

Electrical Measuring Instruments

Course 204.1: Electrical Measuring Instruments

Covers the principles on which electrical test instruments operate. Basic instruments covered include voltmeter, ammeter, wattmeter, ohmmeter, and megohmmeter. Covers AC metering, split-core ammeter, use of current and potential transformers. Includes detailed coverage of modern multimeters. Explains functions and uses of oscilloscopes.

TPC Training is accredited by IACET to offer **0.5 CEU** for this program.



Lesson 1: Principles of Meter Operation

Topics

Meter Principles; General Digital Meter Design; Integrating ADCs; Digital Displays; Sensitivity, Accuracy, and Resolution; Introduction to Analog Meters; The D'Arsonval Movement; Electrodynamometer Movements; Moving-Vane Meters; Magnetic Shielding; Parallax Error; Analog Instrument Sensitivity; Analog Accuracy

Objectives

- Define the terms digital meter and analog meter.
- Describe the purpose of the analog-to-digital converter in a digital meter.
- Identify and label graphs of integrator output from a dual-slope integrating meter.
- Explain how time is related to voltage measurement in an integrating digital meter.
- Differentiate among the terms accuracy, sensitivity, and resolution.
- Explain how a D'Arsonval meter movement works.
- Describe the parallax effect, and explain how to avoid it when using an analog meter.
- State the sensitivity formula for an analog meter.

Lesson 2: Ammeters, Voltmeters, and Wattmeters

Topics

Measurement Considerations; Current Measurement; Measuring Direct Current; Multirange Ammeters; Hooking Up an Ammeter; Measuring Alternating Current; Clamp-On Ammeters; Voltmeters; Using a Voltmeter; Wattmeters

Objectives

- Describe the differences and similarities between an analog ammeter and a voltmeter.
- Explain how ammeters and voltmeters are protected internally from overcurrent.
- Explain how a make-then-break switch works.
- Identify which meters should be connected in series in a circuit and which should be connected in parallel.
- Describe how an analog wattmeter works.
- Explain how it is possible to overload a wattmeter, even with the meter's pointer at less than full-scale deflection.

Lesson 3: Resistance Measurement

Topics

Measuring Resistance with an Ohmmeter; Ohmmeter Currents Are Small; Checking and Calibrating an Ohmmeter; How Does a Multirange Ohmmeter Work?; Shunt Ohmmeters; Advantages and Disadvantages of Shunt Ohmmeters; Megohmmeters; How to Use a Megohmmeter

Objectives

- Explain characteristic differences between a series ohmmeter and a shunt ohmmeter.
- Explain why ohmmeter scales read from right to left, instead of left to right, and why they are nonlinear.
- Describe the internal circuits and basic operation of an opposed-coil megohmmeter.
- State the primary safety precaution to take when using an ohmmeter.
- Describe two methods used by ohmmeter manufacturers to extend the range of their instruments.
- Explain how to test for opens, shorts, and grounds, using a megohmmeter.
- Describe how to make zero-adjustments on ohmmeters and megohmmeters.
- Explain why variable resistors are needed in battery-powered ohmmeters.

Lesson 4: Multimeters

Topics

The Multimeter; Guidelines for Using a Multimeter; An All-Purpose Graphical DMM; More Advanced Meter Functions; Multimeter Accessories; Multimeter Safety

Objectives

- Demonstrate how to measure ac and dc current and voltage with a multimeter.
- Describe the function of a current probe.
- Explain how to isolate the source of a glitch with a graphical multimeter.
- Demonstrate how to read the screen display of a graphical multimeter in the Trend mode.
- Explain why you set a meter to its highest range before taking your first measurement.
- Define autoranging and auto-polarity.
- List three safety precautions to take when using multimeters.

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Lesson 5: Oscilloscopes

Topics

Who Needs an Oscilloscope?; Kinds of Oscilloscopes; How an Analog Oscilloscope Works; Triggering; Digital Oscilloscopes; Dual-Trace Oscilloscopes; Real-Time vs Sampling Oscilloscopes; Selecting the Right Oscilloscope; Oscilloscope Controls; Probes; Basic Measurement Procedures; Using the Oscilloscope in Troubleshooting

Objectives

- Describe how an analog oscilloscope works.
- Describe advantages of a digital oscilloscope over an analog oscilloscope.
- Demonstrate how to measure voltage with an oscilloscope.
- Show two methods of determining phase angles with an oscilloscope.