ANSYS Workbench Acoustics Analysis

Target Audience

This course is designed for mechanical engineers, acoustics specialists, and simulation professionals who want to develop practical skills in **acoustic modeling and analysis** using ANSYS Workbench. It is ideal for learners working in industries such as automotive, aerospace, HVAC, and product design where noise, vibration, and acoustic performance are critical.

Course Outcomes

By the end of this course, participants will be able to:

- Understand the fundamentals of engineering acoustics and wave propagation.
- Apply acoustic physics concepts including reflection, resonance, and damping.
- Navigate ANSYS Workbench for acoustic simulations and configure solver settings.
- Prepare CAD geometry and generate meshes for acoustic domains.
- Perform harmonic and modal acoustic analyses to evaluate sound pressure and resonance.
- Conduct vibro-acoustic simulations coupling structural and acoustic responses.
- Apply fluid–structure interaction (FSI) techniques for acoustic applications.
- Analyze duct and pipe acoustics including resonance and transmission loss.
- Implement engineering noise control strategies with materials and barriers.
- Execute industrial acoustic case studies and complete a capstone project.

Course Objectives

- Provide a structured foundation in engineering acoustics and ANSYS Workbench workflows.
- Train learners in geometry preparation, meshing, and boundary condition setup for acoustic domains.
- Develop proficiency in harmonic, modal, vibro-acoustic, and FSI analyses.
- Enable learners to evaluate duct acoustics and noise control strategies.
- Teach best practices for acoustic modeling, validation, and reporting.

- Reinforce learning through hands-on labs and a capstone project simulating industrial applications.

Course Outline

The course comprises **32 hours** of theory and labs and is divided into **11 different chapters**. Each chapter will be followed by hands-on lab exercises to reinforce learning and gauge understanding of the topics covered.

Table of Contents

Module 1: Fundamentals of Engineering Acoustics

- Introduction to Engineering Acoustics
- Fundamentals of Sound and Wave Propagation
- Acoustic Quantities and Measurement Parameters
- Sound Pressure Level and Decibel Scale
- Frequency Analysis and Octave Bands
- Human Hearing and Noise Perception
- Engineering Applications of Acoustics
- *Hands-on Lab:* Fundamentals of Sound Wave Visualization

Module 2: Acoustic Wave Physics

- Sound Wave Behaviour
- Reflection, Refraction, Diffraction and Interference
- Standing Waves and Resonance
- Acoustic Impedance and Damping
- Wave Equation and Helmholtz Equation
- Acoustic Boundary Conditions
- Fluid Domains and Acoustic Materials
- *Hands-on Lab:* Acoustic Cavity and Standing Wave Analysis

Module 3: Introduction to ANSYS Workbench Acoustics

- Overview of ANSYS Workbench
- Acoustic Simulation Workflow
- Project Schematic and Analysis Systems

- Geometry Import and Preparation
- Engineering Data and Material Definition
- Acoustic Boundary Conditions
- Solver Configuration and Result Visualization
- *Hands-on Lab:* Creating Your First Acoustic Simulation

Module 4: Geometry Preparation and Meshing for Acoustic Analysis

- Preparing CAD Models for Acoustic Simulation
- Fluid Volume Extraction and Acoustic Enclosures
- Acoustic Domain Creation
- Acoustic Element Types
- Mesh Generation Techniques
- Mesh Quality Assessment
- Mesh Independence Studies
- *Hands-on Lab:* Geometry Preparation and Acoustic Mesh Generation

Module 5: Harmonic Acoustic Analysis

- Fundamentals of Harmonic Acoustics
- Acoustic Excitation Sources
- Frequency Response Analysis
- Harmonic Loading and Boundary Conditions
- Sound Pressure Distribution
- Sound Pressure Level Evaluation
- Result Interpretation and Post-Processing
- *Hands-on Lab:* Harmonic Response Analysis of an Acoustic Cavity

Module 6: Modal Acoustic Analysis

- Fundamentals of Modal Acoustics
- Acoustic Eigenvalue Extraction
- Natural Frequencies and Mode Shapes
- Acoustic Resonance

- Modal Participation Factors
- Acoustic Mode Visualization
- *Hands-on Lab:* Modal Analysis of an Enclosed Acoustic Cavity

Module 7: Vibro-Acoustic Analysis

- Introduction to Vibro-Acoustics
- Structural and Acoustic Coupling
- Harmonic Structural Excitation
- Coupled Vibro-Acoustic Response
- Noise Radiation Mechanisms
- Vibro-Acoustic Result Interpretation
- *Hands-on Lab:* Coupled Structural–Acoustic Simulation

Module 8: Fluid–Structure Interaction (FSI) for Acoustic Applications

- Fundamentals of Acoustic Fluid–Structure Interaction
- Coupled Acoustic–Structural Analysis
- Flexible Structures and Acoustic Loading
- Pressure–Structure Interaction
- Coupled Solver Configuration
- Acoustic Response Evaluation
- *Hands-on Lab:* Acoustic FSI Analysis of a Flexible Enclosure

Module 9: Duct and Pipe Acoustics

- Fundamentals of Duct Acoustics
- Plane Wave Propagation
- Acoustic Resonance in Pipes
- Reflection and Transmission Loss
- Expansion Chamber Silencers
- Quarter-Wave Resonators
- Acoustic Performance Evaluation
- *Hands-on Lab:* Acoustic Analysis of Duct and Pipe Systems

Module 10: Engineering Noise Control

- Fundamentals of Noise Control Engineering
- Airborne and Structure-Borne Noise
- Acoustic Absorption Materials
- Vibration Isolation Techniques
- Acoustic Barriers and Liners
- Muffler Design Concepts
- Engineering Noise Reduction Strategies
- *Hands-on Lab:* Evaluation of Noise Control Techniques

Module 11: Industrial Acoustic Applications and Capstone Project

- Industrial Acoustic Modelling Best Practices
- Acoustic Performance Evaluation
- Acoustic Design Optimization
- Engineering Reporting and Documentation
- Industrial Case Studies
- *Capstone Project:* End-to-End Acoustic Analysis of an Engineering Assembly
    - Geometry Preparation
    - Acoustic Domain Creation
    - Material Assignment
    - Mesh Generation
    - Harmonic Acoustic Analysis
    - Modal Acoustic Analysis
    - Vibro-Acoustic Analysis
    - Fluid–Structure Interaction
    - Sound Pressure Level Evaluation
    - Design Optimization
    - Engineering Report Generation