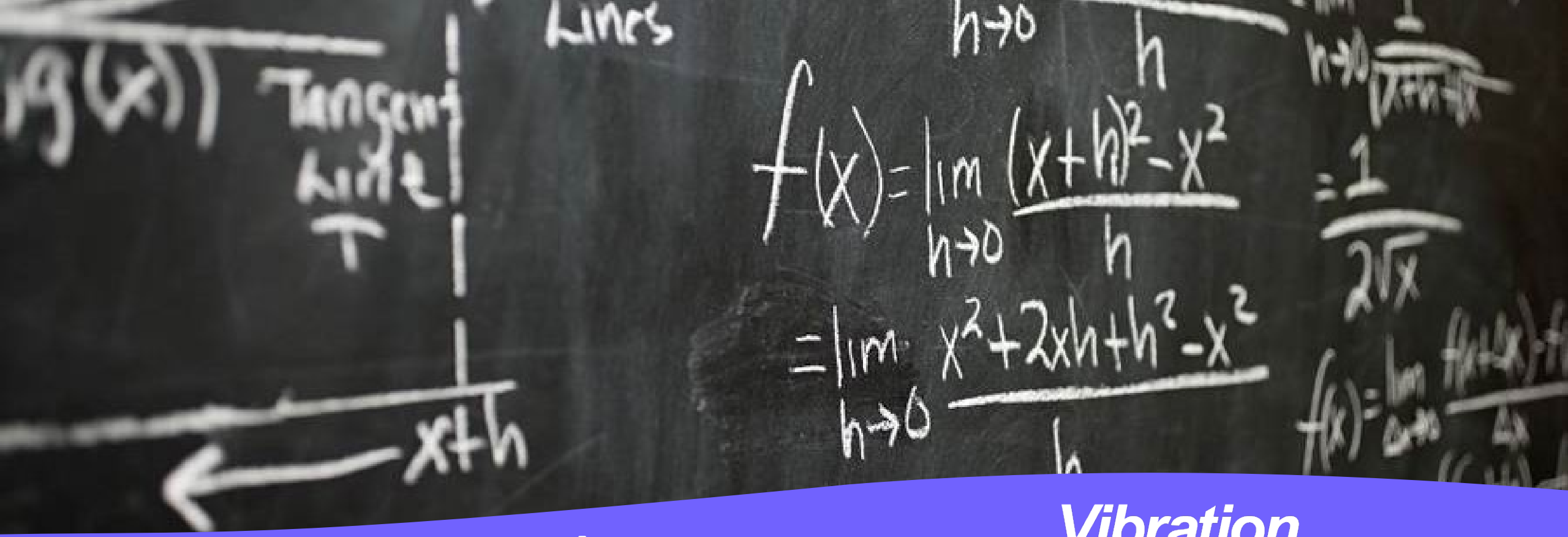


Training Webinar

Vibration Institute

Janine Komornick, Manager of Operations

Monroe Voyles, Training Committee Chair

Austin Creasy, Technical Director of Online Learning

Janine Komornick

Manager of Operations

Monroe Voyles

Training Committee Chair

Austin Creasy

Technical Director of Online Learning

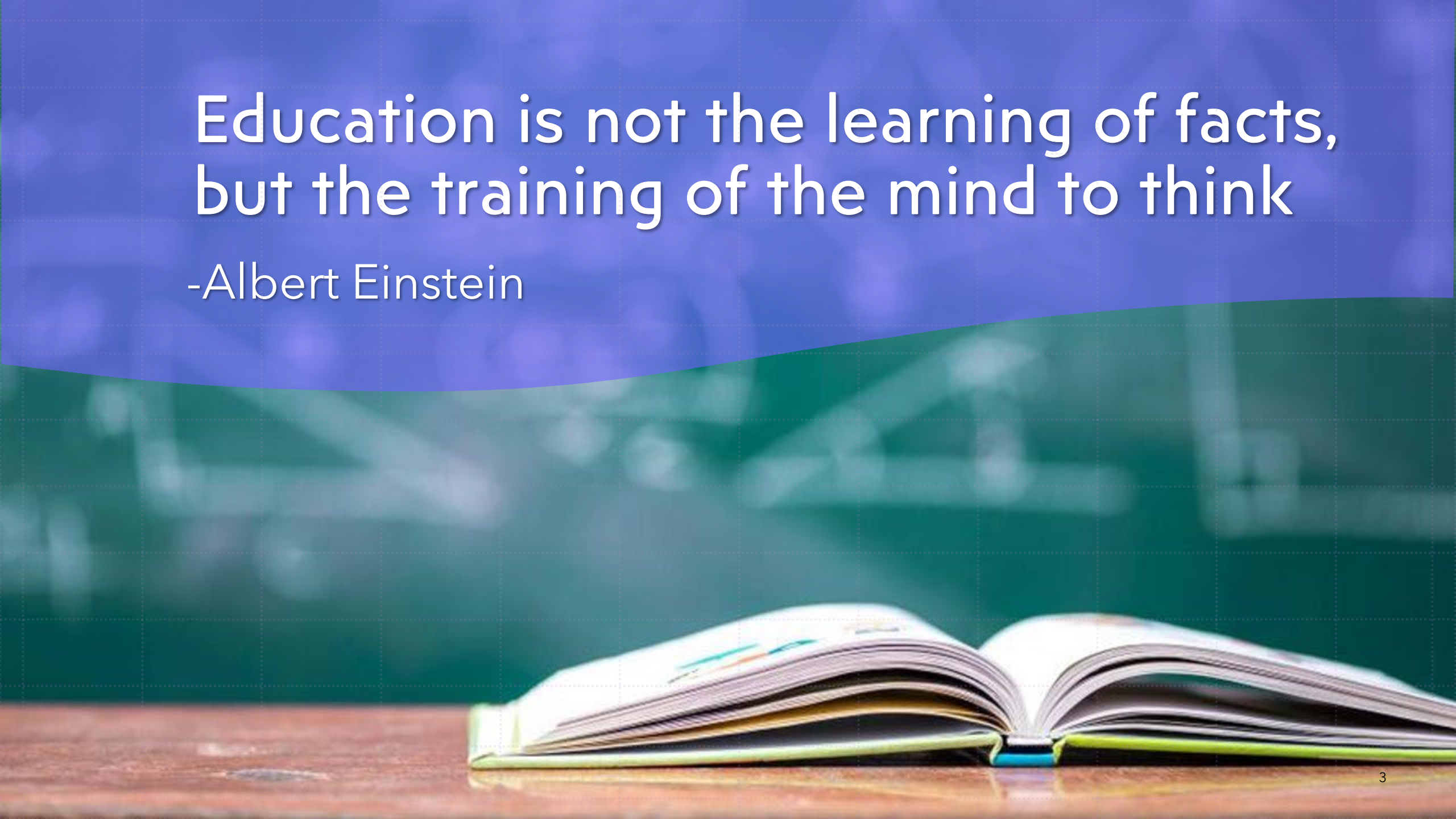
Erik Anderson

Senior Training/Certification Specialist & Moderator

Today's Presenters

Education is not the learning of facts, but the training of the mind to think

-Albert Einstein



About Our Training Courses

Our training program is designed to provide you with the knowledge and skills necessary to become a certified vibration analyst.

With our comprehensive training courses, you'll learn everything you need to know about vibration analysis, including how to diagnose and correct machinery defects before they lead to costly downtime.

Our courses provide procedures to augment to your practical knowledge of machines

Offer case studies to contextualize various types of equipment

Hold demonstrations and workshops that illustrate methods to solve vibration problems

Our Training Courses

- Administer the Body of Knowledge compliant with ISO 18436-2 Vibration Condition Monitoring Diagnostics ; and

1. Follow ISO 18436-3 Requirements for Training Bodies and the Training Process which defines the requirements for bodies that operate training programs in the non-intrusive machine condition monitoring, diagnostic, and correction technologies.

