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INTRODUCTION TO ACOUSTICS AND NOISE — AME 60633

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.