AUTOMATION, ELECTRONICS AND COMPUTING 1 FIELD_11 ECTS

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Analog electronics

Introducing

Description

This course is divided into 8 chapters :
Chapter 1: Electronics – a whole world to discover.
Chapter 2: First-year review.
Chapter 3: Diodes, Zener diodes, and LEDs.
Chapter 4: The bipolar transistor in switching applications.
Chapter 5: How to receive a light signal: the photodiode.
Chapter 6: Mathematical tools for the electronics engineer.
Chapter 7: How to filter a signal? Passive filters.
Chapter 8: How to amplify a signal? The linear operational amplifier.

Objectives

This analog electronics course is intended for 2nd-year IMACS students. Its objective is to provide a foundation of knowledge and skills for students who are just beginning in this subject.

Necessary prerequisites

The required concepts are as follows :

- General laws of electrokinetics : Kirchhoff's voltage law, Kirchhoff's current law, Ohm's law, constitutive relation (current/voltage) for capacitors and inductors.
- Thévenin's and Norton's theorems.
- Superposition theorem.

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Practical info

Location(s)

Toulouse

INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Signal

Introducing

Description

Teaching is organized into 12 class sessions, 12 practical sessions and 3 practical sessions. The course is organized as follows:

1. Introduction; notions of signal, signal processing, system response, filtering

2. Chapter 2 is dedicated to defining the properties of linear time-invariant (LTI) systems, and the concepts of excitation and response. A prerequisite for calculating the response of a system is to find the type of excitation that facilitates this task. We will highlight two types of excitation families: complex exponential and impulse. These will enable us to define two complementary ways of modeling a system: in the time domain by the impulse response, and in the frequency domain by the transfer function.

3. Chapter 3 is devoted to the Laplace transform. This tool, which transforms a mathematical function in time into a new function expressed in the complex frequency domain, provides a highly efficient means of calculating the transient response of LTI systems, whatever the input excitation applied.

4. Chapter 4 deals with frequency analysis and filtering. Filters are LTI systems like any others. Their specific purpose is to eliminate unwanted frequency components from a signal. To design a filter, its transfer function must be analyzed. This chapter introduces a graphical tool for filter analysis: the Bode diagram, as well as the vocabulary associated with filter characterization.

5. Chapter 5 introduces the decomposition of a periodic signal into a series of (co)sinusoidal terms, known as the Fourier series. This forms the basis of frequency signal analysis. After a description of the different forms taken by the series, the main properties of Fourier series are presented. Several examples of signal decomposition in Fourier series are given. A line spectrum representation of the signal is also introduced, providing a powerful graphical analysis tool.

6. Fourier series are a formidable tool for signal analysis, but are limited to periodic signals. The Fourier transform is an extension for a class of non-periodic signals. Chapter 6 is dedicated to presenting the Fourier transform and its application. The chapter also shows that the Fourier transform is a special case of the Laplace transform.

7. Chapter 7 returns to the calculation of the time response of systems. This was covered in Chapter 3, where the signal was transformed into the frequency domain using the Laplace transform. In this chapter, we show how this calculation can be performed directly in the time domain. This requires the use of the convolution product.

8. In the final chapter, we return to the concepts of signal power and energy. We present calculation methods in the time and frequency domains. We introduce another fundamental tool for studying the similarity of signals: correlation. It also has another major interest: knowledge of it enables us to determine the power spectral density of a signal, giving the signal's power distribution in the frequency domain.

Practical sessions are also dedicated to getting to grips with digital signal processing tools (Matlab, Octave).

Objectives

The aim of this course is to introduce the main mathematical concepts, methods and tools for continuous-time signal processing (Laplace, Fourier, convolution, correlation, spectrum, frequency analysis, etc.).

Necessary prerequisites

Mathematics for enginners (trigonometry, complex numbers, integration)

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Practical info

Location(s)

Toulouse

Feedback systems

Introducing

Description

Outline :
Chapter 1 Introduction to Automation
What is automation
On the notion of system and input/output/disturbance
Determining the I/O of a system
BO vs BF and Setpoint vs Command
Introductory example
The systems considered and the I/O model (linear diff. equation of order n).
Chapter 2 Mathematical tools
Some definitions
time response, step, ramp, Dirac, causality, Analysis, Control, linearity, Invariance
The Laplace transform, a short and useful version
Def., table, derivation=<EDO role of ICs, final value theorem
The notion of transfer function
Chapter 3 Modeling
Why model...How to model
Qq reminders (elec, mech, basic fluid) => Passage to Laplace
Block diagram - Definition and conventio
Simplification and transformation
Linearization
Chapter 4 Time Response
Reminder of simple EDO resolution
Solving by Laplace (simple element decomposition)
1st-order systems
Second-order systems
On the notion of performance: response time, overshoot and accuracy
Other systems (unstable and pole dominance)
On the notion of performance: response time, overshoot and accuracy
Chapter 5 Harmonic response
Why and how
A complex example and introduction to the various plots
The pure integrator and the pure derivator
The first order
Second order
Method for plotting asymptotes for a qcq order
From BO to BF: black's chart

Objectives

Frequency approach to continuous linear control

Necessary prerequisites

Ordinary differential equation
Complex variable

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