Introduction to Electronic Theory

Course No. 103 (formerly 104-2)

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 begins with the concept of an electrical circuit, with an example. A brief review of related mathematics follows, including vectors, phasors, RMS and scientific and engineering notation. The course covers basic concepts of electrical theory, starting with the simple DC circuit and Ohm's Law. Sinusoidal and non-sinusoidal waveforms are discussed as they apply to electrical technology.

The course then 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. 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.

Moving from electricity to basic electronics, we cover the theory of solid-state electronics, including semiconductor physics, diodes and transistors. The course presents amplifiers, including various applications of power amplifiers, negative feedback etc. This leads to the study of oscillators and digital logic circuits.

RELATED COURSES This course is related to TTi's courses 104 and 104/105, which form part of TTi's Dynamic Test Specialist (DTS), Electronic Telecommunications Specialist (ETS), Mechanical Design Specialist (MDS) and Instrumentation Test Specialist (ITS) Diploma Programs. Course 103 may be used as an *optional course* for any TTi Specialist Diploma Program for which course 104 is not required. 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 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: Review of a typical electronic circuit
- Schematic of a Radio Receiver • Electronic Symbols and Abbreviations
- Path of Signals through Circuit • Block Diagram

Mathematical Fundamentals • Scientific and Engineering Notation
- Radians • Vectors • Angular Frequency • Phase • Complex Algebra

Electrical Fundamentals Review: Electrostatic Field and Potentials
- Charge • Conductors, Insulators • Current, Voltage • Ohm's Law
- EMFs in Series and Parallel • Resistors • Series Circuits
- Network Laws: Kirchhoff's Laws • Thevenin's and Norton's Theorems
- Alternating Current • Sine and Non-sine Waveforms • Square Wave
- Pulse Shape of Square Wave • Complex Waveform • Harmonics
- Digital vs. Analog Waveforms • Unwanted Digital Signals
- Examples: Parallel Circuits • Conductance • DC Series-Parallel circuits
  - Thevenin's Theorem • Effective or rms Value of Current or power
  - Addition of Sine Waves

Capacitors and Inductors: Capacitors in DC circuits • Capacitance
- Capacitors in Parallel and in Series • Inductance • Mutual Inductance
- Inductors in Series and Parallel

Transient RC and RL Circuits: RC and RL Time Constants
- Examples: RC Time Constant • RL Time Constant
- Current Fall in an Inductor • Change in Voltage

Reactance, Impedance in AC Circuits: Capacitive, Inductive Reactance
- Impedance Triangle • Impedances of a Reactive AC Circuit
- Inductive and Capacitive Reactance in an AC Circuit
- Reactance in Series AC Circuits: RL, RC, RLC
- 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 • Example
- Parallel Resonance • Band-pass and Band-stop Filters

Transformers: Equivalent Circuit • Turns Ratio
- Power Relationships, Efficiency • Impedance Matching
- Transformers: Loosely coupled, Single and Double Tuned
- Local Power Distribution Systems • Voltage Transformations

Rectifiers and Filters: Power Supply with Regulator
- Half and Full Wave Rectification • Bridge Rectifier • Filters
- Capacitive Load • Power Supply Loading • Filter Choke

Semiconductor Physics: N-type and P-type Doping • Diffusion

Diodes, Transistors and Biasing: Alloy Junction Diode
- Planar Technology (Diffusing) • P-N Junction Behavior • Junction Barrier
- Transistors and Biasing • How transistors amplify • NPN Transistor
- Amplifier Gain • Common Base, Emitter, Collector Circuits

Amplifier Fundamentals and Considerations: How Transistors Amplify
- Transistor voltage, Power Gain and Operating Point
- Base Bias Adjustment • Signal Clipping • Classes of Operation
- Coupling Methods • Frequency Response • Distortion • Slewing Rate

Tuned Amplifiers, Oscillators and Feedback: AM and FM IF Bandwidths
- IF Amplifier Stage • Detector and AGC Circuit • Oscillators
- Kinds of Oscillators • RC Oscillators • Feedback • Negative Feedback

Differential and Operational Amplifiers: One Input • Two Inputs
- Common Mode Rejection • Op Amp characteristics
- Mini-DIP Integrated Circuit • Rules for External Feedback Op Amps
- Op Amp Circuits: Inverting or Noninverting Amplifier • Follower
- Basic Cautions • Applications

Digital Logic Functions: Logic Gates
- Inverter, AND, OR, NAND, NOR, XNOR, XOR

Summary, Discussion • Final quiz

Award of Certificates for Successful Completion

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