Vibration Institute Training Courses

CAT I – Introduction to Machinery Vibration

CAT II – Basic Machinery Vibration

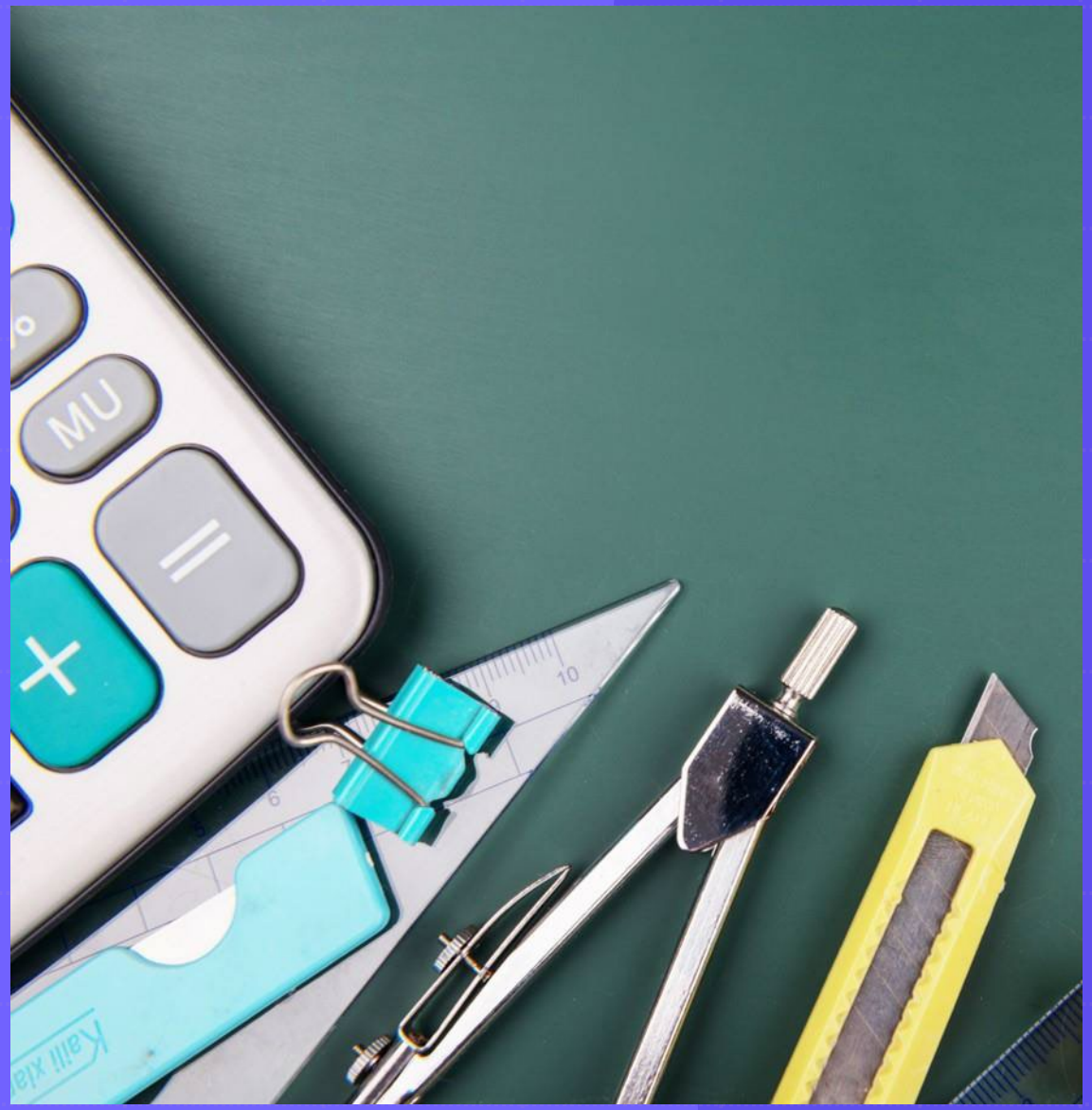
CAT III – Machinery Vibration Analysis

CAT IV – Advanced Vibration Analysis

CAT IV – Advanced Vibration Control

Training Courses

- Vibration Analysis Overview (VAO)
- Balancing of Rotating Machinery (Balancing Specialist Exam)
- Vibration Diagnostics Using Case Studies (Continuing Education for CAT III, CAT IV, PE)



Training Course Learning Objectives

- CAT I
- CAT II
- CAT III
- CAT IV

CAT I Learning Objectives

Training and Workshops Include:

Vibration Sources and Use ; definitions, units, properties, measurements, motions time, frequency and amplitude.

Basic Machinery Vibration ; conversions, analysis, excitation, natural frequencies, resonance and critical speeds.

Data Collection and Analysis; physical observations, sensors, frequency spans, measures, triggering, sensor mounting, sensor location and instruments.

Machine Characteristics; fault sources, frequencies, design, function, acceptance testing, fault and condition analysis.

Vibration Instruments; meters, oscilloscopes, data collectors, analyzers and virtual instruments.

Vibration Testing; periodic monitoring, data collection, transducer positioning, alarms and reports.

Basic Analysis; mass unbalance, mis-alignment, looseness, rolling element bearings, blade pass, vane pass and gear mesh.

Vibration Severity; bearing housing evaluation, shaft vibration, gears, bearings, charts and graphs.

CAT II Learning Objectives

Training and Workshops Include:

Basic Machinery Vibrations; units, properties, measurements, motions, time, excitation, critical speeds, frequency and amplitude.

Data Acquisition; selecting a measure, transducers, frequency spans, data displays, and calibration.

Data Processing; instruments, sampling, aliasing, windows, dynamic range, averaging, analyzer set-up, and filters.

Fault Diagnostics; techniques, operating speed, rolling element bearings, gearboxes, motors, pumps, fans and compressors.

Condition Evaluation; shaft vibration, bearing vibration, casing vibration, historical data base, charts and graphs.

Machine Testing; equipment, site inspection, acceptance testing, baseline development, transient testing, presentation of data and reports.

Periodic Monitoring; listing assets, categorizing priorities, route selections, measurement points, frequency of data collection, reporting of results.

Single Plane Balancing; type of unbalance, balancing equipment, pre-balancing checks, measurements, trial weights, vector method and balancing solution.

CAT III Learning Objectives

MVA Course Content Includes:

MVA provides in-depth discussions on time waveforms, FFT's, phase and orbit analysis techniques for the evaluation of industrial machinery. It includes ten chapters covering:

Principles of Vibration; the physical nature of vibration, vibratory motion, degrees of freedom, measures & magnitudes, relationships of displacement, velocity and acceleration.

Data Acquisition Procedures; accelerometers, velocity sensors, proximity probes, encoders, signal conditioning, triggering and calibration.

Signal Processing; instrumentation, digital signal processing, resolution, dynamic range, demodulation, data displays.

Time Waveform Analysis; signal processing and presentation, phase measurement and analysis, harmonic relationships, and time waveform shape analysis.

Frequency and Phase Analysis; frequency analysis, beats, orders, nonsynchronous frequencies, resonance, sidebands, modulation and spectral shapes.

Orbit Analysis and Shaft Centerline Position; orbital construction, orbital timing, orbital analysis, centerline position, and case histories.

Machine Testing; concepts, mode shapes, shaker excitation, impact testing, damping, amplification and critical speed testing.

Balancing of Rotating Machinery; mass unbalance, force, single plane balancing, critical speeds, trial weights, pitfalls, one shot methodology, and four run method.

Condition Monitoring and Evaluation; machine knowledge, types of monitoring, route based, permanent monitoring, protection, screening and trending.

