

SEMESTER 4_ 2nd YEAR IMACS

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

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.

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Practical info

Location(s)

 Toulouse

Analysis 2

Introducing

Location(s)

 Toulouse

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.
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Necessary prerequisites

Analysis lectures of first year

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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

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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.

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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.

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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

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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.

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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)

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

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

L'évaluation des acquis d'apprentissage est réalisée en

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

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Practical info

Location(s)

 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.

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Practical info

Location(s)

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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

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Practical info

Location(s)

 Toulouse

Foreign language 1

Introducing

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Practical info

Location(s)

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Foreign language 2

Introducing

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Practical info

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Professional Path Initiative 2nd Year

Introducing

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Physical Activities and Sports

Introducing

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