Vibration and Shock Test Control Techniques

Course No. 194

FOR WHOM INTENDED Engineering or technical personnel involved in specifying, tailoring (e.g. MIL-STD-810) and performing state-of-the-art random vibration and shock tests; those who obtain/analyze/ review field and laboratory test data; and those who design/certify hardware/structures/instrumentation to meet dynamic environmental requirements. Members of the automotive, aerospace, aircraft, shipboard and weapons technical communities will benefit.

COURSE DESCRIPTION (See course outline, over.) The objective of the first portion of the course (also available separately as Course 196, Digital Data Acquisition) is to provide participants with the knowledge required to specify, evaluate and use a wide variety of digital data acquisition systems in laboratory and field applications. Basic principles of sampling and digitizing theory are presented and reinforced with practical examples from everyday testing operations.

Hardware discussions concentrate on performance capabilities and practical problems that arise in laboratory and field applications. Heavy emphasis is placed on new technologies and system concepts that will be available in the near future. The aim is to prepare participants to design and procure state-of-the art systems that will satisfy their technical requirements efficiently and economically.

Literature describing the latest available hardware will be used as examples of good (and bad) practice. Particular emphasis will be placed on critical evaluation of commercially-available hardware and software systems.

The objective of the second part of the course (also available separately as Course 194-3) is to provide an overview of vibration testing technology with emphasis on the practical everyday problems that are encountered in testing laboratories. Emphasis is placed on the basic principles of vibration hardware, control systems, and analysis techniques used for random, sine, and shock testing. Capabilities and limitations of available systems will be discussed.

This course presents an application-oriented approach to digital computer control of random vibration and shock testing on shakers and analysis of vibration and shock data. Complex mathematical concepts are reduced to graphic form for intuitive understanding. Illustrative examples from the “real world” are used throughout.

The course is presented as a series of highly interactive lecture/discussion sessions. Problems for individual and group solution are interspersed throughout the course to act as training aids and to evaluate class progress. Special-interest discussions are encouraged outside of the regular course sessions.

DIPLOMA PROGRAMS This course is required for TTi's Dynamic Test Specialist (DTS) Diploma Program and may be used to satisfy the course 196 requirement of the Data Acquisition & Analysis Specialist (DAAS) Diploma program. It may be used as an optional course for any other TTi specialist diploma program.

RELATED COURSES Course 194-3 is an abbreviated version of course 194, intended for on-site presentations only. The first part of open Course 194 is also available as Course 196, Digital Data Acquisition, which runs concurrently

PREREQUISITES Participants should previously have participated in TTi’s Course 116, *Fundamentals of Vibration for Test Applications* or in related training. In addition, it would be helpful if participants have some experience in specifying and/or conducting computer-controlled tests on shakers and some exposure to spectrum analysis.

TEXT Each student will receive 180 days access to the on-line electronic course workbook. Renewals and printed textbooks are available for an additional fee.

INTERNET COMPLETE COURSE 194 features over eighteen hours of video as well as more in-depth reading material. All chapters of course 194 are also available as OnDemand Internet Short Topics. See the on-line course outline for details.

COURSE HOURS, CERTIFICATE AND CEUs Class hours/days for on-site courses can vary from 14–35 hours over 2–5 days as requested by our clients. Upon successful course completion, each participant receives a certificate of completion and one Continuing Education Unit (CEU) for every ten class hours.

Technology Training, Inc.
(a tti group company)
Toll-free telephone:
866-884-4338 (866-TTi-4edu)
International Tel. 805-845-5050
E-mail: Training@ttiedu.com
pubs.ttiedu.com

Vibration and Shock Test Control Techniques

Course No. 194

Part I (also available as Course 196)

- Overview of the Measurement Process—The System Approach
  - The role and function of digital data acquisition.
  - Testing and experiment types—what capabilities are required?
  - Accuracy, Dynamic Range, Headroom
- Basic Concepts
  - Basic calculations
  - The Fourier Transform as a "Black Box"
  - Data presentation in time and spectral domain
- Sampling and Digitization Theory
  - Data acquisition speed and accuracy/resolution considerations
  - Aliasing
  - Noise and other data corruption problems
- Data Acquisition Hardware
  - Signal Conditioning
  - Amplifiers
    - Common-mode rejection
      - Transducer wiring practice
  - Anti-alias filters
    - Estimating aliasing errors for different filter types
    - Filter/Sample-rate tradeoffs
  - Sample-and-hold amplifiers
  - Multiplexers
  - Analog-to-digital converters
    - Flash, Successive-approximation, Multi-pass, Sigma-Delta, Integrating
- The Computer System
  - Candidate computer systems–tradeoffs
  - Interface concepts—speed, implementation ease and robustness
  - Data storage—speed, volume considerations
- Types of Digital Acquisition Systems
  - Applications, Special considerations, Performance and limitations of available system architectures
- Data Analysis
  - Engineering-Unit Conversions
  - Data Interpolation
  - Correction of Anti-Alias filter distortion
- Evaluating Data Acquisition Systems
  - Simple tests to evaluate system accuracy/capability
- Specifying a system
  - How do you specify a system to get what you want?

Part II (also available as Course 194-3)

- Review of Data Acquisition
- Introduction and Basic Concepts
  - Structural Resonances, Time History and Spectral Analysis
- Test Objectives and Philosophy
  - Damage Potential
  - MIL-STD Testing
- Environmental Simulation Concepts
  - Sine, Random, and Simulated Shock Excitation.
  - Vibration and Shock History Reproduction
  - Test Specification
- Simulation Methods
  - "Programmed" Excitation
    - Excitation Hardware
      - Electrodynamic and Electrohydraulic Shakers
      - Specifications and Real-World Behavior
    - Excitation Functions
  - "Impact" and "Drop" Machines
- Fixtures
- Simulation "Accuracy" using different approaches.
- Measurement Systems
  - Transducers for Vibration and Shock
- Data Acquisition Requirements and Methods
- Analysis Tools
  - Averaging Concepts, Degrees of Freedom
  - Power Spectral Density (PSD) and Shock Response Spectrum (SRS)
- Control Systems
  - Closed-Loop Control Concepts
    - Random Control
      - Spectral Control
      - Response and Force Limiting
    - Sine Controllers
    - Shock Synthesis and Control
  - Real-World Systems
    - System Demonstration—videos
    - System/Physical/Method Limitations
    - What do the Control Parameters Mean?
    - How do they effect the results?
- Multiple-Degree-of-Freedom Systems
  - Hardware Implementation
  - Control Strategies
- Random Vibration for HALT, HASS and ESS applications
- Review of currently available hardware
- Real-World Test Laboratory Applications
- Student Topic/Problem Discussion
- Final Review
- Award of Certificate for Successful Completion

Technology Training, Inc.
E-mail: Training@ttiedu.com · https://pubs.ttiedu.com