

Electronics for Non-Electronic Engineers

Course No. 104-3

FOR WHOM INTENDED This course is intended for individuals whose primary formal training is not in the field of electronic engineering. Electrical controls and electronics are incorporated in almost every technical activity, and all technical personnel have to deal with some aspects of electronics. A basic understanding of electronics is essential to better perform their main function.

OBJECTIVES To help participants to understand the concepts and terminology of electronics. It is not an in-depth electronics course but rather a course aimed at individuals who require an intensive review of basic principals, without the assumption of any prior knowledge of the topic. The course is fast paced and as non-mathematical as possible.

BRIEF COURSE DESCRIPTION The course covers basic concepts of electrical theory, starting with the simple DC circuit and Ohm's Law. It describes basic components encountered in electrical circuits, such as resistors, capacitors, inductors etc. The course discusses transient RC RL circuit analysis and delves into ESD and lab safety. Then reactance and impedance in AC circuits are discussed, along with series and parallel resonance.

The course covers basic theory and types of transformers, before covering instrumentation errors. Instruments including ohmmeters, voltmeters and oscilloscopes are discussed before covering electrical power circuits.

Moving from electricity to basic electronics, the course covers theory of solid state electronics including semiconductor physics, diodes, transistors, FETs, thyristors and photoelectric devices. The course presents rectifiers and filters, before an in-depth look at amplifier theory, applications and types, including oscillators and tuned, differential and operational amplifiers. An appendix provides material for further study in related mathematics, including vectors, phasors, RMS and scientific and engineering notation.

DIPLOMA PROGRAMS This course is required for TTI's [Dynamic Test Specialist \(DTS\)](#), [Instrumentation Test Specialist \(ITS\)](#) or [Metrology/Calibration Specialist \(MCS\)](#) diploma programs. It may be used as an optional course for any other TTI [Specialist Diploma Program](#).

RELATED COURSES [Course 103](#) introduces the basics of electronics. A longer version of Course 104-3, [Course 104/105](#) includes material on digital electronics. [Course 105, Understanding Digital Electronics](#), covers the same material on digital electronics in greater depth and with additional topics. Any TTI course may be presented at your facility.

PREREQUISITES: An understanding of basic algebra will be useful. This course is meant for individuals working in a technical field other than electronics.

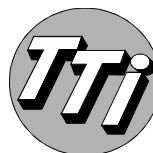
TEXT Each student will receive 180 days access to the on-line electronic course workbook. Renewals and printed textbooks are available for an additional fee.

COURSE HOURS, CERTIFICATE AND CEUs

OnDemand Internet course 104-3 features eleven hours of video as well as more in-depth reading material. 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.

Course Outline

Introduction: Typical electronic circuit • Schematic Diagram • Symbols
Electrical Fundamentals Review: Electrostatic Field and Potentials • Charge • Conductors, Insulators • Current, Voltage • Ohm's Law • EMF • Resistors • Network Theorems • Alternating Current • Non-Sinusoidal Waveforms • Square Waves • Harmonics • Analog vs. Digital
Capacitors and Inductors: Capacitance • Capacitors in DC Circuits • Capacitors in Parallel and in Series • Typical Inductors • Inductance • Right-Hand Rule • Mutual Inductance • Inductors in Series and in Parallel
Transient RC and RL Circuits: RC Time Constant • RL Time Constant
Electrostatic Discharge: Static Generation • ESD Effects, Prevention
Workshop/Laboratory Safety Practice: Safety Rules • Grounds
Reactance and Impedance in AC Circuits: Reactance (X) • Impedance (Z) • Frequency and Phase • Complex Numbers, Polar Coordinates • Capacitive and Inductive Reactance • Impedance of various AC circuits
Series and Parallel Resonance: Series Resonance • Resonant Frequency • Q of a Series Circuit • Bandwidth of Series R-L-C Circuit • Parallel Resonance • Filters: Band Pass, Band Stop
Transformers: Construction • Equivalent Circuit • Turns Ratio • Power Relationships, Efficiency • Impedance Matching • Loosely coupled, Single Tuned and Double Tuned Transformers
Instrumentation Errors: Precision and Accuracy • Errors in Measurements • Input Impedance and Loading • Using Meters • Meter Errors
Analog and Digital Meters and Oscilloscopes: Using Ohmmeters • Digital Electronic Meters • Analog Oscilloscopes • Making Measurements • Oscilloscope Errors • Digital Oscilloscope • Function Generators
Electrical Power Circuits: Alternating Current (AC) • Phase in AC Circuits • Single-Phase and Three-Phase Electric Power • Electric Motors • Electrical Power Transmission and Distribution System • Color Coding
Semiconductor Physics: N-type and P-type Doping • Current Flow
Diodes: Alloy Junction Diode • Planar Technology (Diffusing) • P-N Junction Behavior • Junction Barrier • Biasing • Diode types
Transistors and Biasing: Bipolar Junction Transistor • Operation of an NPN Transistor • How Transistors Amplify • Amplifier Gain • Common Emitter, Base, Collector Circuits • Feedback
Field Effect Transistors (FETs): JFET • Channel Depletion • MOSFET • N-channel Enhancement and Depletion • Transfer Characteristics
Thyristors: Operation of SCR • SCR Parameters • Dimmers
Photo-Electric Devices: Photo-voltaic/Solar Cells • Photo Conductive Diodes • Photo-transistors • High Gain Light Detector • LASCR • LED
Rectifiers and Filters: Power Supply with a Regulator • Half and Full Wave Rectifiers • Bridge Rectifier • Filters • Capacitive Load • Power Supply Loading • RC Filter • Filter Choke
Introduction to Amplifiers: Radio Frequency (RF) Amplifiers • Quality • Gain, Output Range • Bandwidth (BW) • Efficiency • Noise • Amp types
Amplifier Fundamentals: Transistor voltage, Power Gain and Operating Point • Base Bias Adjustment • Bypass Capacitor • Clipping • Classes • Coupling Methods • Frequency Response • Distortion • Slewing Rate
Tuned Amplifiers: Tuned Intermediate-Frequency (IF) Amplifiers • AM and FM IF Bandwidths • Detector and AGC Circuit • RF Amplifiers • Sensitivity
Oscillators: Kinds of Oscillators • Configurations • Transistor Hartley, Colpitts or Clapp Oscillator • Crystal Oscillator • RC Oscillators
Differential Amplifiers: One Signal Input • Two Differential Inputs • Two Identical Inputs • Common Mode Rejection
Operational Amplifiers: Typical Characteristics • External Feedback Op Amps • Inverting and Non-inverting Amplifiers • Follower • Applications Summary, Discussion • Final Review
Award of Certificates for Successful Completion



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