PD231
Shock and Vibration Analysis

Day One

- Introduction
- Single-degree-of-freedom systems (SDOF)
  - Free Vibration: Natural frequencies and critical damping
  - Forced Vibration: Harmonic, transient, and impulse forces
  - Base excitations: response spectra
  - Dynamic amplification factors
  - Resonance
  - Equivalent Static Load
  - Torsional vibration: shafts, rotors, and gear trains
  - How to reduce vibration levels in SDOF
- Shock spectrum
  - How to develop shock spectra from force time histories
  - How to use shock spectra to compute dynamic response to shock loads
- Multiple-degrees-of-freedom systems (MDOF)
  - Natural frequencies and mode shapes
  - Direct Time-history response analysis
  - Modal Time-history response analysis
  - Shock spectrum method of response analysis
  - Comparison of Methods: Relative advantages, accuracy and suitability
  - How to reduce vibration levels in MDOF

Day Two

- Earthquakes and Other Base Excitations
  - Load specification
  - Time-History Analysis
  - Response Spectrum Analysis
  - Design Aspects
- Finite Element Analysis (FEA)
  - Basic concepts, assumptions and limitations
  - Guidelines to FE modeling (keys to successful analysis)
  - Example FE models and results
- Modal testing of equipment and structures
  - Definitions
  - Practical aspects
- Test-Analysis Correlation
  - Sources of errors in test results
  - Sources of errors in analysis
  - Test-analysis correlation of natural frequencies

- Fine-tuning analysis models using test-analysis correlations

- Shafts, disks, and rotors
  - Torsional vibrations (one, two or multiple rotors)

Day Three

- Vibration Absorbers (Tuned-Mass Dampers)
  - Basic Concepts
  - Analysis and design
  - Where used?
  - Advantages and disadvantages

- Vibration Isolation
  - Basic Concepts
  - Design
  - Where used?
  - Advantages and disadvantages

- Transportation of Sensitive Equipment
  - Forces during transportation (oscillatory, shock and drop forces)
  - Qualification by analysis

- Vibration of Rotating Equipment
  - Forces acting on rotating equipment
  - Response computation
  - Design to meet manufacturer or operator specifications

- Foundations for Rotating Equipment
  - Harmonic forces due to operation of rotating machines
  - Modeling foundation stiffness and damping
  - Design to avoid resonance and/or large displacements

- Flow-Induced Vibrations
  - Vibration mechanisms
  - Design against vortex shedding
  - Vortex suppressors

- Machinery Vibration Monitoring and Problem Diagnosis
  - Periodic and continuous vibration monitoring
  - Methods and equipment
  - “Symptoms” and diagnosis

- Worked-out Numerical Examples
  - 32, detailed, step-by-step, worked-out examples of analysis and design are presented in the various chapters

- Case Histories
  - Five case histories are presented to demonstrate how the various concepts and methods presented in the course are applied in complex vibration projects