

## **PD146**

### **Flow Induced Vibration with Applications to Failure Analysis**

#### **Day One**

- Introduction to Flow-Induced Vibration
- Dimensional analysis in fluid-structure interaction
  - Theoretical and experimental approaches to Flow-Induced Vibration analysis
  - Dimensional analysis and model scaling
  - Application to motions of a tall building in wind
- Natural Frequencies of Fluid and Structures
  - Single degree of freedom
  - Multi degree of freedom
  - Natural frequencies of Beams, plates and shells
- Forced Vibration
  - One degree of freedom spring-mass systems
  - Vibration of continuous structures:
    - Beams, plates, and shells
  - Damping and damper design
- Fluid Forces on Structures
  - Drag and added mass of structures in flow
  - Pressure and shear drag, drag coefficients, forces on cylinder in a wake
  - Added mass and coupling between structures in water and dense fluids

#### **Day Two**

- Vortices and Vortex Shedding from Stationary Structures
  - Strouhal numbers and the vortex street
  - Reynolds number effects
- Vortex Shedding from Vibrating Structures
  - Lock in and lift coefficients
  - Feedback and the motion induced changes in vortex shedding
- Prediction of Vortex-Induced Motion of Cylinder in a Flow
  - Coupled response
  - Application to stacks and off shore structures
- Reduction of Vortex-Induced Vibration in Air and Water
  - Design of strakes and dampers
- Galloping and Flutter
  - Lift and torsion on in inclined airfoils, and rectangular bodies
  - Divergence in a steady wind
  - Galloping an mixed mode phenomena
  - Application to bridge decks and vanes

### Day Three

- Heat Exchanger Tube Flow-Induced Vibration
  - Tube and shell heat exchanger design and fluid dynamics
  - Fluid Forces on clusters of tubes
  - Onset of instability and tube wear
  - Application to heat exchangers in chemical and nuclear power industry
- Aeroacoustics: Sound Generation by Flow
  - Free propagation
    - Ray acoustics, SPL, and dB
  - Traveling and stationary acoustic waves in ducts and cavities
  - Heat exchanger acoustic resonance
  - Flow excitation of cavities
- Vibration Due to Internal Flow
  - Sources of acoustic energy in ducts and piping systems
  - Transmission of sound and turbulence
  - Case histories of internal flow induced vibration
  - Reduction of sound in piping
  - Thermal-acoustic excitation and internal flow instability
- Turbulence-Induced Vibration and Buffeting
  - Application of random vibration theory to turbulence
    - Calculation of spectra and structural response
  - Models for turbulence in practical systems
  - Application to process and power plants and in aerospace