

Analog Circuit Modelling with Falstad

Circuit fundamentals and simulation practice

FA-0663 · 2 days

Embedded Systems and Hardware

Introduction

Explore analog-circuit fundamentals through the Falstad/CircuitJS simulator. The course combines basic circuit analysis with selected component, amplifier, filter and power-supply examples.

Participants build and inspect small simulated circuits. Simulation supports learning and hypothesis testing; results depend on the models and do not replace component specifications, physical measurement or engineering validation.

Learning outcomes

- Explain basic component behaviour and apply introductory DC and AC analysis.
- Create, edit and inspect simulated circuits in Falstad.
- Compare selected diode, transistor, op-amp and filter configurations.
- Diagnose a simple circuit problem and explain model and measurement limitations.

Prerequisites

- Basic electrical/electronic principles and component familiarity.
- Ability to read introductory circuit diagrams.
- A computer with a supported browser and access to the arranged Falstad environment.

Training outline

1. Day 1 — Fundamentals and Circuit Simulation

Analog Circuits and Components

- Definition and importance of analog circuits
- Differences between analog and digital circuits
- Overview of common analog circuit applications

Electronic Components and Their Functions

- Resistors: types, characteristics, and applications
- Capacitors: types, characteristics, and applications
- Inductors: types, characteristics, and applications
- Diodes: types, characteristics, and applications
- Transistors: types, characteristics, and applications

Circuit Theory

- Ohm's Law and Kirchhoff's Laws
- Series and parallel circuits
- Voltage and current dividers
- Thevenin's and Norton's Theorems

Falstad Workflow

- Overview of the Falstad simulator interface
- Basic navigation and tools
- Creating and saving circuit projects
- Running simulations and interpreting results

DC and AC Analysis

- Understanding DC voltage and current sources
- Analyzing simple resistive circuits
- Simulating DC circuits in Falstad

AC Circuit Analysis

- Understanding AC voltage and current sources
- Frequency, amplitude, and phase concepts
- Analyzing capacitive and inductive reactance
- Simulating AC circuits in Falstad

Work through selected resistor and reactive-circuit examples, comparing calculations with simulated voltage and current.

2. Day 2 – Active Circuits and Practical Projects

Diodes and Transistors

- Characteristics of diodes and their I-V curve
- Rectifier circuits: half-wave and full-wave
- Clipping and clamping circuits
- Simulating diode circuits in Falstad

Transistor Circuits

- Overview of BJT and FET transistors
- Configurations: common emitter, common base, common collector
- Amplifier circuits: small signal and power amplifiers
- Simulating transistor circuits in Falstad

Operational Amplifiers

- Characteristics and ideal model of op-amps
- Inverting and non-inverting amplifiers
- Integrator and differentiator circuits
- Selected op-amp applications: active filters and oscillators; compare practical limits with ideal behaviour
- Simulating op-amp circuits in Falstad

Filters, Oscillators and Power Supplies

- Amplification, attenuation, and filtering concepts
- Low-pass, high-pass, band-pass, and band-stop filters

- Selected RC/LC oscillator examples and a conceptual comparison with crystal oscillators
- Simulating signal processing circuits in Falstad

Power Supply Circuits

- Rectification and smoothing techniques
- Linear regulation example and an introductory switching-regulator comparison
- Power supply design considerations
- Simulating power supply circuits in Falstad

Integrated Practice

- Designing and simulating a simple audio amplifier
- Simulating a power supply circuit for a specific application
- Creating and simulating a signal processing circuit
- Troubleshooting and optimizing circuit designs using Falstad

Complete one small amplifier, filter or power-supply simulation; use the other prepared examples for comparison. Consider supply limits, saturation, loading and component/model assumptions rather than treating ideal simulations as a production design.