ME 4520 Acoustics & Noise Control Fall 2023

Instructor

Richard J Ruhala, PhD
E-mail: rruhala@kennesaw.edu
Office Phone: 470-578-2748
Cell Phone: 812-589-2983
(personal -text or call if needed)
Office Location: Online (Home -Fall 2020)
Office Hours: M 11am—3pm, Tu 3-4pm, W 1—3pm
http://facultyweb.kennesaw.edu/rruhala/index.php

Course Description

Catalog Description (Credit Hours: 3)

This course provides an introduction to acoustics with an emphasis on the engineering application of noise control. Students will learn the acoustic wave equation and apply it to spherical and plan wave sources; including the reflection, absorption, and transmission of sound waves through barriers, as well as reverberation and HVAC noise standards within indoor spaces. Applications of acoustics to noise control are evaluated.

Prerequisites

- ENGR 3125: Machine Dynamics & Vibrations
- MATH 2306: Ordinary Differential Equations

If you do not meet the prerequisite requirements, you are expected to withdraw from this course. If it is discovered that a student is lacking in prerequisites (at any time during the semester), the instructor reserves the right to remove the student from the class and assign a grade of W (or WF if past the drop date).

Course Details

Term: Fall 2023
Course name: Acoustics & Noise Control
Course number: ME 4520
Section number: 01
Meeting times: Monday and Wednesday, 11am – 12:15pm
Room number: G205

Learning Outcomes

By the end of this course, students should be able to:

1. Understand the relationship among, and the conversion of sound pressure from pascals to decibels, sound intensity from watts/m2 to decibels, and sound power from watts to decibels.
2. Calculate the intensity of the incident, reflected, and transmitted plane wave on a boundary.
3. Determine the effect the doubling of sound power has on the sound pressure level, and the same for the

doubling of sound pressure and the perceived doubling of loudness.

4. Understand the relationship between of the acoustic wavelength and the frequency.
5. Calculate the sound reduction through a wall across the 3 main frequency regions.
6. Determine how tall a highway noise barrier needs to be to obtain the desired decibel reduction for a specific frequency range.
7. Determine the reverberation time in a room, and compare to recommended standards.

Textbook

Barron, Randal F., Industrial Noise Control, 1st Edition, CRC Press, 2002. (ISBN 9780824707019)

Alternatively, there is also a less expensive digital version (ISBN 9781135551681)

Important Dates

First day of class:	Classes begin on Monday, August 14
Add/drop Period:	Monday August 14 – Friday, August 18
Last day to withdraw:	Thursday, October 10
Last day of classes:	Monday, December 4
Final Exams:	Final Exam period is TBD. This time slot may be set aside for project presentations if no final exam.

Course Delivery

KSU may shift the method of course delivery at any time during the semester in compliance with University System of Georgia health and safety guidelines. In this case, alternate teaching modalities that may be adopted include hyflex, hybrid, synchronous online, or asynchronous online instruction.

Face Coverings

Based on guidance from the University System of Georgia (USG), all vaccinated and unvaccinated individuals are encouraged to wear a face covering while inside campus facilities. Unvaccinated individuals are also strongly encouraged to continue to socially distance while inside campus facilities, when possible.

Technical Requirements

Access to D2L is essential for the course material and instructions.

PC, Mac, or laptop required with a Web Camera if the campus switches to remote learning mode.

Grading Policy

Exams	50%
Project	25%
Homework and Quizzes	25%
Total	**100%**

Grade Conversion: A: (90-100), B: (80-89), C: (70-79), D: (60-69), F: (0-59)

Course Expectations

Attendance Policy

Students are expected to attend all classes for their full length.

Course Communication

Course material will be disseminated in D2L including lecture notes, homework solutions, etc. All official course announcements, including instructions when class may be cancelled, will be posted in the D2L course news. Be sure to check D2L regularly.

Course Outline with Topics

This is the course outline, but does **not** correlate to specific dates of topics covered, exams, and assignments due. For that please see the D2L page often and check your email for updates. Note that the Instructor may update the schedule anytime. See *Assignments* and Announcements on D2L for specific homework problems that may be collected for grading and their due dates.

