
Instrumentation for Electrical Test and Measurement

Course No. 164

FOR WHOM INTENDED Engineers, aides and technicians. Some background in electronics is helpful but is not essential. The course will be tailored to student objectives.

OBJECTIVES To provide a basic understanding of electrical measurement systems. To alert the students to the many varieties of meters, 'scopes and transducers available, their operating principles, strengths and weaknesses. To give students enough applications information that they can select optimum meters, transducer, amplifier, recording and readout devices to assemble a system for routine measurements of electrical phenomena.

BRIEF DESCRIPTION OF COURSE Mainly lectures, supported by slides, transparencies, videotapes and sample hardware. Students are expected to participate in classroom discussions, as well as read text materials and class notes.

Course 164 presents basic information on selection, application, calibration and usage of modern measurement systems to measure electrical phenomena. The course emphasizes a non-mathematical approach to understanding concepts and mechanisms. A variety of measurands and device types is covered, as well as signal conditioning, recording and analysis.

Participants are encouraged to bring a specific measurement problem to class for use as a case study. The instructor will introduce one or more student problems (and/or a preselected case) on the first day. Each day's course material will further develop the case study. A solution will be given at the end.

CERTIFICATE PROGRAMS This course is required for TTI's [Instrumentation Test Specialist \(ITS\) Certificate program](#). It may be used as an elective for any other [TTi Certificate program](#).

PREREQUISITES There are no definite prerequisites, but participation in TTI's course "[Electronics for Non-Electronic Engineers](#)" or the equivalent would be helpful.

TEXT Each student will receive a set of [course notes](#) including most of the view-graphs 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

Introduction: Characteristics of Dynamic Measurements
What makes data dynamic • Types of dynamic data
Periodic, transient and non periodic (random)
Sine waves, frequency and phase
The language of electrical measurements
Charge, Voltage, Current • Electrical units
Average, peak and root-mean-square values
Digital measurement systems • Noise • decibels
Parameters of linear systems
Accuracy • Calibration • Precision • Errors
Simple statistics of measurement
Accuracy and error assessment • Performance testing and calibration
Quantifying and minimizing measurement error
Electrical laboratory practice
Safety • Grounds • Circuit protection devices
Input impedance, output impedance and loading
Power transfer and impedance matching
Analog DC and AC meters
DC and AC ammeters and voltmeters • Analog multimeters
How to use basic meters • Meter errors • Digital Electronic Meters
Oscilloscopes: Subsystems • Probes • How to operate
Special-purpose • Digital
Time and frequency measurements
Power and energy measurements: Power in AC circuits
Single-phase measurements • Polyphase • Higher frequencies
Measurement of resistance: Voltmeter-ammeter method
Ohmmeters • Wheatstone bridges
Measurement of Capacitance, Inductance, Impedance
Bridge circuits for measuring capacitance
AC voltmeter measures capacitance, inductance
DC and AC signal sources
Batteries • DC power supplies: How to use
Oscillators • Sweep-frequency generators
Pulse generators • Function generators
Transducers: Strain gauges, Silicon Transducer
Principles • Piezoelectric • Temperature transducers
Interference signals
Capacitive interference • Inductive interference, shielding
Electromagnetic interference and shielding
Ground loop interference
Measurement Systems
Signal conditioners • Amplifiers • Integrating, differentiating and filters
Digital signal processing
Introduction to generating and processing digital data
Introduction to digital analytical techniques
Recording and readout devices
Summary and overview • Final Examination
Award of Certificates for successful completion



Technology Training, Inc.

(a tti group company)

Toll-free telephone:

866-884-4338 (866-TTi-4edu)

805/715-2638 Fax: 805/715-2650

E-mail: Training@ttiedu.com

<http://www.ttiedu.com>