Machine, Components, and Potential Fault Frequencies; common or shared fault frequencies, fluid film bearings, rotors, rolling element bearings, gearboxes, motors, generators, pumps, fans, compressors, belt and roll frequencies.

CAT IV Learning Objectives

AVA Course Content Includes:

Signal Processing RMS, coherent and non-coherent signals, peak detection, vector addition, filters, signal-to-signal noise ratio, and FFT calculations.

Signal/Noise Demonstration

Workshop I: Signal Processing Introduction to the FFT, A/D converters, dynamic range, FFT batch process, buffer fill times, averaging, and overlap.

Workshop II: FFT Basics and Filters FFT Topics, Aliasing, windows, resolution, and demonstrations.

Workshop III: Aliasing, Windows, and Resolution FFT Accuracy, Side-lobe areas; accuracy of rectangular, Hanning, and flat-top windows, window resolution, order spectra, correction of amplitude and frequency from bin location.

Workshop IV: Window Function and Order Spectra Beats and Modulation Time domain of digitized signals, beats, AM and FM modulation, sum & difference frequencies, suppressed carrier signals and enveloping, case histories.

Workshop V: Beats and Modulation Time Series Averaging Frequency synthesizers, averaging one signal and noise, averaging two signals, effect of synchronous time averaging on bearing defects and modulation, digital filers and the FFT as a brick wall filter, case histories of synchronous time averaging.

Workshop VI: Time Series Averaging Dual-Channel Basics Test methods, transfer functions, coherence, mass/spring model, real and imaginary displays, Nyquist and Bode plots, basic mode shapes, and operating deflection shapes. Introduction to the Hilbert Transform Torsional Vibration.

Workshop VII: Dual-Channel Analysis Damping Measurement and Calculation Half-power, real or imaginary plots, slope of phase shift, log decrement, dB decay of waterfall data, and demonstrations.

Workshop VIII: Damping Measurement Modal Testing Testing, analysis, natural frequencies, damping, and modes. Structural Measurements Vertical pumps, machine supports, floors, phase leads, turbine blades and fans, axial resonance on motors with sleeve bearings.

Workshop IX: Basic Modal Testing. Coherence, impact and response measurement techniques. Use of real and imaginary components to measure damping and provide mode shape information. Modal mass.

Workshop X: Torsional Vibration -Sources of torsional vibration, torsional test techniques, basic torsional modeling

Workshop XI: Transient and Forced Harmonic vibrations- Basic shaft and bearing modeling, response to unbalance

CAT IV Learning Objectives

AVC Course Content Includes:

Introduction Effect of vibration level on fatigue, structural vs. mechanical vibration severity evaluation, industry specific severity standards.

Transient Free Vibrations Damped and undamped free vibrations of single and multiple degree-of-freedom systems. Modal testing to determine natural frequencies, damping, and mode shapes. Intro to the concept of modal participation. Log decrement, equivalent spring and natural frequency calculations. Tuning natural frequencies to avoid resonance by changing stiffness and/or mass. Linear & non-linear stiffness, and temperature & strain rate effects on stiffness.

Workshop I: Free Vibrations

Forced Vibrations Forced harmonic response, damping analysis, and base motion response. Forced response to periodic non-harmonic and impulse forces. Sensitivity of modes to placement of dynamic forces. Case histories involving force modification as a form of vibration control.

Workshop II: Forced Vibrations

Rotor Dynamic Vibration Control Single & multiple degree- of-freedom models, modal mass, mode shapes, limitations of different modeling techniques, support and rotor stiffness asymmetry, flexible impellers, gyroscopic effects, centrifugal stress stiffening, and Lomakin effect in pump and multi-stage blower rotors. Basic Rotor Instabilities on Oil-Film Bearings. Natural frequency tuning Natural frequency tuning techniques for rotors.

Workshop III: Rotor Dynamics

Basic Structural Dynamics Dynamic response of structural components of machines and flexible floor framing systems. Natural frequency tuning techniques to reduce vibration of structures. Theory and application of tuned Dynamic Vibration Absorbers (DVA) and Auxiliary Mass Dampers.

Rigid Foundations Rules-of-thumb for foundation design. Single & multiple degree-of-freedom models. Natural frequency tuning methods for foundations.

Workshop IV: Vibration Control for Structures

Interaction of Rotating and Stationary Vibrating Components
Evaluation of response of systems where there is significant interaction between rotor and structural dynamics using computer-aided solution techniques and manual multi-degree-of-freedom calculation methods.

Workshop V: 2 degree-of-freedom calculations for rotor/structural interaction.