Week #	Date	Description
1		1st class. Syllabus. Course introduction. Ruhala background. Chapter 1 and start Chapter 2. • "The Sound of Silence" • RESEARCH Presentation – Acoustics of Face Coverings • Some Acoustic definitions and equations • Wheel of Acoustics • Principles of noise control • Sec 2.7: Conversion of acoustic pressure: Pa to dB, bel vs decibel (dB) • Human hearing effects: A and C frequency weighting, dBA
2		Chapter 2 + • acoustic wave equation derivation • speed of sound waves in air, water, solids Some acoustic simulations
3		More on Chapter 2 + • acoustic pressure, particle velocity, intensity, and power • energy density • dB levels for intensity, power
4		More on Chapter 2 & Chapter 4 • Plane waves • Spherical Waves • Monopole, dipole, and other acoustic sources • Directivity factor and index
5		• Combining sound sources • Octave bands (frequency scale) and narrow bands ○ Summing octave bands to get total level and CFA to get dB(A) REVIEW HW for Exam 1

6		**Exam 1** Sound transmission – normal incident (chapter 4) Reflection, and Transmission, and Transmission loss
7		Sound transmission – oblique incident (chapter 4) Critical frequency Sound transmission through a homogenous wall (intro)
8		Sound transmission through walls – random incident • Detailed calculation of TL vs f Simplified calculation of TL vs f (octave bands)
9		Sound transmission through walls – continue • Composite walls • STC = Sound transmission loss • Sound absorption and vibration damping
10		**Project introduction** Acoustic measurements (chapter3) Sound level meter measurements in classroom • A and C weighting options • Fast or slow settings • FFT (Fast Fourier Transform) & frequency scales Measuring the Frequency Response of speakers in classroom
11		Sound intensity and measurement methods Room acoustics introduction (chapter 7) Reverberation Time and Sound Absorption in rooms Open office/classroom acoustical challenges
12		**Exam 2** Room acoustics introduction (chapter 7) Reverberation Time and Sound Absorption in rooms Open office/classroom acoustical challenges
13		**Project Selection** Sound level in a room due to reverberant sound field plus direct sound field - calculations Sound Barriers – highway application, etc. N = Fresnel #, a_b = barrier coefficient Lp at receiver with and without barrier Absorption vs reflection barriers
14		Acoustic Criteria (chapter 6) • Human hearing – mechanics and loudness scales • Indoor background noise • Speech intelligibility • Environmental noise (outdoors rec levels)
15		Muffler silencers in automobiles • Expansion chambers – reflective • Helmholtz resonator and ¼ wave tubes • Absorptive mufflers

		• Transmission loss vs Insertion loss of silencers
16	Final time period	Individual or team presentations

KSU Academic Integrity Statement

Every KSU student is responsible for upholding the provisions of the Student Code of Conduct, as published in the Undergraduate and Graduate Catalogs. Section 5c of the Student Code of Conduct addresses the university's policy on academic honesty, including provisions regarding plagiarism and cheating, unauthorized access to university materials, misrepresentation/falsification of university records or academic work, malicious removal, retention, or destruction of library materials, malicious/intentional misuse of computer facilities and/or services, and misuse of student identification cards. Incidents of alleged academic misconduct will be handled through the established procedures of the Department of Student Conduct and Academic Integrity (SCAI), which includes either an "informal" resolution by a faculty member, resulting in a grade adjustment, or a formal hearing procedure, which may subject a student to the Code of Conduct's minimum one semester suspension requirement.

Help Resources

Contacts to get Help

Student Help Desk: email studenthelpdesk@kennesaw.edu or call 470.578.3555 or go to this webpage for the KSU Service Desk Portal or go to: https://uits.kennesaw.edu/

All Federal, BOR and KSU Student Policies
https://cia.kennesaw.edu/instructional-resources/syllabus-policy.php

KSU Student Resources
https://cia.kennesaw.edu/instructional-resources/syllabus-resources.php

KSU Coronavirus (COVID-19) Information and Recourses
https://coronavirus.kennesaw.edu/

Basic Needs Security Statement
Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live and believes this may affect their performance in the course, is urged to contact CARE Services (care.kennesaw.edu). The Campus Awareness, Resource and Empowerment (CARE) Services offers support to students who have experienced

homelessness, food insecurity and/or the foster care system. Contact them at 470-578-5260 or careservices@kennesaw.edu for help.