**ME413/513 Engineering Acoustics**

**(3 credits)**

## General Information

Instructor: Mike Anderson
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Course Time: MWF 12:30PM-1:20 PM
Course Location: JEB 021
Office Hours: To be determined
Course Web Page: http://calvin.engr.uidaho.edu/~anderson/me413Spr07.htm
Text: *Fundamentals of Acoustics*, Lawrence E. Kinsler, Austin R. Frey, Alan B. Coppens, James V. Sanders, Fourth Edition, John Wiley and Sons, 2000.
Computer Usage: Matlab will be used extensively in the course. Matlab is available in UI PC Laboratories, and individual copies can be purchased at an academic price from the UI bookstore.

## Topics, You Will Learn...

- How to use impedances to model electrical and mechanical systems;
- How to use impedances to compute power dissipation in electrical and mechanical models;
- How to model electromagnetic loudspeaker drivers
- How to design simple passive filters,
- About the physical quantities that describe the propagation of acoustic waves in fluids, density, velocity, temperature and pressure;
- About the physical basis for the derivation of the wave equation used to model propagation of acoustic waves in fluids;
- About the fundamental solution of the wave equation, D'Almberts solution, that shows how acoustic waves propagate at the speed of sound;
- How to estimate the effect of ambient conditions on the speed of sound in gasses;
- How to specify constant frequency acoustic waves, and to interpret concept of wavelength;
- How to use the most common steady state models for sound propagation, plane and spherical waves;
- About the scientific measures of acoustics, intensity and Sound Pressure Level (SPL in decibels).

- How to use a microphone to make acoustic measurements, microphone interaction with the sound field, calibration charts, pressure and free field sensitivites, free field correction factor;
- How to decompose an acoustic signal into frequency components with the Fast Fourier Transform (FFT);
- How to apply a weighting scale (such as the A scale), to an acoustic signal;
- How acoustic waves are propagated across a boundary between two substances;
- How acoustic waves are propagated through a layer;
- How to design acoustic layers to block or enhance acoustic energy transport from one substance to another;
- How acoustic waves are used to perform NonDestructive Testing (NDT); A, B and C scans.
- About the physics of the simplest acoustic source, the monopole;
- How and when to model "complex" sources as simple monopoles;
- Physics and modeling of dipole sources;
- About the physics of the most common acoustic source, the plane piston radiator (used to model acoustic transducers), on axis response, far field distance, beam pattern in the far field;
- How to incorporate the plane piston model into acousto/mechanical/electrical models of transducers;
- How to use the plane piston model to compute the acoustic power output of transducers;
- How and when to apply the lumped parameter Helmholtz resonator model to acoustic systems for evaluation and design;
- Properties of the Helmholtz resonator model, frequency response, resonance frequency and Q;
- How to model an electromagnetic acoustic driver (e.g., a loudspeaker, this is the same model as for a servomotor or electromagnetic shaker);
- How to model and design a sealed cabinet loudspeaker.

**Homework, Exams, and Design Project**

<u>Exams:</u> There will be three exams, and a final

<u>Homework:</u> Homework assignments will be given during the course.

<u>Design Project:</u> A design project will be required. Students taking ME513 will be required to complete a design project of higher sophistication that those required of ME413 students.

**Grading**

| *Item* | *Grade Percentage* |
|---|---|
| Exams | 20% each |
| Design Problem | 10% |
| Final Exam | 30% |