

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 the basic components encountered in electrical circuits, such as resistors, capacitors, inductors etc. The course discusses behavior of inductors and gives examples of circuit theory, including LCR circuits and filters, also transient RL circuit analysis. Resonant circuits and their applications are covered. Sinusoidal and non-sinusoidal waveforms are discussed as they apply to electrical technology.

The basic theory of transformers and their various types: power, current, potential and transformers used in measurement systems are discussed, as are rectifier and filter circuits. Instrumentation is covered next, including measuring devices such as ohmmeters and voltmeters, before covering polyphase circuits used in power distribution.

Moving from electricity to basic electronics, we cover the theory of solid state electronics including semiconductor physics, diodes, transistors, FETs, thyristors and photo-electric devices. The course presents amplifiers, including the various applications of power amplifiers, negative feedback etc. This leads to the study of oscillators and digital logic circuits. An appendix provides material for further study in related mathematics, including vectors, phasors, RMS and scientific and engineering notation.

CERTIFICATE PROGRAMS This course satisfies the 104 requirement for TTI's [Mechanical Design Specialist \(MDS\)](#), [Metrology Specialist \(MSC\)](#) and [Instrumentation Test Specialist \(ITS\)](#) certificate programs.

RELATED COURSES A longer version of Course 104-3, [Course 104-5](#) includes material on digital electronics. [Course 105, Understanding Digital Electronics](#), covers the same material on digital electronics in greater depth and with additional topics. Either Course 104-3, Course 104-5 or Course 105 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 Participants receive a [course workbook](#), which contains most of the viewgraphs used during 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: Review of a typical electronic circuit
Schematic Diagram of a Radio Receiver • Electronic Symbols and Abbreviations
Path of Signals through Circuit • Block Diagram
Electrical Fundamentals Review: Electrostatic Field and Potentials • Charge
Conductors, Insulators • Current, Voltage • Ohm's Law • EMF • Resistors • Series
Circuits • Network Theorems • Alternating Current • Non-Sinusoidal Waveforms •
Square Waves • Harmonics • Analog vs. Digital Waveforms • Examples
Capacitors and Inductors • Transient R-C and R-L Circuits • Examples
Reactances in Series and Parallel: Inductive and Capacitive Reactance • Phasor
Diagrams • Impedances in Series or Parallel • Parallel Reactance • Examples
Series and Parallel Resonance: Resonant Frequency • Q of a Series Circuit
Bandwidth of Series R-L-C Circuit • Parallel Resonance • Filters
Transformers: Construction • Equivalent Circuit • Turns Ratio • Power Relationships,
Efficiency • Impedance Matching • Loosely coupled, Single and Double Tuned
Instrumentation: Average and RMS Values of Common Waveforms • Decibels
Grounds • Log vs. Linear Scales • Precision and Accuracy • Errors • Output
Impedance, Loading • Power Transfer, Impedance Matching • Meters
Oscilloscopes • Measuring Voltage, Current, Time, Frequency, Phase
Digital Oscilloscopes • Ohmmeters • Function Generator • Safety, Grounds
Polyphase Circuits: Phasor Voltages • Three-phase Generators • Power Distribution •
Local Power Distribution Systems
Semiconductor Physics: N-type and P-type Doping • Diffusion • Current flow
Diodes: Alloy Junction Diode • Planar Technology (Diffusing)
P-N Junction Behavior • Junction Barrier • Biasing
Diode types: Rectifier, Signal, Zener, Tuned • Voltage Regulator • Tunnel diodes
Transistors and Biasing: NPN Transistor • Amplifier Gain
Common Base, Common Emitter, Common Collector Circuits
Field Effect Transistors (FETs): JFET • Channel Depletion • MOSFET
N-channel Enhancement and Depletion • Transfer Characteristics
Thyristors: Operation of SCR • I-V Characteristics of a Typical SCR • Dimmers
Photo-electric Devices: Photo-voltaic Cells/Solar Cells • Photo Conductive Diodes
Photo-transistors • PIN Diodes • 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 • Filter Choke
Amplifier Fundamentals and Considerations: How Transistors Amplify
Transistor voltage, Power Gain and Operating Point • Base Bias Adjustment
Operating Point Stabilization • Bypass Capacitor • Signal Clipping • Classes
Coupling Methods • Resistive-Capacitance (RC) Coupling • Direct Coupling
Frequency Response • Distortion • Slewing Rate
Tuned Amplifiers: AM and FM IF Bandwidths • IF Amplifier Stage
Detector and AGC Circuit • RF Amplifiers • Sensitivity
Oscillators: Kinds of Oscillators • Positive Feedback • Configurations • Transistor
Hartley, Colpitts or Clapp Oscillator • Crystal Oscillator • RC Oscillators
Feedback: Types of Negative Feedback • Voltage Shunt Feedback
Input Impedance • Voltage Series
Differential Amplifiers: One Input • Two Inputs • Common Mode Rejection
Operational Amplifiers: Characteristics • Mini-DIP Integrated Circuit • External
Feedback • Op Amp Circuits: Inverting or Noninverting Amplifier • Follower
Summing Amplifier • Gain and Frequency Response • Basic Cautions
Clipping and Clamping Circuits
Clipping Circuits • Differentiator Followed by Clipper with Bias • Clamper Circuits
Multivibrators: Monostable or Astable Multivibrator • Flip-Flop Circuits
Appendix: Mathematical Fundamentals • Scientific and Engineering Notation
Vectors • Understanding RMS • AC Circuits • Phasors • Impedance
Summary, Discussion • Final quiz • Award of Certificates for Successful Completion



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