergencies or other extreme circumstances which must be documented and brought to my attention immediately.

The tests are closed book and only a pen/pencil is allowed. No calculators or other electronic devices (PDA’s , cell phones, etc.) are allowed**.** The questions on the tests are mostly of the short-answer type but are not open-ended (such as "what is your philosophy of life?") . Cell phones must be switched off during all classes.

The following grades boundaries will serve as a guide (I may adjust these if the overall curve is much lower):

0 ≤ F < 50 ≤ D < 56 ≤ D+ < 63 ≤ C < 70 ≤ C+ < 76 ≤ B < 83 ≤ B+ < 90 ≤ A ≤100

Dates for the tests and final (These are tentative. Please check the course web site for the latest information.):

Test 1	Thursday February 2, 2012	2-3:15pm
Test 2	Thursday March 1, 2012	2-3:15pm
Test 3	Thursday March 29, 2012	2-3:15pm
Final exam	Wednesday May 2, 2012	9-noon

~ GOOD LUCK ~