2nd YEAR MATERIALS DEVICES AND SYSTEMS ENGINEERING

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

Analysis 1

Introducing

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.

Necessary prerequisites

Basic Calculus, Basic Linear algebra

Évaluation

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Practical info

Location(s)

Toulouse

Algebra

Introducing

Location(s)

Toulouse

Description

Euclidean spaces.
Orthogonal matrices.
Reduction of quadratic shapes.

Objectives

Reduce symmetric endomorphisms.
Manipulate scalar products and understand the notion of orthogonality in euclidean spaces.
Express quadratic forms as sums of squares.

Necessary prerequisites

1st year Mathematics course

Évaluation

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Practical info

Electromagnetism

Introducing

Description

Course Structure

The course is divided into six main chapters:

1- Magnetostatics:

˚Study of static magnetic fields and magnetic forces.
˚Application of Biot-Savart and Ampère's laws.
˚Analysis of magnetic circuits and magnetic materials.

2- Induction Phenomena:

˚Introduction to Faraday's law and Lenz's law.
˚Study of induced currents and electromotive forces.
˚Practical applications of induction phenomena in transformers and generators.

3- Maxwell's Equations in Vacuum:

˚Derivation and understanding of Maxwell's equations.
˚Relationship between electric and magnetic fields in vacuum.
˚Introduction to electric and magnetic potentials.

4- Electromagnetic Wave Propagation:

˚Study of the propagation of electromagnetic waves in different media.

5-Electromagnetic Energy and the Poynting Vector:

˚Calculation of energy stored in electric and magnetic fields.
˚Introduction to the Poynting vector and its role in the propagation of electromagnetic energy.

6-Study of the Special Case of Monochromatic Progressive Plane Waves:

˚Analysis of progressive plane waves and their properties.
˚Study of monochromatic waves and their polarization.

This course aims to provide a deep understanding of the fundamental concepts of electromagnetism and to develop your analytical and practical skills to solve complex problems in this field.

Objectives

Course Objectives:

1- Master the basic theoretical tools and concepts of electromagnetism, such as Maxwell's equations, induction phenomena, and quasi-stationary regimes. These foundational concepts will lay the groundwork for understanding the propagation of electromagnetic waves, which will be further developed in the following year.
2- Identify relevant variables in problems related to magnetostatics and time-varying electromagnetism.
3- Simplify real-world problems to calculate useful physical quantities.
4- Geometrize any electromagnetism problem in 3D, whether it is in a static or time-varying regime.
5- Extract the full set of physical properties of an electromagnetic wave from Maxwell's equations.

This course aims to provide you with a deep understanding of the fundamental concepts of electromagnetism and to develop your analytical and practical skills to solve complex problems in this field.

Évaluation

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Practical info

Location(s)

Toulouse

Materials

Introducing

Description

- Introduction
- Atomic Structure
- Structures and ordering in condensed matter
- Phase diagrams
- Mechanical properties of crystalline materials
- Ceramics / Polymers
- Electronic properties of materials and their applications (electronic, thermal and optical properties).

Objectives

At the end of this module, the student will be able to:
Describe the main macroscopic properties of materials (mechanical, electronic, thermal, magnetic, dielectric and optical) and identify their origins in terms of structural arrangement and electronic structure.

Necessary prerequisites

No necessary knowledge.

Évaluation

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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.

Évaluation

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Practical info

Location(s)

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)

Évaluation

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES 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

Évaluation

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Practical info

Location(s)

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse

Expression

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

Contemporary economy and ecological transition

Introducing

None

Description

The main areas studied are as follows:

- The market
- Economic actors
- Income and distribution
- Economic growth
- Unemployment
- Financing the economy
- Currency and inflation
- Economic policies
- New economic models

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

Objectives

The objective of this course is to provide basic concepts allowing students to better understand their current and future environment and to identify the main issues.

Students will be able to carry on a conversation and debate using arguments based on knowledge of fundamental economic mechanisms and some theories of economic thought.

Necessary prerequisites

Foreign Language 1

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Internship defense

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

Professional path initiative

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

Physical Activities and Sports

Introducing

Description

The APS (Physical and Sports Activities) offering is structured around several categories:

Team sports: football, basketball, volleyball

Individual sports: tennis, badminton, climbing, judo, strength training, gymnastics

Artistic and expressive activities: circuit training, dance

Outdoor activities: outdoor physical and nature-based activities (OPNA), golf

Adapted sports: adapted strength training, learn-to-swim, learn-to-ride, Pilates, sophrology

At the beginning of the academic year, students use a dedicated platform ("choix APS") to rank the available APS options in order of preference. Each student is then assigned an activity based on their choices and availability.

