ME249 Jan. 3.0

Fundamentals of acoustics

Instructor

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Department: Mechanical Engineering

Course Time: Tue., Thu., 10-11:30 AM

Lecture venue: small lecture room in mechanical engineering

Detailed Course Page: http://www.mecheng.iisc.ernet.in/~sonti/

Announcements

ME249: Fundamentals of acoustics. First lecture will be held on Tue. Jan 2nd in the small lecture room of mechanical engineering at 10:00am.

Brief description of the course

This course is a basic course on acoustics. This is meant for students who have a bachelors degree in engineering. The student should have some background in vibrations of mechanical systems. This is a completely theoretical course and mathematically challenging. Here we derive the partial differential equation for sound. Then derive its analytical solutions for some typical simple systems. We give an understanding of the physics of sound wave propagation in 1-D and 3-D space. We teach about the measures of sound such as sound pressure levels and also what decibels mean.

Prerequisites

None.

Syllabus

Fundamentals of vibration, vibrations of continuous systems (strings, rods, beams and membranes), acoustic wave equation, one dimensional wave equation and solutions. Kirchhoff Helmholtz Integral Equation (exterior and interior). Neumann and Dirichlet Green Functions. Exterior sound fields: Introduction to

spherical coordinates. Exterior sound fields of simple sources in spherical coordinates using KHIE. Scattering of a plane wave from a rigid sphere. KHIE to Rayleigh Integral. Piston in a baffle. Near field and far field, directivity of exterior sources. Interior sound fields: modeshapes and resonances of a rectangular box and a closed cylinder. Green function using modes. Interior response using the forced KHIE. Decibels, A-weighting, octave bands. The Sommerfeld radiation condition. Solution to the wave equation with initial and boundary conditions using Integral Transforms. Lumped parameter modeling of acoustic systems.

Course outcomes

1) The student will learn how to pose an engineering problem that involves sound propagation. This will be in the form of an integral equation that can be solved either analytically or numerically.

2) The student will understand the physics of sound propagation outdoors and in enclosed spaces.

3)The student will learn how to solve a hyperbolic pde with initial conditions and boundary conditions.

4) The student will get an exposure to Green Functions that are fundamental to pdes.

5) He will get exposed to deep concepts like, integral equations, Sommerfeld radiation condition, sound structure interaction.

Grading policy

1) 20% for assignments (4 in number)

2) 15% each for two mid term exams

3) 50 % for the written final exam

Assignments

Four assignments are given that progressively include concepts taught in the class. These are quite exhaustive so that each takes about 3 weeks to complete.

Resources

I follow my own notes developed over years. I recommend the following books as reference material:

1) L. E. Kinsler, A. R. Frey, A. B. Coppens and J. V. Sanders, Fundamentals of Acoustics, John Wiley, 1982.

2) Earl Williams, Fourier Acoustics.