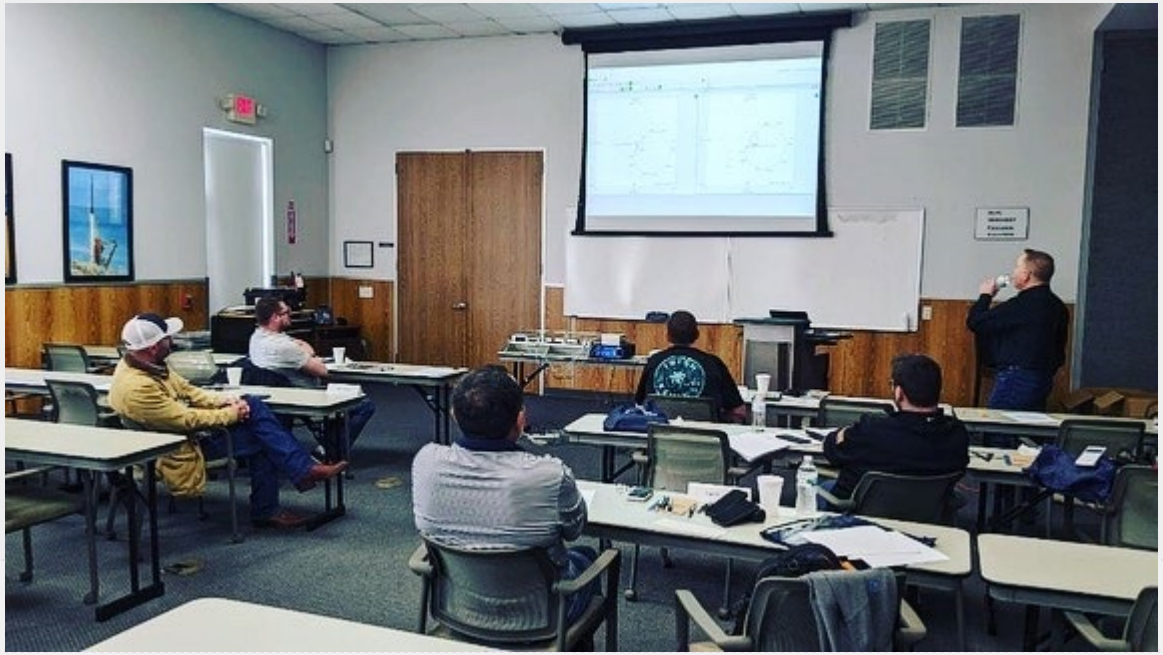
Isolation Theory of dynamic force Isolation, advantages and disadvantages of different isolator types, stability requirements for isolation systems, decoupling of isolated systems from support system. Case histories involving proper and improper use of isolation.

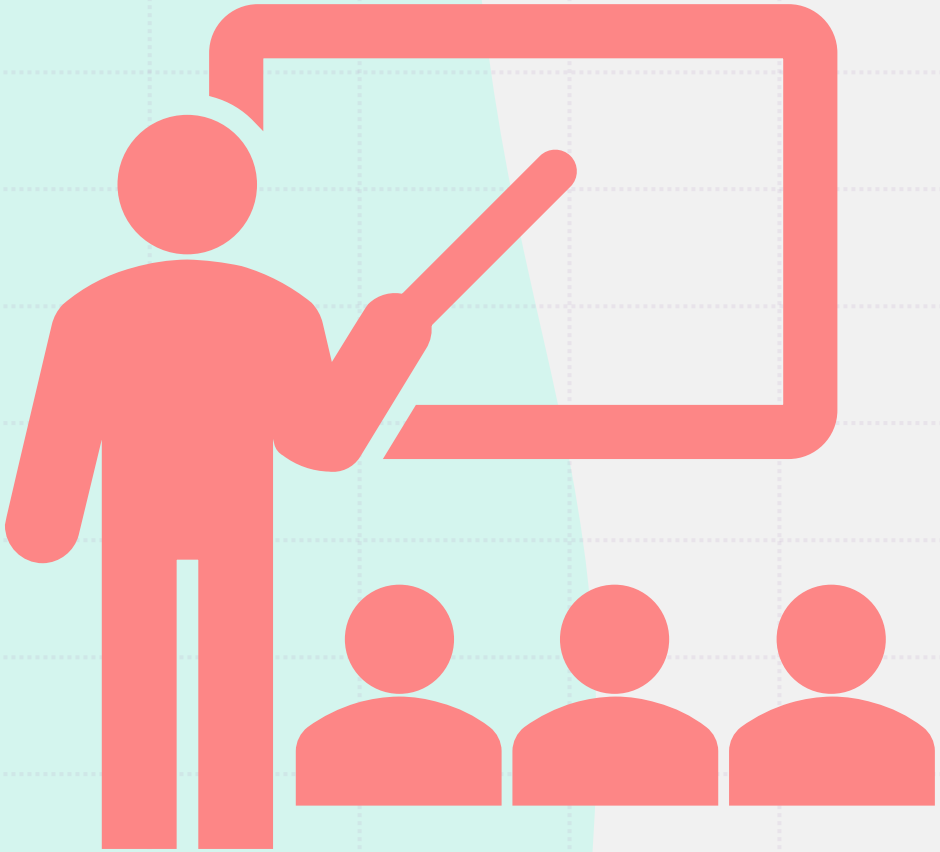
CAT IV Learning Objectives

Workshop VI: Isolation

Systems Subjected to Dynamic Pressure Pulsations

in pumps, fans and compressors, structural dynamics of piping and ductwork, acoustic resonance, vibration severity criteria for pipes, vortex shedding problems and solutions.