All APS sessions are supervised by certified PE teachers, either permanent staff (CAPEPS, AGREGATION holders) or external instructors.

Objectives

At the end of this module, the student should have understood and be able to explain the following key concepts:

Deepened self-awareness.

Ability to interact effectively with others.

The student should be able to:

Analyze a problem collaboratively (identify the issue, define possible approaches through interactive discussion).

Facilitate group expression and decision-making, allowing everyone to share their opinion.

Adjust and regulate their behavior in response to others.

Identify their own strengths and weaknesses, as well as those of others.

Apply these insights in the context of physical and sports practice.

Évaluation

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Practical info

Location(s)

Toulouse

Nanophysics

Introducing

Description

Wave phenomena, interferences and diffraction. Particle phenomena. The dual nature of waves and particles, application to electron microscopy. Quantum physics
laws. Quantum effects and applications. Scanning tunnelling microscope, quantum wells and quantum dots, application to radioactivity, harmonic oscillator, vibrations of molecules and Infrared spectroscopy, kinetic momentum and its application to molecular rotation spectroscopy, spin and its applications in NMR and MRI. Atomic and molecular orbitals. X-rays . Lasers. Crystalline solids, concept of energy bands, application
in semiconductor electronic devices.

Objectives

At the end of this module, the student will have understood and be able to explain :
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 underlying 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.

Necessary prerequisites

L1 level in Mechanics, Electrostatics, Optics and Mathematics.

Évaluation

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Practical info

Location(s)

Toulouse

Analysis 2

Introducing

Description

Numerical series, power series.

Objectives

At the end of this module, the student will have understood and be able to:
- determine the different kinds of convergence of numerical series.
- study the convergence of power series.

Necessary prerequisites

Analysis lectures of first year

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...

Location(s)

Toulouse

Practical info

Probabilities and statistics

Introducing

Description

- Random variables (discrete or continuous) and their characteristics
- Multidimensional random variables, conditional distributions and independence
- Limit theorems (LLN and CLT) and approximation of laws
- Statistical estimation, both punctual and using confidence intervals
- Statistical test for mean.

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):
- what a random variable (discrete or continuous) and its characteristics are
- how to apply limit theorems such as the Law of Large Numbers (LLN) or the Central Limit Theorem
(CLT)
- the notion of statistical estimation
- the notion of statistical test.

The student will be able to:

- to determine the law of a random variable, to compute its expectation, variance, cumulative distributive, etc
- to study the independence of random variables
- to approximate distributions by using underlying limit theorems
- to estimate using confidence intervals some unknown parameters (expectation, variance, proportion) associated to a large population
- perform a statistical test for a mean.

Necessary prerequisites

Analysis I and Analysis II

Évaluation

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Practical info

Location(s)

Toulouse

Energy Mix and Transition

Introducing

Description

The main concepts covered during the course are: conversion, transport, storage and usage efficiencies / power flux density / material resource intensity / load factor / stock and flow concepts / production and demand profiles / networking / energy mix / energy transition scenarios for 2050.
The course covers the following technologies: wind generation, electrolytic storage (H2), photovoltaics, electrochemical batteries, hydroelectricity / WWTP, fossil-nuclear-biomass power stations, biogas production.

Objectives

To understand the stakes involved in supplying energy to our production system.
To be able to answer the following questions:
- How do we obtain our energy today (knowing the different means of conversion and storage, and the different mixes) ?
- What are the orders of magnitude for our individual and national energy consumption on a day-to-day basis ?
- Where are the dependencies, weaknesses and limits of our energy supply ?
- How can we build an energy mix that meets our demand profile up to 2050 and the challenge of decarbonization ?

Necessary prerequisites

Be familiar with the concepts of electrical power and energy, as well as the general concepts of efficiency and density.
Have acquired the knowledge and skills of the first year at INSA, especially in electrokinetics, mechanics and thermodynamics.

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

Elective scientific course

Introducing

Description

Students take one of the following courses, of their choice:
- spatial data acquisition,
- mechanics for health,
- Python for engineers,
- networks and electrical machines.

