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# Digital Data Acquisition

## Course No. 196

**FOR WHOM INTENDED:** This course is intended for laboratory and field test technicians and engineers.

**COURSE DESCRIPTION:** The objective of the course 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. Emphasis is placed on understanding the theoretical concepts through “mechanical feel” rather than mathematics.

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. Special emphasis will be placed on critical evaluation of commercially-available hardware and software systems.

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.

**CERTIFICATE PROGRAMS** This course may be used as an elective for any TTI [specialist certificate program](#).

**RELATED COURSES** [Course 194, \*Vibration and Shock Test Control Techniques\*](#), includes the entire content of Course 196 plus test control topics.

**PREREQUISITES:** Participants should have attended TTI’s course, [Instrumentation for Test and Measurement](#), or some equivalent training program. A good understanding of the engineering problem to be analyzed is expected. An understanding of basic computer and data acquisition principles will be useful.

**TEXT** Each student will receive a set of [course notes](#) including most of the visuals used in the presentation.

**COURSE HOURS, CERTIFICATE AND CEUs** Open courses meet seven hours per day. Upcoming presentation dates can be found on our current [open course schedule](#). 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.

For [schedules](#), [general information](#) and [registration forms](#), see TTI’s web site.

### Course Outline

- 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?
- Final Examination
- Award of Certificates for successful completion



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