Training - Fundamentals of Electrical Engineering applied to Power Electronics

ELECTRO-EN-P

Face-to-face only

5 days
The first part must be completed before the classroom training

This training aims to provide learners with the basics of electronics necessary to tackle power electronics. It covers passive and active components, as well as basic circuits, to establish the fundamental knowledge needed to understand and design power electronics systems

Level
Knowledge

Public
Engineers and technicians with industrial experience, regardless of sector, who wish to specialize in power electronics or deepen their knowledge of applied electronics, particularly for applications in electric and hybrid vehicles (R&D engineers - Test and validation technicians - Systems engineers and architects - Engineers and technicians retraining in the electrical field - Test, design office, or CAD technicians)

Objectives
Attendees will be able to implement the following skills:

- Understand and use passive components (capacitors, resistors, inductors, transformers) and active components (diodes, transistors, integrated circuits) in signal conditioning or processing circuits in power electronics systems.
- Analyze the transient and sinusoidal responses of basic circuits (RC, RL, RLC) and apply Fourier and Laplace transforms in the study of these circuits.
- Analyze the frequency characteristics of real components.
- Implement signal processing circuits, including operational amplifiers and comparators, for signal conditioning and protection.
- Design driver stages for power transistor control and understand the control logic of power circuits,
- Use microcontrollers to control power electronic circuits, including PWM signal generation for power converters.
- Test and characterize the performance of basic electronic circuits, including RLC circuits and drivers.

Pedagogical & technical resources

- Integrated training combining theory and practice on a continuous basis.
- Theoretical courses supplemented by practical work and experiments in the classroom, including circuit assembly and real measurements.
- Simulations and calculations using specialized software to reinforce understanding of electronic circuits.
- Use of measuring instruments (oscilloscopes, multimeters, current probes, differential voltage probes, signal generators) to illustrate the principles of circuit measurement and analysis.

Assessment of achievements

- Trainees are assessed throughout the training through practical application phases and interactions with the trainer
- A final on-the-spot evaluation may also be carried out at the end of the course and/or at the end of each

module using tests designed to verify the learners' understanding and assimilation of the knowledge linked to the training objectives

Prerequisites

No prerequisites are necessary to follow this course.

Complementary informations

All courses in this module will be applied in practical work, tutorials, or case studies. The courses include exercises in simple electronic circuit design, simulation analysis, calculations, and real-time measurements

Responsable

IFP Training instructors, with expertise in the field and trained in modern teaching methods adapted to the specific needs of learners from the professional world

Program

ASYNCHRONOUS PROGRAM TO BE FOLLOWED BEFORE THE FACE-TO-FACE COURSE

VIDEOS

Capacitors and resistors.
Inductors and transformers.
Diodes and transistors.
Operational amplifiers and comparators.
Microcontrollers and PWM generation.
Fundamental electrical circuits: RC, RL, and RLC.

SYNCHRONOUS/FACE-TO-FACE PROGRAM

TRANSITIONAL CIRCUITS: INDUCTANCE AND RL CIRCUITS — 0.25 day

This course explores the transient responses of RL circuits, analyzing the behavior of inductors when subjected to voltage changes. Participants will learn how to model and analyze these circuits under switching conditions. Time and frequency analysis of the response. Notions of transfer functions. This course is fundamental for understanding the precise operation of inductors, filters, and static energy converters.

TRANSITIONAL CIRCUITS: CAPACITORS AND RC CIRCUITS — 0.25 day

This module focuses on the transient responses of RC circuits. Participants will learn how capacitors respond to voltage changes and how this affects the charging and discharging dynamics in circuits. Time and frequency analysis of the response. Introduction to transfer functions. This course is fundamental for understanding the precise operation of capacitors, filters, snubbers, time circuits, and parasitic components in static power converters.

TRANSITIONAL CIRCUITS: RLC CIRCUITS — 0.25 day

RLC circuits combine resistors, inductors, and capacitors, resulting in complex transient behavior. This course teaches how to analyze the natural and forced responses of these circuits, with practical examples of damped oscillations. This course is fundamental for understanding real models of electronic components and the operation of soft-switching converters.
Study of RC, RL, and RLC circuits: Fourier transforms, and Laplace transforms through practice: Application of Fourier and Laplace transforms to the study and design of electronic circuits (filters and power stages). Use of transforms in the study of RC, RL, and RLC circuits.