Public Training Courses

1. Our Public Training Courses are offered throughout the year in different cities in the US. These courses are taught by Vibration Institute Instructors. You can find our course schedule and more information on our events calendar at: https://www.vi-institute.org/events/

2. If you do not reside in the US and are looking to take an in person course, we ask that you reach out to one of our International Representatives. You can find that listing on our website at: https://www.vi-institute.org/international-representative-directory/

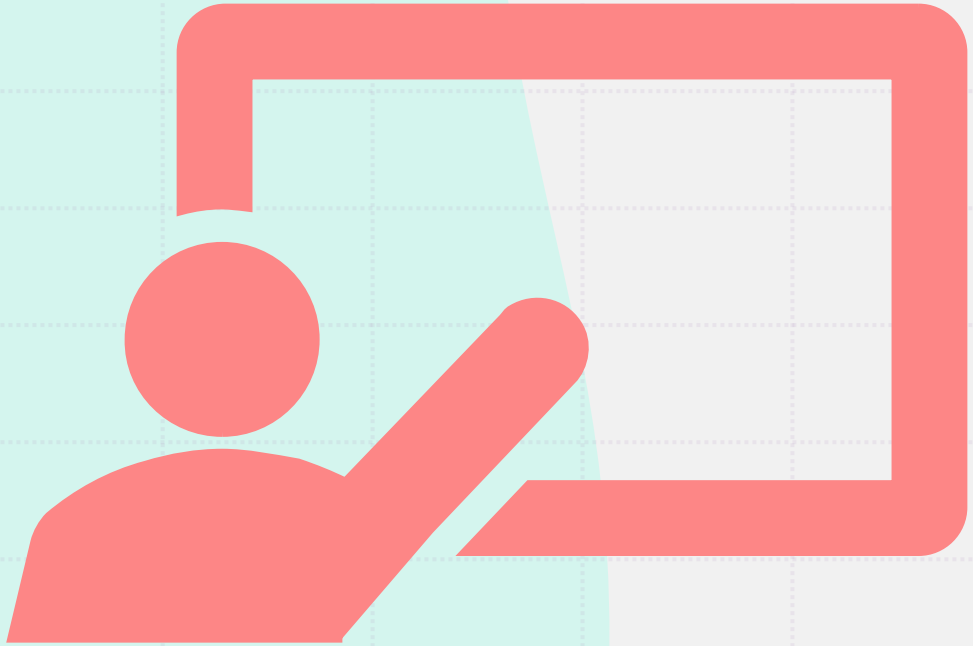
Correspondence (Self Study) Courses

For those unable to attend an in-person training course, we offer self-study courses that meet the training requirements for our certification exam upon completion, these courses also include continuing education credits.

Courses must be completed within four months of purchase

Courses may be purchased directly from our online store at: https://www.vi-institute.org/shop/

To learn more about this option, please visit our website: https://www.vi-institute.org/correspondence-courses-self-study/



Corporate (Onsite) Training

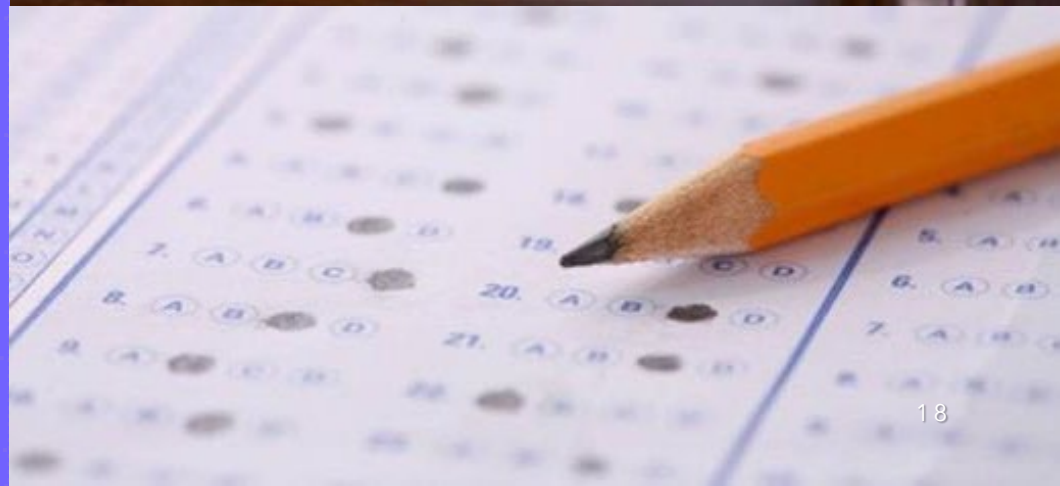
1. We offer our courses at your facility with our instructors!

2. This is cost effective for your company, especially if multiple employees require the same training. It eliminates the need for employees to travel, saves on travel expenses and other related costs.

