BOOST
THE LEADING TRAINING PROVIDER

Maintenance & Reliability Management

# Advanced Vibration Analysis for Equipment Reliability

# Course Introduction

**Vibration Analysis for Equipment Reliability**

This advanced course is designed to equip participants with the skills and knowledge to solve complex vibration problems, including transient and forced vibrations, resonance, isolation, damping, advanced signal processing, and torsional vibration analysis. It provides a deep dive into advanced vibration analysis techniques such as two-channel analysis, modal analysis, operating deflection shape (ODS), synchronous time averaging, and torsional vibration analysis. The course also serves as partial preparation for the **ISO 18436-2:2014 Vibration Analyst Category IV Certification Exam**. Hands-on workshops and demonstrations are integrated throughout the course to reinforce theoretical concepts with practical applications.

This course builds on foundational vibration analysis knowledge and focuses on advanced data processing, machinery diagnostics, and integrating spectral, waveform, phase, and transient data for comprehensive problem-solving. Participants will gain expertise in advanced resonance detection, transient analysis during run-up/run-down, and the interpretation of machinery operating parameters.

# Target Audience

- Condition Monitoring Engineers
- Vibration Analysts and Specialists
- Rotating Equipment Engineers
- Maintenance and Reliability Engineers
- Mechanical and Electrical Engineers involved in machinery diagnostics
- Professionals preparing for the ISO 18436-2:2014 Vibration Analyst Category IV Certification

## Learning Objectives

- Develop advanced vibration analysis procedures and equipment databases.
- Create detailed and actionable vibration analysis reports.
- Integrate and analyze data from multiple sources, including spectrum, waveform, phase, transient, and trending data.
- Apply advanced signal processing techniques, including sampling rate optimization, windowing, averaging, and alarm limit settings.
- Diagnose complex machinery problems involving resonance, damping, and transient vibrations.
- Perform modal analysis, operating deflection shape (ODS) analysis, and torsional vibration analysis.
- Utilize dual-channel analysis techniques for transfer functions, coherence, and mode shapes.
- Interpret and apply advanced diagnostic tools such as Nyquist plots, Bodé plots, and Hilbert transforms.
- Conduct damping measurements and calculations using various methods.
- Understand and apply synchronous time averaging and transient analysis techniques.

## Course Outline

- **01 DAY ONE**

#### Module I: Signal Processing Fundamentals

- Introduction to the Fast Fourier Transform (FFT)
- Analog-to-Digital (A/D) Converters and Dynamic Range
- FFT Batch Processing and Buffer Fill Times
- Averaging Techniques and Overlap Processing

#### Module II: FFT Basics and Filters

- Key FFT Concepts: Aliasing, Windows, and Resolution
- Demonstrations of FFT Applications
- Filter Types and Their Applications in Vibration Analysis

- **02 DAY TWO**

**Module III: Advanced FFT Topics**

- Aliasing, Windows, and Resolution in Detail
- Side-lobe Areas and Window Accuracy (Rectangular, Hanning, Flat-top)
- Order Spectra and Correction of Amplitude/Frequency from Bin Location

**Module IV: Window Functions and Order Spectra**

- Time Domain Analysis of Digitized Signals
- Beats, AM/FM Modulation, and Suppressed Carrier Signals
- Enveloping Techniques and Case Histories

- **03 DAY THREE**

**Module V: Beats, Modulation, and Time Series Averaging**

- Frequency Synthesizers and Signal Averaging
- Synchronous Time Averaging for Bearing Defects and Modulation
- Digital Filters and FFT as a Brick Wall Filter
- Case Studies on Synchronous Time Averaging

**Module VI: Transient and Forced Harmonic Vibration**

- Dual-Channel Analysis Basics
- Transfer Functions, Coherence, and Mass/Spring Models
- Real and Imaginary Displays, Nyquist and Bodé Plots
- Introduction to the Hilbert Transform

- **04 DAY FOUR**

**Module VII: Dual-Channel Analysis and Damping Measurement**

- Half-Power Method, Real/Imaginary Plots, and Phase Shift Slope
- Log Decrement and dB Decay in Waterfall Data
- Demonstrations of Damping Measurement Techniques

**Module VIII: Modal Testing and Structural Measurements**

- Modal Testing: Natural Frequencies, Damping, and Mode Shapes
- Structural Measurements for Vertical Pumps, Machine Supports, and Floors
- Phase Leads, Turbine Blades, and Axial Resonance in Motors with Sleeve Bearings

- **05 DAY FIVE**

**Module IX: Advanced Signal Processing and Noise Analysis**

- RMS, Coherent, and Non-Coherent Signals
- Peak Detection and Vector Addition
- Filters and Signal-to-Noise Ratio (SNR)
- FFT Calculations and Signal/Noise Demonstrations

## Confirmed Sessions

| FROM | TO | DURATION | FEES | LOCATION |
|---|---|---|---|---|
| May 11, 2025 | May 15, 2025 | 5 days | 4250.00 $ | KSA - Riyadh |
| June 30, 2025 | July 4, 2025 | 5 days | 4250.00 $ | UAE - Dubai |
| Sept. 15, 2025 | Sept. 19, 2025 | 5 days | 4250.00 $ | UAE - Abu Dhabi |
| Sept. 15, 2025 | Sept. 19, 2025 | 5 days | 4250.00 $ | UAE - Dubai |
| Nov. 3, 2025 | Nov. 7, 2025 | 5 days | 5950.00 $ | USA - Los Angeles |
| Nov. 17, 2025 | Nov. 21, 2025 | 5 days | 4950.00 $ | Turkey - Istanbul |