TRANSITIONAL CIRCUITS: TESTING AND CHARACTERIZATION OF RLC CIRCUITS — 0.25 day

This practical course focuses on methods for testing and characterizing RLC circuits. Participants will learn how to measure characteristic parameters and interpret transient responses using test tools.

SINUSOIDAL CIRCUITS: RL CIRCUITS — 0.25 day

In this module, participants will study the sinusoidal behavior of RL circuits, focusing on the concepts of impedance and phase shift between current and voltage. This course is fundamental for understanding the operation of AC machines and inverter control. Concept of complex impedance and vector representation.

SINUSOIDAL CIRCUITS: RC CIRCUITS — 0.25 day

This course examines the behavior of RC circuits under sinusoidal conditions, with a focus on filtering applications and frequency response calculation. Concepts of complex impedance and vector representation.

SINUSOIDAL CIRCUITS: RLC CIRCUITS — 0.25 day

This module explores RLC circuits in sinusoidal mode, covering the concepts of resonance, bandwidth, and circuit quality. Participants will learn how to calculate and analyze these parameters. This course is fundamental for understanding real-world models of electronic components and the operation of soft-switching converters. Introduction to complex impedances.

SINUSOIDAL CIRCUITS: THREE-PHASE CIRCUITS — 0.25 day

Three-phase circuits are at the heart of power systems. This course covers the basics of three-phase systems, star and delta connections, and the calculation of active and reactive power in these systems.

FUNDAMENTALS OF ACTIVE COMPONENTS: TRANSISTORS AND DIODES — 0.25 day

This course presents the basic principles of junction and field-effect transistors, diodes, their characteristics, and their applications in power electronics. Participants will study the linear conduction and switching properties as well as the limitations of these components. This course covers the fundamental knowledge required to study all electronic circuits.

SIGNAL ELECTRONICS: IMPLEMENTATION FOR POWER ELECTRONICS — 0.25 day

This module explores signal processing circuits used in power electronics, including signal conditioning, amplification, and component protection.

SIGNAL ELECTRONICS: DRIVER STAGE DESIGN — 0.25 day

This course focuses on the design of driver stages for power transistors, addressing control requirements and necessary protection circuits.

ANALOG ELECTRONICS: OPERATIONAL AMPLIFIERS – PRINCIPLES — 0.25 day

Operational amplifiers are essential components in analog electronics. This module covers their operating principles, basic configurations, and common applications. Their application in signal processing: comparators, subtractors, integrators useful in power electronics in the implementation of analog regulators.

ANALOG ELECTRONICS: CONTROLLER DESIGN — 0.25 day

This course teaches the design of analog voltage regulators, with a focus on linear regulators and stability and efficiency characteristics.

ANALOG ELECTRONICS: COMPARATORS AND OSCILLATORS — 0.25 day

This course introduces comparators and oscillators, their operating principles, and their applications in measurement, protection, control, and signal generation circuits.

COMBINATIONAL ELECTRONICS: LOGIC CIRCUITS AND FLIP-FLOPS — 0.25 day

Participants will learn the basics of combinational logic, including basic logic circuits and flip-flops used in digital signal processing.

COMBINATIONAL ELECTRONICS: APPLICATION - BRIDGE DRIVER LOGIC — 0.25 day

This course focuses on the control logic of bridge drivers for power transistors, enabling the management of power converter control signals.

DIGITAL ELECTRONICS: HOW A MICROCONTROLLER WORKS — 0.25 day

This course introduces the operation of microcontrollers, their internal structure, and their programming for power electronics applications.

DIGITAL ELECTRONICS: APPLICATION - PWM GENERATION — 0.25 day

This course covers the generation of PWM (pulse width modulation) signals for power converter control, focusing on frequency, resolution, and modulation aspects.

EXAM & ASSIGNMENTS — 0.25 days

This final session is dedicated to assessing the knowledge acquired during the week and completing tutorials to apply the concepts studied.

Sessions

To French entities : IFP Training is referenced to DataDock ; you may contact your OPCO about potential funding.
Please contact our disabled persons referent to check the accessibility of this training program : referent.handicap@ifptraining.com