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## INTRODUCTION TO ACOUSTICS — AME 60633

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### TOPICAL OUTLINE

This course gives an introduction to waves and acoustics with emphasis on sound propagation, radiation, transmission, and scattering and application to fluid structure interaction.

#### **Wave Phenomena.**

- Fundamentals of Vibration.
- Linear Oscillators.
- Waves in Fluids.
- The Fundamental Wave Equation.
- Plane Waves, Spherical Waves.
- Waves in Bars, Strings, Membranes and Plates.
- Dispersive Waves.
- Phase and Group velocities.
- Energy of Waves.

#### **Acoustic Waves.**

- General Characteristics of Sound.
- The Linear Wave Equation.
- Waves in an Infinite Medium.
- Harmonic Acoustics Waves.
- Conservation Relations: Sound Intensity and Energy.
- Acoustic Impedance.
- Decibels Scales.

#### **Reflection and Transmission of Sound.**

- Boundary Conditions at Solid Surfaces.
- Reflection and Transmission at Interface Between Two Fluids.
- Normal Oblique Incidence.
- Reflection from the surface of a Solid.
- Method of Images.

#### **Radiation and Propagation of Sound.**

- Radiation from a Pulsating Sphere.
- Point Sources: Monopoles, Dipoles, Quadrupoles.

Green's Function.  
Acoustic Reciprocity.  
Radiation from a Plane Piston.  
Periodic Sources.  
Application to Propeller Noise.

### **Sound Waves in Ducts.**

Sound Propagation in Ducts.  
Higher Modes in Ducts – The cut-on Phenomena.  
Acoustic Energy.  
Standing Waves.  
Green's Function.

### **Scattering of Sound.**

Scattering from Hard and Soft Structures.  
The Sommerfeld Problem.  
Diffraction.  
Acoustics of Thin Plates.

### **Resonators and Filters.**

Guided Waves.  
Resonance in Pipes  
Lumped-Parameters Models.  
Helmholtz Resonator.  
Acoustic Filters and Mufflers.

### **Acoustics in Moving Media.**

Fundamental Equations.  
Plane Waves.  
Sound Propagation in Ducts.  
Sound from Moving Sources: Subsonic and Supersonic.

### **Fluid Structure Interaction**

Sound and Unsteady Aerodynamics.  
Sound Radiated from a Flat Plate in a Gust.  
Sound Radiated from a Bluff Body.  
Scattering of Sound by Shock Waves.  
Application to Fan Noise.

### **Aerodynamically Generated Sound**

Generation of Sound by Fluid Motion.  
Lighthill's Analogy.  
Application to Jet Noise.  
Application to Aircraft Noise.