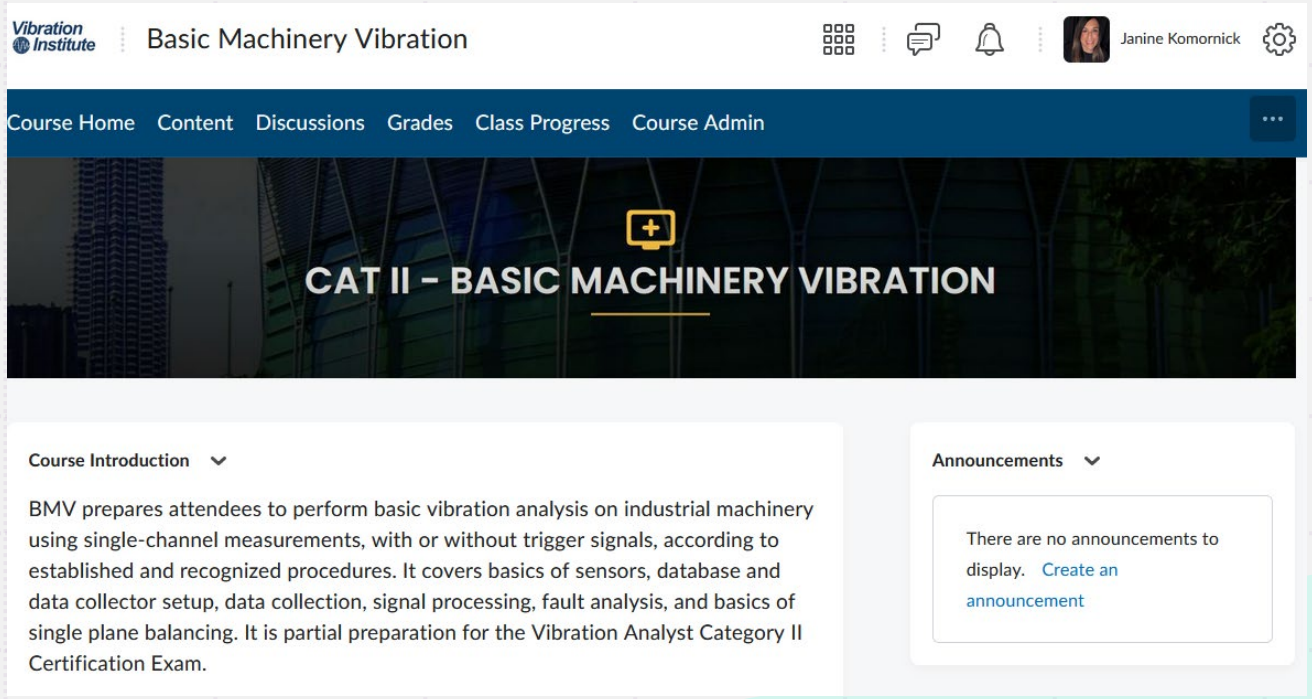
3. If you would like to consider this option for your company, we ask that you submit a request through our website for a quote at: https://www.vi-institute.org/corporate-courses/

Online Learning

- Vibration Institute online courses use the Desire2Learn (D2L) Brightspace Learning Management System (LMS).
- You will interact with one of our highly qualified instructors and other students through chapters and discussion boards through D2L
- Our courses are on a rolling basis, and you may register at any time.
- Our courses are asynchronous, which allows you to learn according to your schedule.
- Our certification exams are not online and will need to be scheduled to take in person.



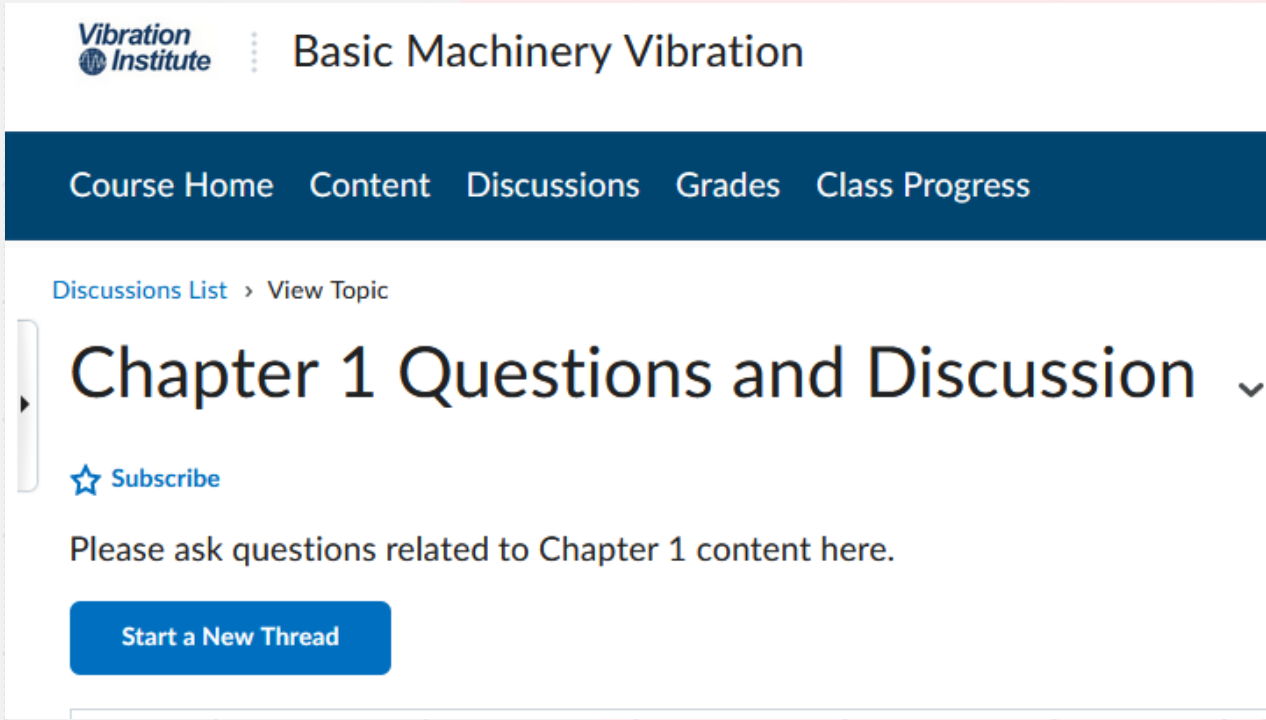
Online Learning



- Currently, our CAT II Course is online in both English Units and SI Units and available to anyone in the US and outside the US
- Our CAT I Course is scheduled to go live next Thursday, October 12th.
- To Learn More Visit:
- https://www.vi-institute.org/online-learning/

