

## 2nd YEAR IMACS\_SEMESTER 3 INSA

# Introducing

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## Description

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## 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

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## Location(s)

 Toulouse

# Nanophysics : wave propagation, photonics, nanotechnologies



ECTS  
5 crédits



Hourly volume  
58h

## Introducing

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## Description

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## Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- The fundamentals of wave propagation and quantum physics that are necessary for the understanding of modern electronic devices and analytical techniques
- The principle of analytical techniques commonly used in laboratories and the molecular mechanisms of quantum physics

The student will be able to:

- Formulate in his own words some nano-scale mechanisms and give concrete examples of micro and nano-devices together with well-known analytical methods using these mechanisms
- Master elementary phenomena of nano-scale physics
- Select the best method for a specific characterisation on the basis of the acquired concepts.
- Carry out some nano-scale characterisation methods
- Link mathematical formalism of quantum physics to real applications
- Grasp the necessary approximations that are required in quantum physics
- Bring together these different concepts to assimilate

them, extract them from their context in order to apply them to real situations

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## Necessary prerequisites

1st year Mechanics, Electrostatics, Optics and Mathematics

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## Practical info

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## Location(s)

Toulouse

## Analysis 1

# Introducing

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## Description

- The notion of differentiability of a function of multiple variables, partial derivatives
- The concept of norms, convergence of sequences in vectorial spaces, basic topological concepts: open and closed sets,
- Integrals of functions unbounded or on unbounded domains, with several variables

## Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- The notion of differentiability of a function of multiple variables, partial derivatives
- The concept of norms, convergence of sequences in vectorial spaces, basic topological concepts: open and closed sets,
- Integrals of functions unbounded or on unbounded domains, with several variables

The student will be able to:

- Carry out computations of integrals on bounded intervals, of unbounded functions.
  - Study the differentiability of a function of multiple (real) variables, carry out an asymptotic expansion
  - Manipulate norms of vectors and matrices, study the convergence of a sequence limits in vectors spaces.
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## Necessary prerequisites

Basic Calculus, Basic Linear algebra

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## Practical info

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### Location(s)

 Toulouse

# 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.).

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## Necessary prerequisites

Mathematics for engineers (trigonometry, complex numbers, integration)

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## Practical info

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### 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= $\leq$ 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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## Practical info

## Location(s)



## Company knowledge and communication



ECTS  
5 crédits



Hourly volume  
75h

## Introducing

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### Description

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### Objectives

Objectives:

At the end of this module, the student will have understood and be able to explain (main concepts):

- how to give an oral presentation
- some of the historical, geographical and/or geopolitical aspects of different English-speaking socio-cultural contexts
- how to produce a structured written synthesis in French.
- how to write a training period report and present it orally
- inner workings of contemporary economy and interdependence of macroeconomic scales

The student will be able to:

In French

- write the synthesis of a set of press articles and present it orally with Powerpoint visual aids
- write a training period report and give an oral presentation describing a particular company, reporting on and analysing a work experience.

In English:

- give a Powerpoint oral presentation in front of a group and orally interact with the audience
- demonstrate creativity, initiative and open mindedness in teamwork
- develop a thorough knowledge and a critical mind about different English-speaking socio-cultural contexts, taking into account historical, geographical and/or geopolitical considerations.

In Economics :

- understand current major economic and societal stakes
- discuss and debate using arguments grounded in the knowledge of fundamental economic mechanisms and some economic thinking theories

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### Necessary prerequisites

Expression 1 in the first-year « Grand Domaine Humanités » (D1ANHU01)

Writing and oral skills in English in the first-year « Grand Domaine Humanités » (D1ANHU01)

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examen écrit, oral, compte-rendu, rapport écrit,  
évaluation par les pairs...

## Practical info

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### Location(s)

 Toulouse

## Improving one's autonomy and building one's own professional project – level 2A



ECTS  
2 crédits



Hourly volume  
44h

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## Practical info

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### Location(s)

 Toulouse

## Refresher course 2nd year



ECTS



Hourly volume  
162h

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