Objectives

Elective courses are scientific courses related to the content of the pre-orientation, i.e. courses that can be used by future engineers in the Civil Engineering and Mechanical Engineering sectors. These courses are not prerequisites for the rest of the curriculum.

Necessary prerequisites

See detailed descriptions of each course.

Évaluation

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Practical info

Location(s)

Toulouse

Logics

Introducing

Description

This course deals with logic. After introducing Boolean algebra and logical functions, various minimisation methods are discussed. The general structure of a sequential system and elementary sequential systems are also studied (counters, flip-flops, etc.). A method for designing synchronous sequential systems using flip-flops is studied.

Objectives

By the end of this module, students should have understood and be able to explain (key concepts):

- The concepts of combinational and sequential systems,
- The concepts of synchronous and asynchronous systems (circuits),
- The methods for designing and implementing these systems.

Students should be able to:
- Represent and minimise logic functions,
- Design a combinational or sequential logic system.

Necessary prerequisites

none

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

Hardware architecture

Introducing

Description

- Functional description of the fundamental components of a conventional processor-based computer and their interactions.
- Description and contextualization of computer architecture models.
- Functional description of the processor, its memory and caches, and associated technologies.
- Hardware-level functional description of paging and memory virtualization.

Objectives

At the end of this module, students will be able to describe how a computer works, based on its internal structural elements, and define the actions required at hardware level to perform a given task.

Necessary prerequisites

Basic notions of algorithmics and logic.

Évaluation

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Practical info

Location(s)

Toulouse

Digital electronics

Introducing

Description

Numerical representation of information (base 2, binary coding, signed numbers, hexadecimal)
Basic digital components: diodes, Zener, LED, trigger, level adaptation circuits
Combinational logic: TTL logic gates, Fan-In, Fan-Out
Synchronous counters, reset circuits
Oscillators (ICM7555), LED blinking
Sampling and analog-to-digital conversion
Prototyping and component selection (BOM, datasheets)

Objectives

Learning Objectives
Acquire fundamentals of digital electronics.
Understand data representation and analog-to-digital conversion.
Design and size logical circuits and digital interfaces.
Explore the operation of digital integrated circuits.
Learning Outcomes
Represent and manipulate digital signals.
Design digital circuit architectures.
Interpret component datasheets.
Analyze and size circuits based on specifications.

Évaluation

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Practical info

Location(s)

Toulouse

Operating systems

Introducing

Description

The command interpreter (the shell), variables, iterative structures, control structures,
Programming using the command language (essentially bash),
Handling the file system and, in particular, access rights,
User management (uid, gid, home directory, etc),
I/O and pipe redirection mechanisms.
Some general information on documentation, archiving, compression and a few network commands.

Objectives

At the end of this module, the student will be able to use the command interface of the Unix operating system independently.

Necessary prerequisites

No required

Évaluation

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Computing

ECTS

Hourly volume
56h

Introducing

Description

Programme (detailed contents):
1- breakdown in sub programs
2- constraint and non constraint arrays
3- recursive algorithms: principle, examples
4- pointers and linked lists

Objectives

At the end of this module, the student will have understood and will be able to explain (main concepts):
- functional breakdown: procedure choice, setting of procedures
- differences between several data structures: arrays, records, pointers and linked lists
- recursive algorithms
- array exploring, sorting and merging

The student will be able to:
- analyze an advanced problem
- breakdown it into subprograms
- choose adapted data structures
- specify (recursive) algorithms
- implement algorithms in ADA language
- specify and realize test cases.

Necessary prerequisites

L1 algorithm lecture.

Évaluation

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Practical info

Location(s)

Toulouse

Digital culture and skills 1

Introducing

Description

Introductory course to AI: history, algorithms, issues.
"No code" discovery of neural networks on Vittascience; notebook for building a small character recognition network.
Presentation of PIX and study of a certain number of themes independently with the objective of passing the PIX certification at the end of the 3rd year.

Objectives

At the end of this module, the student will have discovered the first dimensions of the field of AI: history, examples of what AI allows, distinction between supervised and unsupervised learning, rapid scope of techniques and algorithms, ethical aspects, risks and controversies. In a second part, the student will have advanced his PIX course according to the defined program.

Necessary prerequisites

Basics of Python Programming

Évaluation

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Practical info

Location(s)

Toulouse

Foreign language 1

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

Foreign language 2

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional Path Initiative 2nd Year

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

Physical Activities and Sports

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