THE OHIO STATE UNIVERSITY
Department of Mechanical and Aerospace Engineering
ME 5194

ENGINEERING ACOUSTICS

Autumn 2017, Class 36001/36000
Course Syllabus

Lecture Meeting Times: Tuesday/Thursday 12:45pm - 2:05pm. Scott Lab E141

Instructor: Prof. Ryan L. Harne. Office: E540 Scott Lab. Email: harne.3@osu.edu

Office Hours: Scott E540, Thurs 10:30am - 11:30am, Fri 11:30am - 12:30pm or by email appointment

Prerequisites: ME 3260, or graduate standing, or instructor approval

Disability Information: Any student who feels s/he may need an accommodation based on the impact of a disability should contact the Instructor privately to discuss their specific needs. The Instructor will communicate with the Office for Disability Services (150 Pomerene Hall) to coordinate reasonable accommodations for students with documented disabilities.

Conduct: Students are expected to maintain professional and open-minded conduct throughout the course. All suspected cases of academic misconduct will be reported to the OSU Committee on Academic Misconduct. Information on academic misconduct is posted at http://oaa.osu.edu/coam.html

Objectives: The objectives of this course are to
1. Introduce fundamental concepts of acoustical system analysis and design
2. Understand linear wave propagation phenomena, including radiation, absorption, and transmission of sound from and through simple structures/materials and in enclosures/rooms, and learn about human perception of these wave propagation behaviors
3. Acquire essential knowledge and skills to participate in fundamental practices of engineering noise control, architectural acoustics, and acoustic transducer development
4. Explore introductory aspects of diverse acoustics applications, ranging from those of the arts, the life sciences, the earth sciences, and throughout engineering

Course Description:
Acoustics applications survey. Wave propagation phenomena. Introduction to human hearing. Mathematics review. Acoustic wave equation, propagation, and metrics. Instrumentation for and evaluation of acoustic measurements. Understanding acoustic sources and sound radiation characteristics. Introductory architectural acoustics, engineering noise control, and psychoacoustics.

Course Notes:
Course Notes will be posted on the Carmen course website. The Course Notes will be a valuable resource for study and review. The Course Notes should be considered to be an alternative to a required Textbook.

Useful References:
L.E. Kinsler, A.R. Frey, A.B. Coppens, J.V. Sanders, *Fundamentals of Acoustics*, 4th Edition, Wiley, 1999.
H.W. Lord, W.S. Gatley, H.A. Evensen, *Noise Control for Engineers*, McGraw-Hill, 1980.
D. Russell, "Acoustics and Vibration Animations", http://www.acs.psu.edu/drussell/Demos.html
Brüel & Kjær, "Primers and Handbooks", http://www.bksv.com/Library/Primers

Course Website: There will be a Carmen website for this course. On the website, Homework assignments, Course Notes, resource materials, occasional video lectures, and grades will be posted. Students are responsible for regularly checking the Carmen website for such material.

Homework: There will be between 6 and 8 Homework assignments and/or in-class HW quizzes subject to following guidelines. Deviations from the guidelines will result in points deductions. **Guidelines**:

- Homeworks are individual efforts unless otherwise noted
- Although homework may be prepared using a word processing software, the homework submissions must be submitted in paper form and must be stapled in the top left corner
- All Homework submissions must include (i) page numbering and (ii) a header on the top of every page that includes the following information: Name, name.#, Homework # (where the red text indicates the appropriate substitution)
- Word processed (i.e. from Microsoft Word) or legible, hand-written assignments are acceptable
- Show your work and indicate solutions by enclosing, **emphasizing**, or underlining the solutions
- All plots must be generated in MATLAB and include MATLAB code used to generate results
- Label all curves and axes on plots or sketches
- Late submissions will not be accepted without a valid reason.

Software and Computing: MATLAB will be used in lectures and will be necessary for many of the Homework assignments. MATLAB is available in the MAE Department. A calculator, such as the Texas Instruments TI-36X or the Texas Instruments TI-84, is permitted for use during the Midterm and Final Exam. Students are expected to acquire an approved calculator in order to complete these in-class evaluations. Cell phones are not approved for use during in-class evaluations.

Grading Policy:
Students will be graded using the following evaluations that will be developed from course material presented in lectures, in the Textbook, from the Course Notes, on the course website, and from Homework and Reading assignment material. While the OSU Standard Grade Scheme will be used, the Instructor reserves the right to make appropriate grade adjustments according to class/student performance.

(40%) Midterm Exams

(35%) Homework

(25%) Final Exam

TENTATIVE COURSE TIMETABLE

Date			Topics	HW/Quiz Due
Aug	22	Tue	Course introduction. Acoustics introduction and applications survey. Fundamental wave propagation phenomena.	
	24	Thu	Fundamental wave propagation phenomena. Introduction to human hearing	
	29	Tue	Introduction to human hearing. Effects of noise on hearing	
	31	Thu	Mathematics review. Vibrations. Analysis by complex functions. Frequency response.	Quiz
Sep	05	Tue	Transfer functions. Mechanical impedance. Combining harmonic oscillations. Root mean square	
	07	Thu	One-dimensional wave equation. General solution. Phase speed. Harmonic waves	
	12	Tue	Acoustic wave equation derivation.	HW1
	14	Thu	Acoustic wave equation. Sound speed	
	19	Tue	Harmonic plane waves. Impedance. Intensity	HW2
	21	Thu	Spherical waves. Sound power. Comparison of wave types.	
	26	Tue	Decibels, sound pressure level. Combining SPL	
	28	Thu	Elementary acoustic sources. Monopoles, point sources. Multiple point sources. Directivity. Source characteristics.	HW3
Oct	03	Tue	Midterm 1	
	05	Thu	Dipoles. Method of images	
	10	Tue	Measuring sound power. Outdoor sound propagation	HW4
	12	Thu	Autumn Break	
	17	Tue	Barriers. Environmental sound attenuation. Examples in community acoustics	Quiz
	19	Thu	Acoustic instrumentation, measurement. Microphones. Sound level meters. Selection of transducer	
	24	Tue	Frequency bands. Weighting networks. Sound measurement techniques	HW5
	26	Thu	Room acoustics. Transient sound field. Room sound absorption	
	31	Tue	Midterm 2	
Nov	02	Thu	Direct and reverberant fields. Sound transmission through partitions	
	07	Tue	Sound transmission loss. Examples in room sound isolation	
	09	Thu	Sound transmission through panels	
	14	Tue	Architectural and building acoustics	HW6
	16	Thu	GUEST LECTURE: Kevin Herreman, Owens Corning Science & Technology, Acoustics Labs	
	21	Tue	Architectural and building acoustics. Noise exposure and ordinances	
	23	Thu	Thanksgiving Break	
	28	Tue	Noise exposure and ordinances	HW7
	30	Thu	Psychoacoustics. Binaural hearing. Speech intelligibility. Sound perception and recognition phenomena	Quiz

Dec	05	Tue	Last class. Review	
Dec	12	Tue	Final Exam. Cumulative with emphasis on last third of course	