Online Course Highlights

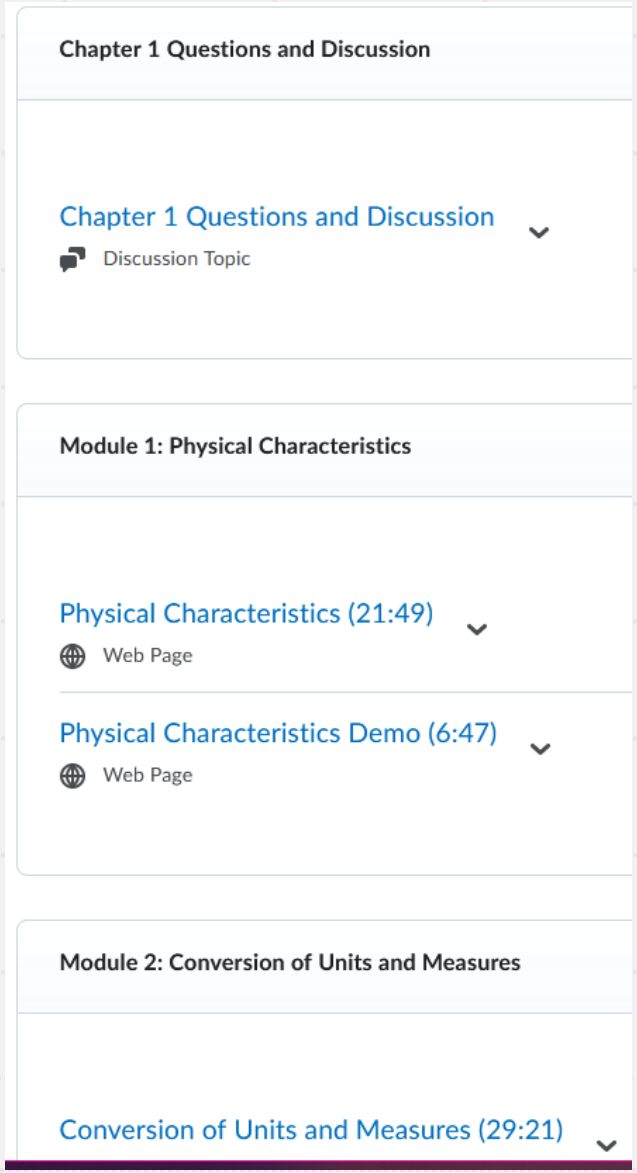
Discussion Board – post questions and comments where your instructor and other students may comment



Online Course Highlights

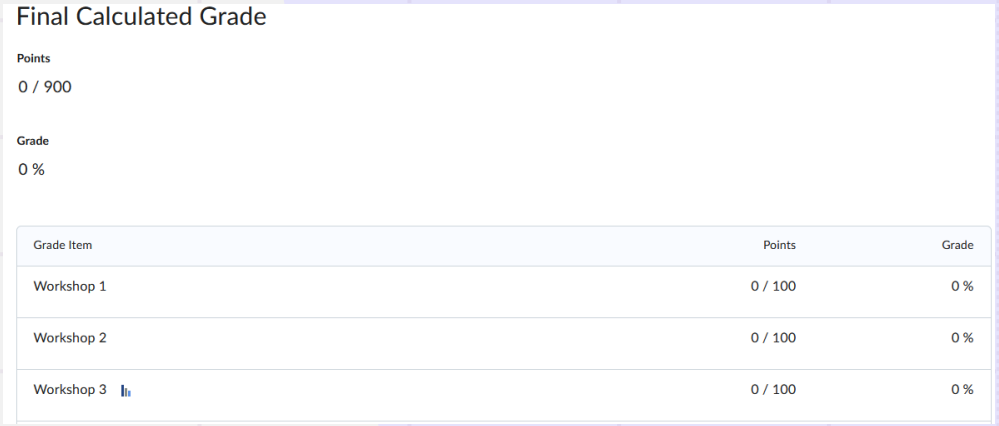
Training Chapters

1. Basic Machinery Vibrations
2. Data Acquisition
3. Data Processing
4. Fault Diagnostics
5. Condition Evaluation
6. Machine Testing
7. Periodic Monitoring
8. Single Plane Balancing



BMV Course Content Includes

An introduction and background to Basic Vibration, Sensors, Instrumentation, Measurements, Conversion of Measurements, Analysis Techniques, Balancing, Machine Condition and Evaluation. The course content is divided into 8 chapters. The chapters are only accessible in sequential order and can be viewed by clicking on the content in the navigation bar or by clicking on the chapter on the "Course Home" page.



Thank you

Questions?

information@vi-institute.org