**Department:** Communication Sciences

**Course No:** CDIS 155Q

**Title**: Applied Sound Science

**Credits**: 3

**Contact**: Peter M. Scheifele

**WQ:**Q

**Catalog Copy**: -COMS 1XX Q: Applied Sound Science for Bioacoustics Second semester. 3 credits. Two class periods. Recommended preparation: MATH 109 or the equivalent. This course emphasizes the fundamentals of physical acoustics but specifically oriented to speech and audiology including frequency, intensity, decibels, critical bands, filters, masking, noise and vibration. Includes introduction to specific acoustic instrumentation and software used in communication sciences (disorders), animal science, biology and ecology.

**Course Information:**

-a ) A good understanding of the fundamentals of sound and acoustics is paramount for those working in the communications sciences be it as a clinician or researcher, the biological sciences and in architecture. This is especially important with the advent of the new AUD degree. This includes basic physics of sound, mathematics involved in acoustics, characteristics of sound, acoustical measurement, the acoustical environment, noise and practical applications. The course is intended to relate theory in a practical way (dimensions of measurement, terminology, knowledge of waves and wave equations as they apply to acoustics and characteristics of sound). Mathematical calculations and equations will be those that are most fundamental and necessary to understand sound science. This course is specifically designed for students who are non - engineers but who will be using acoustics as pat of their major.

b) Course Requirements: The format is standard with 2 in-class and a final examination, weekly homework assignments and topical area quizzes, reading and practical assignments. MOst problems on homework, quizzes and exams are quantitative and require mathematical calculation and solution. MOst problems require at least algebra and/or analytical geometry to obtain a solution.

c) Major Themes, Issues, Topics, etc.:

1. Introduction: What is Sound

Short history of sound and sound measurement Characterization of sound Vibrations Plane waves The concept of resonance Wave propagation

2. Mathematical Bases of Sound

Acoustic waves

Amplitude and frequency

Wave derivation from a unit circle

Wave characteristics including amplitude, frequency, period and wavelength Overview of the wave equations

3. Environmental Media and Intensity I

Acoustic waves in air and water media and their relationship to sound propagation Acoustic impedance and speed of sound Acoustic intensity, acoustic energy density and power, intensity measurement and units of measurement Root mean square ( rms ) values Sound pressure including: the decibel, calculations of the decibel (basic logarithms) and relationship of dB to values of intensity (W/m2) Conversions from dynes, reference pressures and SPL Proper use and reporting of sound pressure and intensity Spreading and attenuation of sound in relation to intensity

4. Frequency and Wavelength I

Concept of frequency, relationship of frequency to wavelength Fundamental frequency, harmonics and phase Units of measurement and correct way to report frequency Frequency bands and bandwidth, octaves, 1/3-octave bands, and frequency versus pitch

5. Noise and Reverberation

Noise- different types of noise with emphasis on Gaussian white noise Electronic and environmental noise Signal-to-noise ration (SNR) and the implications of SNR on acoustical measurements Reverberation and the concepts of noise limited and reverberation- limited environments

6. Sound Graphics: Representing Sound for Measurement and Analysis

Representations of sound that are routinely used in acoustical analysis and measurement. Familiarization with some basic hardware for sound measurement such as the sound level meter, oscilloscope and the spectrum analyzer Specific representations of sound including power spectra, waveforms and spectrograms

7. Acoustical Analysis Tools

Filters and filtering

Fourier transforms

Sampling and sampling rate

Weighting windows

## Q Criteria:

-1. Acquire intellectual breadth and versatility.

An understanding of the basic physics and mathematics of acoustics is critical for anyone working in the speech and audiology fields however; the field of acoustics is extremely broad and is divided into highly specialized areas. By introducing students to scientific analysis and scientific methodologies intellectual breadth will be increased. This course gives breadth of physics and mathematics to specific real-world applications in current vocational fields of speech, hearing and bioacoustical sciences.

2. Acquire critical judgment.

Relating life sciences to physics and mathematics in a quantitative, practical way will help students critically assess science and technology in both a qualitative and quantitative sense and discern the difference between the two.

3. Acquire consciousness of the diversity of human culture and experience.

Understanding the fundamentals of acoustics that give us speech and hearing or that yield animal vocalization and hearing in nature spans all cultures and makes us aware that these senses are necessary and utilized across all cultures and species.

4. Acquire a working understanding of the processes by which they can continue to acquire knowledge.

Scientific methodologies and investigation is a highly successful and primarily used technique for gaining knowledge and applying it to solve issues of society. This is reinforced in a most practical way in the speeh , hearing and bioacoustic sciences.

5. Includes mathematics and/or statistics at or above the basic algebra level as an

integral part of the course, which is used throughout the course.

(90 percent of all homework, quiz and examination problems will require numerical answers. The degree of the computations will vary throughout the course from arithmetic, logarithms and analytical geometry and trigonometry (waves) to simple calculus (wave equations).

6. Includes use of basic algebraic concepts such as formulas and functions, linear and quadratic equations and their graphs, systems of equations, polynomials, fractional expressions, exponents, powers and roots, problem-solving and word problems.

The course is dependent upon the use of sets of equations used in speech, hearing, room acoustics and bioacoustics. Conversions are paramount and degree of accuracy that may affect a

human or animal during testing is also paramount. Solutions to wave equations, calculation of intensity and decibels are a critical part of the course as is the use of root-mean-square and the Fourier Transform in the decomposition of waves.

6. Requires the student to understand and carry out actual mathematical and/or statistical

manipulations , and relate them to whatever data might be provided in order to draw conclusions.

The solutions that these students will arrive at must be accurate and they will learn to check them carefully since they directly relate to humans and animal audition, room acoustics and vocalization research.

**Role of Grad Students**: -Graduate students in these fields may assist as teaching assistants and tutors. They will be directly supervised by the course instructor.