Course Title: Vibration Analysis Using Finite Element Analysis

Course Length: 6 days, online

Time in Class per day (hours): 2 hours

Class Size: Minimum 1 / Maximum 25

Price Per Student: $1,060.00

Location: Online only

Course Description:

Finite Element Analysis (FEA) has been used by engineers as a design tool in new product development since the early 1990's. Until recently, most FEA applications have been limited to static analysis due to the cost and complexity of advanced types of analyses. Progress in the commercial FEA software and in computing hardware has now made it practical to use advanced types as an everyday design tool of design engineers. In addition, competitive pressures and quality requirements demand a more in-depth understanding of product behavior under real life loading conditions. This course will enable participants to expand the scope of FEA to vibration analysis to simulate product behavior under those conditions.

This six-session web seminar introduces vibration analysis performed with Finite Element Analysis (FEA). By considering time-dependent loads and inertial and damping effects, vibration analysis allows for a more in-depth product simulation thus reducing product development cost and time. The course reviews basic concepts of vibration analysis and illustrates how they are implemented in FEA to simulate product behavior. The most common types of vibration analysis such as modal, time response, and frequency response will be covered.

All topics are illustrated using FEA software, SolidWorks® Simulation, for which participants will be provided a participant license (compatible with 64-bit Windows 7 SP1, 8.1, 10; IE 10,11; MS Excel and Word 2010, 2013, 2016) and opportunity to practice skills learned. Acquired skills, however, will not be software specific and no prior exposure to FEA software is required. The eBook, "Vibration Analysis with SolidWorks® Simulation" by Paul Kurowski, will also be included in the course materials. In-class, hands-on exercises and between-session assignments will provide an opportunity to put what is learned into practice.

Course Learning Objectives:

Upon completion of this course participants will be able to:

- Evaluate the importance of dynamic effects in product simulation
- Analyze inertial and damping effects in structural response
- Perform modal analysis, time response analysis and frequency response analysis

- Apply proper FEA modeling techniques to model system vibration
- Use vibration analysis as a design tool

Course Content/Syllabus:

Session 1:
- Structure vs. Mechanism
- Simulation Process with the FEA
- Verification and Validation of FEA Results
- Discrete and Distributed Systems
- Mode of Vibration Modal Analysis
- Eigenvalues and eigenvectors
- In-class Exercises/Homework Assignment

Session 2:
- Modal Analysis
- Convergence of Frequencies
- Rigid Body Modes
- Properties of Lower and Higher Modes
- Modes of Vibration of Single Degree of Freedom Oscillator (1DOF) and Two Degrees of Freedom Oscillator (2DOF)
- In-class Exercises/Homework Assignment

Session 3:
- Modal Analysis
- Modeling Techniques in Modal Analysis
- Modes Separation
- Modal Analysis as a Tool to Find "Weak Spots"
- Modal Analysis as a Diagnostic Tool
- In-class Exercises/Homework Assignment

Session 4:
- Modal Analysis with Pre-Stress
- Buckling Analysis
- Analogies between Modal Analysis and Buckling Analysis
- Modes of Vibration
- Modal Superposition Method
- In-class Exercises/Homework Assignment

Session 5:

- Time Response Analysis
- Load Excitation and Base Excitation
- Impulse Load
- Static vs. Dynamic Response

- Time Response of a 1DOF and 2DOF Systems Time Response of a Distributed System
- In-class Exercises/Homework Assignment

Session 6:

- Frequency Response Analysis
- Steady State Harmonic Response
- Force and Base Excitation
- Resonance
- Modal Damping
- Frequency Response of a 1DOF and 2DOF Systems
- Frequency Response of a Distributed System
- Linear vs. Non-linear Vibration Analysis
- Summary for Post-Course Learning Assessment

MAGMA short courses are held on a rolling basis, based on industry demand. Please complete this **short form** to express interest for yourself, or your organization.